EMJM
in
Insects as Solutions for a Sustainable Future

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1. Insects as Solutions for a Sustainable Future CURRICULUM outline

Semester 1: University of Tours and University of Orléans						Jointness
Module	**Course name**	**Hours**	**Face-to-face hours**	**Lectures (L) Tutorial (T) Practical (P)**	**ECTS**	**Jointness with modules in preceding/following semesters**
M1.1	Insect Biology 1	112 h	48 h	24 L 24 P	4	All the master program 2.1 Insect Biology 2 2.5 Insects in Industry 3.1 Insect Biology 3 3.2 Fundamental skills 3
M1.2	Fundamental skills 1	112 h	48 h	38 L 10 T	4	2.2 Fundamental skills 2 2.3 Project work on Insect production 3.2 Fundamental skills 3 3.3 Experimental field or lab project
M1.3	Immersive project 1 – Field project	112 h	48 h	18 L 30 P	4	All the master program for experimental design 2.4 Experimental Design 3.2 Fundamental skills 2 3.3 Experimental field or lab project
M1.4	Insects and multitrophic interactions	140 h	48 h	33 L 15 T	5	2.5 Insects in Industry 3.4 Vector-pathogen interactions
M1.5	Integrated Pest management	140 h	48 h	28 L 4 T 16P	5	2.5 Insects in Industry 3.5 Surveillance and vector control
M1.6	Global change, adaptation, and conservation	140 h	48 h	30 L 6 T 12 P	5	3.6 Ecoepidemiology of vector-borne diseases in a global changing environment
M1.7	French Language and Culture in Loire Valley	84 h	24 h	12 L 12 T	3	all the master program for intercultural awareness
		840 h	312 h	183L 47T 82P	30	

Semester 2: KU Leuven						Jointness
Module	**Course name**	**Hours**	**Face-to-face hours**	**Lectures (L) Tutorial (T) Practical (P)**	**ECTS**	**Jointness with courses in preceding/following semesters**
M2.1	Insect Biology 2	130 h	38 h	26 L 12 P	5	1.1 Insect Biology 1 3.1 Insect Biology 3
M2.2	Fundamental Skills 2	156 h	52 h	52 L	6	1.2 Fundamental skills 1
M2.3	Immersive Project 2 - Project Work in Insect Production	84 h	48 h	3 T 45 P	3	1.2 Fundamental skills 1 3.5 Surveillance and vector control
M2.4	Experimental Design	84 h	28 h	28 L	4	1.3 Field project 3.2 Fundamental skills 3 3.3 Experimental field or lab project
M2.5	Insects in Industry	168 h	59 h	42 L 2 T 15 P	6	1.4 Insects and multitrophic interactions 1.5 Integrated pest management 3.5 Surveillance and vector control
M2.6	Innovation and Entrepreneurship	84 h	28 h	26 L 2T	3	all the master programme for entrepreneurship culture
M2.7	Dutch Language and Cultures	84 h	40 h	40 T	3	all the master programme for intercultural awareness
		790 h	293 h	174L 47T 72P	30	

Semester 3: NOVA University of Lisbon						Jointness
Module	**Course name**	**Hours**	**Face-to-face hours**	**Lectures (L) Tutorial (T) Practical (P)**	**ECTS**	**Jointness with courses in preceding/following semesters**
M3.1	Insect Biology 3	196 h	66 h	31 L 11 T 24 P	7	1.1 Insect Biology 1 2.1 Insect Biology 2
M3.2	Fundamental skills 3	112 h	76 h	12 L 12 T 52 P	4	1.2 Fundamental skills 1 1.3 Field project
M3.3	Immersive Project 3 -- Medical Entomology Techniques	112 h	44 h	6 L 8 T 30 P	4	1.2 Fundamental skills 1 1.3 Field project
M3.4	Vector-pathogen interactions	84 h	29 h	15 L 8 T 6 P	3	1.4 Insects and multitrophic interactions 2.1 Insect Biology 2
M3.5	Surveillance and vector control	140 h	48 h	32 L 4 T 12 P	5	1.5 Integrated pest management 2.5 Insects in industry
M3.6	Ecoepidemiology of vector-borne diseases in a global changing environment	112 h	38 h	14 L 6 T 18 P	4	1.6 Global change, adaptation and conservation
M1.7	Portuguese language and culture	84 h	28 h	18 L 4 T 6 P	3	all the master programme for intercultural awareness
		840h	329h	128L 53T 148P	30	

Semester 4: University of Tours, University of Orléans, KU Leuven, NOVA University of Lisbon				
Module	**Course name**	**Duration**	**ECTS**	**Jointness**
Master Thesis	Master thesis	6 months	30	Common list of master thesis projects and evaluation

SEMESTER 1 – University of Tours – University of Orléans

Course Name Insect Biology 1
Semester: 1 ; **Module:** 1.1

University: University of Tours and University of Orléans
Coordinator(s): Christophe Bressac and David Giron
Position of Coordinators: Christophe Bressac (Associate Professor, University of Tours); David Giron (Director of Research, CNRS, Tours)

Goals and outline of the course:
The first part of the course is an immersion of students in the goals of sustainability. It will give them basic knowledge on SDGs and introduce them to the entire master programme along the 3 semesters. The second part of the course is an initiation or a reinforcement – depending on the basic background of students – on the structure and function of insects. Knowledge on developmental programs and stages, and external anatomies will allow students to recognize different insect orders, families, genus and species, and familiarize them with stereomicroscopes and forceps handlings. Dissections of model insects – reared in the laboratory or caught in nature – will give students valuable skills to investigate insect anatomy and prepare for microscopic investigations. This course is designed to provide the basis of insect body plan and functional morphology for the whole master programme.

Learning outcomes:
By the end of the course the students will be able to:

1. Understand the importance of insects in the SDGs – Sustainable Development Goals – in reference to the master programme, with a worldwide approach.
2. Understand the basics of life cycle analyses that are the scientific references of sustainability evaluation in agricultural and agri-food productions.
3. Understand the developmental strategies and recognise the stages of Holometabolous and Hemimetabolous insects.
4. Dissect and understand the anatomy of some insect models.
5. Prepare and recognize tissues and cells by microscopic techniques.
6. Link anatomy and function of organs such as digestive gut, locomotor apparatus, neural system, reproductive tract, sensory organs.

Syllabus:

1. Sustainable development

a. Conferences on how insects are involved in sustainability.
b. Introduction on the measures of sustainability. Life cycle analyses of food products from the Agribalyse® tool. What is a system analysis? How to measure carbon footprint, eutrophication risk, resource consumptions and release into air-water-soil ?

2. Functional anatomy of insects

a. Recognizing and naming the stages of development in Hemimetabolous and Holometabolous insects. Crickets and Black Soldier Flies will be used as models. Morphological approaches.
b. External and internal insect anatomy. Organization and adaptation of the nervous, digestive, circulatory, respiratory, sensorial, locomotion and reproductive systems.
c. Tissues and cells of insects in relation with their functions, shape of the nucleus as a diagnostic of the cell stages and physiology. Testis of Black soldier flies and venomous glands of parasitoids will serve as examples.

Assessment: The first evaluation will take into account: (1) the work performed by students during practicals (anatomical drawings, poster preparation and oral presentation) (2) a final written examination.
Second chance assessment: In case of failure at the first evaluation, a second written evaluation will be proposed.

ECTS	Total number of hours (face-to-face)	Total number of hours (face-to-face + personal work)	Number of hours of lectures	Number of hours of tutorials	Number of hours of practical work
4	48h	112h	24h		24h

Course Name Fundamental skills 1 – Fundamental skills applied to insects
Semester: 1 **Module:** 1.2

University: University of Tours and University of Orléans
Coordinator(s): Emiliane Taillebois and Lucas Marie-Orleach
Position of Coordinators: Emiliane Taillebois (Associate Professor, University of Orléans); Lucas Marie-Orleach (Associate Professor, University of Tours)

Goals and outline of the course:
By the end of the course the students will acquire the necessary knowledge in a variety of disciplines that will be mobilized in other teaching units. This will ensure in-depth comprehension of the different tools, skills and concepts that are needed for studying insects at individual, population and ecological levels. This course intends to give fundamental knowledge applied to insects in the following areas:

- Insect physiology
- Ecology and evolutionary biology
- Insect Behaviour
- Quantitative biology

Learning outcomes:
By the end of the course, the students will have acquired the fundamental skills to:

1. Study insects at an individual level
2. Study insects at the population level
3. Study insect behaviour and sensory ecology

All this broad-based knowledge will be used in the specific teaching units of the first semester and supplemented during the following semesters.

Syllabus:
1. Fundamental approaches and tools in insect physiology
1.1. Central nervous system & sensory systems in insects
1.2. Fundamental functions in insects
1.3. Proteins: expression regulation & analysis
1.4. Epigenetics & molecular markers
1.5 Electrophysiology & cellular imaging

2. Fundamental concepts in ecology and evolution
2.1. Quantitative Genetics : Heritability and Selection
2.2. Population Genetics : Structure and Evolutionary Forces
2.3. Molecular Systematics and Phylogeography
2.4. Community Ecology : Structure and Biodiversity Metrics

3. Insect Behaviour
3.1. Behavioural study at individual level & social life in insects
3.2. Optimal foraging
3.3. Application to nestmate recognition
3.4. Behavioural adaptation

4. Introduction to quantitative tools in ecology and evolution
4.1 Introduction to statistics – rational and concepts
4.2 Introduction to statistics – hands-on
4.3 Introduction to modelling in biology - hands-on

Assessment: The first assessment will consist of a final written exam (100% of the grade) with a document analysis part.
Second chance assessment: In case of failure at the first evaluation, a second oral examination will be proposed.

ECTS	Total number of hours (face-to-face)	Total number of hours (face-to-face + personal work)	Number of hours of lectures	Number of hours of tutorials	Number of hours of practical work
4	48h	112h	38h	10h	

Course Name Immersive Project 1 - Field Project
Semester: 1 **Module:** 1.3

University: University of Tours and University of Orléans
Coordinator(s): Stéphane Boyer and Joël Meunier
Position of Coordinators: Stéphane Boyer (Professor, University of Tours); Joël Meunier (Director of Research, CNRS, Tours)

Goals and outline of the course:
Students will gain knowledge about experimental design, field sampling, data collection, basic statistical analyses, literature search and scientific writing. Theoretical courses will provide the tools and methodology to develop a scientific project and produce a report in the form of a short research article.

Learning outcomes:
By the end of the course the students will have:

1. Acquired the basics of designing an experiment, collecting the corresponding data, and understanding the importance of knowing how to identify what is a scientific question, a hypothesis, and a prediction.
2. Learned the fundamental tools needed to optimize the search for scientific literature related to an experimental project.

They will be able to:

3. Collect samples and data following precise and repeatable protocols.
4. Analyse the data they have generated using appropriate statistical approaches.
5. Reflect critically on their results and present their findings orally in a clear and efficient manner.
6. Present their findings in a written report and use current tools to cite the associated literature.
7. Apprehend the principles of the peer-review system, the complexity of the scientific publication process and the rules of Open Science.

Syllabus:

1. **Experimental design & data collection**
    a. Experimental design
        i. The basic rules of experimental design
        ii. Designing an experiment with constraints
    b. Data collection
        i. Collecting data in the field and in the laboratory
        ii. Methods of data collection (behaviour, biodiversity, physiology, genetic, etc.)
        iii. Data collection by groups of students
2. **Literature search and writing skills**
    a. Literature search and management
        i. Advanced use of a free literature search engine & advanced use of a free AI-based software to improve literature search
        ii. Advanced use of a free literature management/citation software (*Zotero*)
    b. Writing reports and manuscripts
        i. Do's and don'ts of report and manuscript writing
        ii. The costs and benefits of AI-based software for manuscript writing
    c. Publication process and the rise of Open science

Assessment: Students will be evaluated for their motivation and dedication during the field session, the quality of their oral presentation at the end of the field session and the quality of their final written report.
Second chance assessment: A second chance examination will be proposed in the form of a written examination.

ECTS	Total number of hours (face-to-face)	Total number of hours (face-to-face + personal work)	Number of hours of lectures	Number of hours of tutorials	Number of hours of practical work
4	48h	112h	18h		30h

Course Name Insects and multitrophic interactions
Semester: 1 **Module:** 1.4

University: University of Tours and University of Orléans
Coordinator(s): David Giron and Elisabeth Huguet
Position of Coordinators: David Giron (Director of Research, CNRS, Tours); Elisabeth Huguet (Professor, University of Tours)

Goals and outline of the course:
The course will present the role that insects can play in multitrophic interactions, in particular in their relationship with plants. The impact of biotic and abiotic factors in these interactions will be discussed as well as how fundamental knowledge on these interactions can enable the development of innovative strategies in sustainable agriculture and/or conservation biology.

Learning outcomes:
At the end of the course, students should have acquired the knowledge and skills to:

1. Identify the different roles played by insects in their interactions with plants, as pests of plants, vectors of plant diseases or plant pollinators.
2. Analyse mechanisms (in their molecular, physiological, behavioural and ecological components) involved in the interactions of insects with their host plants, taking into account the role played by microorganisms (associated with insects or associated with plants) in these interactions, as well as cascading effects on higher trophic levels.
3. Interpret the impact of abiotic and biotic stressors on insect-plant interactions, in particular in the context of global change.
4. Reflect critically on how fundamental knowledge on insect-plant interactions and how surveillance methods can help to mitigate risks linked to insects as pests or vectors of plant diseases. Reflect critically on the causes and consequences of pollinator decline.
5. Evaluate the risks and opportunities provided by knowledge on plant multitrophic interactions for the development of innovative strategies in sustainable agriculture and/or conservation biology.

Syllabus:
0. Introduction
General concepts in insect multitrophic interactions, presentation of the module syllabus

1. Insects as pests of plants
a. Evolution of plant-insect interactions
b. Plant defence: plant perception and responses
c. Insect manipulation of plant defences / plant physiology
d. Impact of plant-insect interactions at higher trophic levels
e. Role of microorganisms in insect-plant interactions
f. Insect-plant interactions in a changing world
g. How to apply our knowledge to protect plants from insect pests
h. Risk assessment and mitigation concerning plant pests in Europe

2. Insects as vectors of plant diseases
a. General introduction on the main categories of pathogen-vector interactions
b. Receptors in insect vectors and other molecular/cellular interactions between insects and phytopathogens
c. Enabling transmission
d. Vector Manipulation by Plant Pathogens
e. Epidemiology, surveillance, control, decision support

3. Insects and pollination
a. Diversity of pollinating insects and ecosystem service quantification
b. Plant-pollinator interactions in agrosystems: causes and consequences of pollinator decline
c. Plant–pollinator networks: representation and metrics calculation

Assessment: The first evaluation will take into account: (1) the work performed by students during tutorials (oral presentation of a scientific article and active participation) and will represent 40 % of the final mark; (2) a final written examination, which will represent 60 % of the final mark.
Second chance assessment: In case of failure at the first evaluation, a second oral evaluation will be proposed.

ECTS	Total number of hours (face-to-face)	Total number of hours (face-to-face + personal work)	Number of hours of lectures	Number of hours of tutorials	Number of hours of practical work
5	48h	140h	33h	15h	

Course Name Integrated Pest management
Semester: 1 **Module:** 1.5

University: University of Tours and University of Orléans
Coordinator(s): Marlène Goubault and Steeve Thany
Position of Coordinators: Marlène Goubault (Professor, University of Tours); Steeve Thany (Professor, University of Orléans)

Goals and outline of the course:
Students will acquire fundamental knowledge that is mandatory to understand the mode of action of pesticides, the issues linked to their use on the environment and the limit of their sustainability. Specific information about the different alternative strategies to conventional pesticide treatments will be presented. For all these approaches, the advantages and associated risks will be developed. This global overview will help to discuss the methodologies that are the most effective to build an Integrated and Sustainable Pest Management Strategy.

Learning outcomes:
By the end of the course the students will be able to:
1. implement their expertise in pesticides and biopesticides engineering, with a precise comprehension of the advantages & disadvantages of pesticides, of their mode of actions and the risks associated with their use.
2. implement their expertise in biocontrol to identify and critically compare the different types of biological control strategies, with a global understanding of the key biological mechanisms underlying their success or failure.
3. critically evaluate and select the most suitable pest management strategy according to the local ecological and socio-economic context.
4. as transversal skills, the student will be able to i) develop a critical thinking about the problematic of pest management, ii) analyse scientific documents, iii) produce a scientific experimental report.

Syllabus:

1. Insects control by pesticides
1.1. Problematic of insect pests & pesticides
1.2. Synthetic insecticides
- 1.2.1. Neurotoxic Insecticides
- 1.2.2. Insect growth perturbators
- 1.2.3. Evolution of resistance mechanisms

1.3. Biopesticides
1.4. Innovation challenges & Intelligent design

2. Alternative methods of pest regulation
2.1. Biological control using natural enemies
- 2.1.1. Definition, development, and associated risks
- 2.1.2. Biological control by introduction
- 2.1.3. Biological control by augmentation
- 2.1.4. Biological control by conservation
- 2.1.5. Application & case study

2.2. Chemical mediators and insect control
- 2.2.1. Strategical use of chemical and service plants: development and risks associated
- 2.2.2. Application & case study

3. Implementation of new production systems: current challenges
3.1. Temporal synchrony & climatic change
3.2. Landscape & the importance of local context
3.3. Integrated strategies to overcome insecticide resistance
3.4. Agroecological transition & socio-economic context

Assessment: The assessment will consist of a final written exam (50% of the grade) and a report for practical courses (50% of the grade).
Second chance assessment: In case of failure, a second written session (100%) will be proposed.

ECTS	Total number of hours (face-to-face)	Total number of hours (face-to-face + personal work)	Number of hours of lectures	Number of hours of tutorials	Number of hours of practical work
5	48h	140h	28h	4h	16h

Course Name Global change, adaptation, and conservation
Semester: 1 **Module:** 1.6

University: University of Tours and University of Orléans
Coordinator(s): Franck Dedeine
Position of Coordinators: Franck Dedeine (Associate Professor, University of Tours)

Goals and outline of the course:
This module consists of a series of lectures delivered by expert scientists from a range of disciplines. The lectures aim to provide students with insights into the latest scientific advances in ecophysiology, population biology and evolutionary genetics. This will improve their understanding of how insects respond to global changes, and how we can potentially conserve them (conservation biology).

Learning outcomes:
At the end of the course, students should have acquired the knowledge and skills to:

1. Identify the different factors that threaten insects in their natural habitat in the context of global change.
2. Understand and analyse the molecular, organismal and populational mechanisms by which insects can adapt and survive in a changing world.
3. Have some general knowledge of the challenges of insect conservation and the basic applied science involved.
4. Develop an integrative vision of the insect biodiversity, including knowledge of insects at different organization levels (from molecules to communities) and at different scales of space and time.
5. Reflect critically on the causes and consequences of insect population decline.

Syllabus:
0. Introduction
Concepts about global change and threats to insects; syllabus presentation

1. Insect biodiversity under threat
a. Insect populations decline
b. Climate change effects: thermal ecology and thermotolerance
c. Ecological and economic consequences of invasive insects

2. Insect responses to global change
a. Individual acclimatation: phenotypic plasticity and ecophysiology
b. Adaptation: general concepts and constraints
c. Paradox loss: genetic diversity and insect invasion success
d. Introduction to quantitative genetics
e. Genomics and the molecular signatures of selection

3. Insect conservation
a. Conservation biology and museology
b. Conservation of insect communities in forests
c. Conservation of insect communities in wetlands

Assessment: The assessment will consist of a final written exam, which will account for 100% of the grade.
Second chance assessment: In case of failure at this first evaluation, a second chance oral examination will be proposed.

ECTS	Total number of hours (face-to-face)	Total number of hours (face-to-face + personal work)	Number of hours of lectures	Number of hours of tutorials	Number of hours of practical work
5	48h	140h	30h	6h	12h

Course Name French Language and Culture in Loire Valley
Semester: 1 **Module:** 1.7

University: University of Tours, Centre Universitaire d'Enseignement du Français aux Etudiants Etrangers
Coordinator(s): Marie-Pierre Baylocq-Sassoubre and Anne-Sophie Frémont-Gâtineau
Position of Coordinators: Marie-Pierre Baylocq-Sassoubre (Pedagogical engineer, CUEFEE, Tours); Anne-Sophie Frémont-Gâtineau (Certified Professsor, CUEFEE, Tours); Amaury Theret (Pedagogical coordinator), CUEFEE, Tours).

Goals and outline of the course:
Many different activities will be performed, including outside the classroom, focusing on the 4 skills: speaking, listening, writing and reading. The proposed activities favour the intercultural exchanges and place the student in a real communication situation. Discussions in class, excursions and serious games will enable students to acquire cultural skills.

Learning outcomes:
Objective 1: By the end of the course the students will be able to introduce themselves, orientate themselves, speak about their family, friends, country, hobbies, tastes, everyday life and travels, in French.
Objective 2: Students will gain knowledge of Tours and Loire Valley history, monuments, traditions and landscapes.

Syllabus:
1. Introducing oneself - Asking/giving personal information
- Informal and formal ways of addressing someone
- Present tense of usual verbs
- Gender and number
- Nationality adjectives
- Using what and which in French
- Figures and numbers
- Week days/months/seasons

2. Talking about family
- The family and family situations
- Speaking about life events
- Painting a portrait of someone
- Present tense of other verbs
- Possessive adjectives

3. Talking about hobbies and activities - Proposing an outing - Accepting/refusing a proposal
- Vocabulary concerning hobbies and free time
- Present tense of all 1st group verbs
- How to formulate a question
- Prepositions of place

4. Everyday activities
- Relating a whole day
- Expression of time
- Pronominal verbs

5. History and culture of Loire Valley and Tours city - Transport and how to travel
- Discovering French heritage through Loire Valley and Tours emblematic sites and monuments, focusing on historical and cultural venues
- Means of transportation
- Asking/indicating directions
- Using the interrogative words such as: where ? how ?
- The imperative mode of the verbs
- Present tense of some irregular verbs

Assessment: Final assessment (DELF style exam):
- 1 listening test on a covered subject
- 1 reading test on another covered subject
- 1 short writing test to talk about the student's everyday life (for example)
- 1 speaking test, during the class itself, with simple questions about the student's personal life, hobbies, identity, friends, family, ….) related to the program.

Second chance assessment: A second chance examination will be proposed in the form of a writing test.

ECTS	Total number of hours (face-to-face)	Total number of hours (face-to-face + personal work)	Number of hours of lectures	Number of hours of tutorials	Number of hours of practical work
3	24	84	12h	12h	

SEMESTER 2 – KU Leuven

Course Name: Insect Biology 2
Semester: 2 **Module:** 2.1

University: KU Leuven
Coordinator(s): Jozef Vanden Broeck and Vanessa Franssens
Position of Coordinators: Jozef Vanden Broeck (Full Professor) and Vanessa Franssens (Doctor)

Goals and outline of the course:
The student gains profound knowledge in fundamental and applied aspects of the physiology of insects, the largest class of animals on our planet. The student will demonstrate insight into patterns and processes that occur in these animals. He/she will understand the functional role and evolution of physiological mechanisms that allow insects to adapt to changes in their environment. Knowledge of these mechanisms has also led to applications with significant economic or societal benefits.
In this course, the student will analyse and integrate information regarding molecular, cellular, organismal and environmental mechanisms controlling functional processes in insects. These processes will be situated in their ontogenetic and phylogenetic context. In addition, the student will develop practical skills and acquire insight in different research approaches that are followed in fundamental and applied insect physiology.

Learning outcomes:
By the end of the course, students will be able to clearly communicate – in written form as well as orally - the findings of recent scientific research reports on physiological topics to the other students of the course and can critically analyse, interpret and discuss these findings in group. Students are also capable of situating and discussing the importance of scientific findings and applications in the broader context of the human society.
In addition, the students will cooperate with fellow-students and acquire the necessary attitudes, as well as the sense of responsibility, to participate in a team and jointly work out a task plan. They possess a sufficiently critical attitude allowing them to autonomously obtain knowledge, to stay informed of recent international developments, and defend a well-founded point-of-view with a sense of originality and creativity.

Syllabus:
The course is divided in two activities: lectures and exercises.
The following topics in insect physiology are covered in the lectures:

- nutrition and feeding; digestion of food;
- control of metabolism; interplay between regulators of metabolism and developmental hormones;
- excretion; salt and water balance regulation;
- sensory perception and neurophysiology;
- neuroendocrine and endocrine regulation;
- locomotion and biomechanics;
- respiration; integument and moulting;
- reproduction and courtship behaviour;
- circulatory system, haemocytes and immunity;
- ecophysiology of diapause and polyphenisms; epigenetics;
- biotechnological applications;
- insecticides and their modes of action; insecticide resistance mechanisms.

The exercises will consist of a practical course sessions (4x 3 hours):

- microdissection of specific insect organs;
- biological and biochemical assays;
- behavioural and neurophysiological observations;
- analysis of hormone-dependent expression in insect cells carrying a reporter construct;

Assessment:
The CU will be assessed partially via continuous assessment (exercises) and partially via examination with open and closed questions (lectures). The evaluation for the exercise's activity consists of a report. 85% of the total score will be based on examination about the content of the course (college activity): evaluation within the exam period, while the other 15% of the total score is based on the exercise activity.
A student passes when the weighted average of the component scores is at least 10/20. The exercises are mandatory. If a student does not participate, he/she cannot pass for the course (NA).
Second chance assessment:
The examination can be retaken in the second examination period, with the same modalities as in the first examination period but there is no second evaluation opportunity for the mandatory exercise parts.

ECTS	Total number of hours (face-to-face)	Total number of hours (face-to-face + personal work)	Number of hours of lectures	Number of hours of tutorials	Number of hours of practical work
5	38	130	26	0	12

Course name: Fundamental Skills 2 – Fundamental skills applied to bioprocess engineering
Semester: 2 **Module:** 2.2

University: KU Leuven
Coordinator(s): Jeroen De Smet and Dries Vandeweyer
Position of Coordinators: Jeroen De Smet (Associate Professor) and Dries Vandeweyer (Assistant Professor)

Goals and outline of the course:
This course consists of two learning activities: Bioprocess engineering and Unit operations in the food industry. Goals and outlines are separated per learning activity.

Bioprocess engineering
During this course you will learn to apply diverse state-of-the-art (molecular) techniques to engineer and monitor (industrial) bioprocesses. Focus is on the taxonomic and functional characterization of microbial communities and their individual members through the use of state-of-the-art techniques, illustrated with examples and exercises. The second part of the course focuses on the genetic modification of bacteria, yeasts, plants and animals, illustrated with practical examples.

Unit operations in the food industry
By the end of this course, students know the basic principles of unit operations applied in the context of food industry. They can describe and compare unit operations and relate them to specific raw materials, intermediate and end products. The students can explain the working mechanism of relevant equipment, in relation to chemical, microbiological and biochemical prerequisites of a specific production process. They can apply the principles of unit operations on known or unknown production processes.

Learning outcomes:
By the end of the course, the student:

1. has a thorough knowledge of various (molecular) tools that are used in biotechnology and the advantages and disadvantages of these techniques
2. is familiar with innovative technologies in molecular biology
3. is able to use the acquired knowledge to function as a beginning engineer in applied research or in the biotechnological sector
4. is able to think out a strategy to perform cloning and manage and design a biotechnogical process
5. can describe the basic principles of unit operations
6. can discuss and compare different unit operations related to specific raw materials, intermediate and end products
7. can describe the mode of operation of equipment used, in relation to the chemical, microbiological and biochemical prerequisites of a specific production process
8. can apply the principles of unit operations on known (beer production) or new production processes
9. can describe and explain the production process of beer

Syllabus:
This course exists of two learning activities: Bioprocess engineering and Unit operations in the food industry. Two syllabi will be provided, separated per learning activity.

Bioprocess engineering

- Microbial communities: importance, establishment and environmental factors
- Detection, identification, quantification and characterization of microbial strains
- Taxonomic and functional characterization of microbial communities
- Novel cultivation approaches
- Synthetic microbial communities
- Genetic engineering of microorganisms and higher organisms
- New trends in biotechnology
- Biosafety and ethical aspects of biotechnology

Unit operations in the food industry
Part 1: Unit operations

- Preparation of raw materials
  - Cleaning
  - Sorting and ranking
  - Peeling
  - Blanching
- Changing particle size
  - Size reduction
  - Extrusion
- Mixing and forming
- Separating and concentrating
- Temperature change
  - Heat transfer
  - Evaporation and distillation
  - Baking and roasting
  - (Deep-)frying
  - Irradiation
- Applications

Part 2: Case study: beer production
Assessment: The CU will be assessed via a written examination with open questions. The focus of the exam is on understanding the course material insightfully and articulating it scientifically correctly, rather than memorization. **Second chance assessment:** The written examination can be retaken in the second examination period, with the same modalities as in the first examination period.

ECTS	Total number of hours (face-to-face)	Total number of hours (face-to-face + personal work)	Number of hours of lectures	Number of hours of tutorials	Number of hours of practical work
6	52	156	52	0	0

Course name: Immersive project 2 - Project Work Insect Production
Semester: 2 **Module:** 2.3

University: KU Leuven
Coordinator(s): Mik Van Der Borght
Position of Coordinators: Mik Van Der Borght (Associate Professor)

Goals and outline of the course:
Students carry out themselves the different typical steps in the rearing and processing of insects. The students rear insects and investigate various aspects related to this process. They then harvest and process the reared insects and carry out chemical and microbial quality analyses. The students will also isolate valuable compounds such as proteins, fats and chitin from the insects and prepare and evaluate insect-based products. Insects will have acces to the “Insect Pilot Plant”.

Learning outcomes:
Upon completion of this project work, students will have mastered several practical aspects peculiar to the industrial insect industry production and processing chain.

Syllabus:
Lab tutorials are provided via Toledo (the KU Leuven digital learning environment).

Assessment:
The laboratory work requires thorough preparation. After finishing the practical work, students are required to compose a report.
To evaluate student performance, we will employ both continuous assessment (80%, which includes lab reports, and group work) and a written exam to evaluate the practical knowledge of the student (20% of the total point). Continuous evaluation implies compulsory attendance for the lab work. Any absence must be justified with an attestation to the lecturer(s) responsible.
Second chance assessment:
If you do not pass, there will be no practical re-examination, but a written examination will count for 20% of the grade, with the grade obtained in the first examination (80%) being retained.

ECTS	Total number of hours (face-to-face)	Total number of hours (face-to-face + personal work)	Number of hours of lectures	Number of hours of tutorials	Number of hours of practical work
3	48	84		3	45

Course name: Experimental Design
Semester: 2 **Module:** 2.4

University: KU Leuven
Coordinator(s): Peter Goos
Position of Coordinators: Peter Goos (Professor); Arno Strouwen (Professor)

Goals and outline of the course:
This course discusses the design of factorial experiments. Initially, the focus is on completely randomised experimental designs. Next, the focus shifts to experimental designs involving a restricted randomisation. First, the concept of blocking is discussed. Next, split-plot and strip-plot designs are studied.

The emphasis in the course is on the optimal design of experiments. In optimal design of experiments, the experimental design is tailored to the problem at hand (unlike classical experimental design, where inflexible, standard designs are chosen from catalogues). The course builds on concepts from regression and analysis of variance, such as fixed and random effects, power calculations, variance inflation factors, multicollinearity, confidence intervals, prediction and lack-of-fit tests.

Every topic in the course is introduced and illustrated by means of a case study from research and industry. The case studies are realistic in the sense that they involve quantitative and qualitative experimental factors, experimenters have to deal with limited budgets and difficulties to randomise, and forbidden combinations of factor levels. In each of the case studies, the goal is to enhance to performance of a process or a product. The areas of application are the food industry, the pharmaceutical sector, and the metal and chemical industries, among others.

Learning outcomes:
This course deals with modern methods for setting up highly informative experiments. More specifically, it provides an in-depth treatment of the optimal experimental design approach, which is extremely flexible and can handle all kinds of practical constraints that may occur in the planning phase of an experiment. During the course, the students learn how to use the JMP software, which is state of the art for the optimal design of experiments. The focus is on factorial experiments, i.e., experiments studying multiple treatment factors.

Syllabus:
The textbook used is "Optimal design of experiments: A case study approach", co-authored by Peter Goos and Bradley Jones (see references). The software used is JMP.

Assessment:
The exam in June counts for 15 of the 20 points for the course. The assignment counts for 5 of the 20 points in June. A hard copy of the book "Optimal Design of Experiments: A Case Study Approach" can be brought to the exam (photocopies and prints of e-versions of the book are not allowed).
Second chance assessment:
The exam in August/September counts for 20 points. The score for the assignment is not carried over to August/September. A hard copy of the book "Optimal Design of Experiments: A Case Study Approach" can be brought to the exam (photocopies and prints of e-versions of the book are not allowed).

ECTS	Total number of hours (face-to-face)	Total number of hours (face-to-face + personal work)	Number of hours of lectures	Number of hours of tutorials	Number of hours of practical work
4	28h	84h	28h		

Course Name: Insects in Industry
Semester: 2 **Module:** 2.5

University: KU Leuven
Coordinator(s): Mik Van Der Borght
Position of Coordinators: Mik Van Der Borght (Associate Professor)

This course consists of two learning activities: 'Insects for food, feed and biotechnical application' and 'Industrial insect production and processing in practice'. Goals and outlines are separated per learning activity.

Insects for food, feed and biotechnical applications
Goals and outline of the course:
This course delves into the various aspects of the emerging insect value chain in Europe. Firstly, it provides an overview of this new sector, before exploring each aspect in a scientific manner. The course covers biological, chemical, microbial, and technological perspectives, as well as legislation and consumer behaviour. The lectors involved in this course each have extensive expertise in a specific field in which they teach.

Learning outcomes:
Students are expected to accurately articulate their acquired knowledge, while also drawing connections among the different concepts addressed in the lessons.

Syllabus:
Presentations are provided by the lecturers via Toledo (the KU Leuven digital learning environment).

Industrial insect production and processing in practice
Goals and outline of the course:
Students will engage with the practices and background of the various stages in the emerging industrial insect value chain. The program covers insect rearing and the processing of insect-based products. Industry experts will elucidate the context in which they operate and the applicable technologies. A visit to insect sector companies will supplement these explanations and offer a practical outlook.

Learning outcomes:
Students are expected to understand and explain the new insect sector's specific practical aspects.

Syllabus:
Presentations are provided by the lecturers via Toledo (the KU Leuven digital learning environment). Students have to take notes during the company visits.

Assessment: Both learning activities are evaluated with a written exam.
Second chance assessment: The written exam can be retaken in the second examination chance, following the same procedures as the first.

ECTS	Total number of hours (face-to-face)	Total number of hours (face-to-face + personal work)	Number of hours of lectures	Number of hours of tutorials	Number of hours of practical work
6	59	168	42	2	15

Course Name Innovation and Entrepreneurship
Semester: 2 **Module:** 2.6

University: KU Leuven
Coordinator(s): Guy Meynants, Tim Benijts
Position of Coordinators: Guy Meynants (Professor), Tim Benijts (Senior Lecturer)

Goals and outline of the course:
A number of topics are explained around entrepreneurship, innovation and the role of the engineer in a company, using concrete cases or in general terms, around the following topics:

- Enterprises and their context for the engineer
- Disruptive innovation and continuous improvement
- Patents and protection of innovation
- Production chain and production development
- Business planning
- Strategy of an enterprise and start-up
- Marketing
- Staff

Learning outcomes:

- Students gain important experience in following basic skills:
  - Possess basic scientific-disciplinary knowledge and insight into the field of industrial engineering science.
  - Analyse and solve problems
  - Acting ethically
  - Reflecting critically
- The student has an understanding of basic concepts of entrepreneurship and innovation.
- The student will be able to think critically, rationally and logically coherently about the functioning of companies at different stages (start-up and growth of start-ups and operation within medium and large companies).
- The student understands the innovation process, the different forms of innovation and the protection of innovation.
- The student has an understanding of the production process and quality control.

Syllabus:
Presentations containing the content of the 8 topics of this course will be provided via Toledo (the KU Leuven digital learning environment).

Assessment: Assessment via closed-book exam with open-ended and multiple-choice questions. The multiple-choice questions are subject to gamma correction.
Second chance assessment: In case of failure at the first evaluation, a second examination will be proposed.

ECTS	Total number of hours (face-to-face)	Total number of hours (face-to-face + personal work)	Number of hours of lectures	Number of hours of tutorials	Number of hours of practical work
3	28	84	26	2	0

Course name: Dutch Language and Cultures
Semester: 2 **Module:** 2.7

University: KU Leuven
Coordinator(s): Lieve De Wachter
Position of Coordinators: Lieve De Wachter (Professor); Kevin Seurs (Research Associate)

Goals and outline of the course:
The syllabus contains the 800 most frequent words and common constructions in Dutch. Both theory and practice (in the form of exercises) are provided. Students who work through the textbook and workbook will be able to understand and communicate on an A2 level in Dutch after completing the course. Thanks to the texts, the videos, listening exercises, … they will also get acquainted with the Belgian way of life and culture.

Theory and practice are mixed during the course. Students will get acquainted with vocabulary, but will also develop their reading, listening, speaking and writing skills thanks to the multimethods approach that is adopted. Apart from the cultural information in the textbooks and during classes, students also follow two lectures on Belgian cultural issues, organized by KU Leuven in the 'About Belgium' programme.

Learning outcomes:
The main aim of this course is to help students acquire basic communicative skills in Dutch (level A1 of the Common European Framework). The course deals with the basic grammar notions and language functions and aims at the mastering of approximately 800 highly frequent words of Dutch. A lot of attention goes to culture with various lectures about Belgium. The course provides extensive practice in listening, reading, speaking and writing.

Syllabus:
R. Devos en H. Fraeters, Vanzelfsprekend, Leuven (Acco), 2008. The multimedia course materials 'Vanzelfsprekend' offer video, audio CDs, texts and exercises, very frequently used language functions and approximately 800 highly frequent Dutch words. The material also includes a lot of cultural information on Belgium and Flanders.

Assessment:
Exam outside of the normal examination period. There will be a test (writing, speaking, listening and reading) at the end of the course as well as a number of assignments during the course.
Second chance assessment: In case of failure at the first evaluation, a second examination similar to the first assessment will be proposed.

ECTS	Total number of hours (face-to-face)	Total number of hours (face-to-face + personal work)	Number of hours of lectures	Number of hours of tutorials	Number of hours of practical work
3	40h	84h		40h	

SEMESTER 3 – NOVA University of Lisbon

Course Name Insect Biology 3 - Insects as vectors or human disease agents **Semester:** 3 **Module:** 3.1
University: NOVA University of Lisbon **Coordinator(s):** Paulo Almeida **Position of Coordinators:** Full Professor
Goals and outline of the course: This curricular unit addresses the conceptual basis for students to grasp the understanding of Medical Entomology, focusing on arthropod groups as vectors of diseases, analysing the types and mechanisms of pathogen transmission, and the role of Arthropods as agents of disease. Special focus will be given to the most important vector species of the main vector borne diseases and their bioecology. The concepts of Vector Efficiency, Vector Competence, and Vectorial Capacity are central to understanding the epidemiology of vector borne diseases, and an essential basis for the vigilance and control of vectors, addressed in other curricular units. The problematics of biodiversity and population variation, focusing on the introduction of exotic species in the context of climate change, enables the student to discuss vector screening and control programs, in the context of globalization and One Health, directed at re/emergent vector-borne diseases. **Learning outcomes:** Upon completion of this unit students should be able to: 1- Define Medical Entomology in the context of Global Health. 2- Define arthropod vector and arthropod as a pathogenic agent or disease agent, describe and distinguish types and mechanisms of transmission of pathogens. 3- Describe the medical importance, and in what role, geographic distribution, and life cycles of arthropod groups: Scorpionida; Araneae; Acari; Triatominae; Cimicidae; Phtiraptera; Siphonaptera; Simuliidae; Ceratopogonidae; Phlebotominae; Culicidae; Tabanidae; Glossinidae; Muscomorpha. 4- To know the most important vector species of the main vectorborne diseases, namely their bioecology. 5- Identify medically important arthropods, either as vectors or disease agents, using dichotomous keys. 6- Define the concepts of Vectorial Efficiency, Vector Competence, and Vectorial Capacity. 7- Analyse the introduction of exotic species in the context of climate change and vector-borne re/emergent diseases in the One Health context. **Syllabus:** 1- Medical Entomology in the context of Global Health. 2- Definition and concept of arthropod Vector. Types and mechanisms of pathogen transmission. Arthropods as agents of disease. 3- Phylum Arthropoda: taxonomy and identification; 4- Main arthropod groups of medical relevance: scorpions, spiders, mites, ticks, lice, bedbugs, triatomine bugs, fleas, black flies, sand flies, culicoides, mosquitoes, horseflies, tsetse flies and synanthropic flies. Systematics, geographic distribution, life cycle, bioecology. 5- Most important vector species of the main vector-borne diseases, and their bioecology. 6- Identification of medically important arthropods using dichotomous identification keys. 7- Entomological parameters with epidemiological importance: Vector Efficiency, Competence, and Vectorial Capacity. 8- Impact of climate change on vector bioecology, and introduction of exotic species, in the context of (re)emerging diseases and One Health.
Assessment: The assessment/evaluation will have four components: i) theoretical exam with multiple choice and other types of questions, short answer and longer answer questions; ii) practical laboratory exam; iii) seminar, in which the students will present a scientific article, with critical analysis and discussion; iv) continuous assessment/evaluation, concerning point tests and questions in the online Moodle platform, as well as questions and identification of specimens in laboratory practical classes. Each evaluation element will be graded with a score of 0-20 points, in which the students need a 50% approval in each. The final mark is constituted by: (grade of the theoretical exam x 0.4) + (grade of practical exam x 0.3) + (grade of the Seminar x 0.2) + (grade of continuous evaluation x 0.1). **Second chance assessment:** This assessment should be performed before the students leave the country, as it comprises a practical component. For the theoretical exam, online tests will be carried out, similar to the one above, using safe browser system. Oral online exams will also be considered.

ECTS	Total number of hours (face-to-face)	Total number of hours (face-to-face + personal work)	Number of hours of lectures	Number of hours of tutorials	Number of hours of practical work
7	66	196	Lect-8;TeoPrat-4;Eval-5; Seminar-4	11	24

Course Name Fundamental skills 3 - Medical Entomology Techniques
Semester: 3 **Module:** 3.2

University: NOVA University of Lisbon
Coordinator(s): Teresa Novo
Position of Coordinators: Auxiliary Professor

Goals and outline of the course:
Students will be trained to define entomological assessment objectives, plan and execute fieldwork, process and preserve captured specimens, taxonomically identify and analyse them, and organise and digitise results. They will also be able to critically discuss findings, methodologies, and propose necessary adaptations.

Learning outcomes:
At the end of the course, students should have acquired knowledge and skills that allow them to:

1. Define the objectives of an entomological assessment and the respective fieldwork aimed at capturing the target species;
2. Plan and prepare fieldwork;
3. Execute fieldwork according to the defined objectives;
4. Process the captured material for sorting, labelling and long-term preservation/assembly or future laboratory processing;
5. Taxonomically identify and analyse the material according to the objectives;
6. Organize, digitize and analyse the results obtained;
7. Critically discuss the results obtained, the methodologies used and propose adaptations to them.

Syllabus:

1. Assessment of insect populations of medical/veterinary interest: objectives and planning of the respective fieldwork;
2. Entomological collection methods according to the target taxonomic group and life stage. Advantages and disadvantages of each method and its selection;
3. Methods of preservation of captured specimens for transport to the laboratory, according to the objectives of the study;
4. Planning of the fieldwork and preparation of appropriate material for the capture and preservation of specimens for transport to the laboratory;
5. Execution of the fieldwork;
6. Processing of the captured material for preservation and labelling;
7. Taxonomic identification of captured specimens;
8. Laboratory processing of the material according to the study objectives;
9. Collection of field and laboratory data, database elaboration and its statistical treatment;
10. Analysis and critical discussion of the results obtained, the methodologies used and proposals for possible corrections and improvements.

Assessment:
1. Continuous evaluation based on the presence and active participation in classes and fieldwork and tasks proposed throughout the course - 50%.
2. Seminar in which students present a scientific article relevant to the topic - 10%
3. Evaluation of written report with about 2500 words (excluding graphs and bibliography) - 40%.
The evaluation of the UC will have three components: i) evaluation of the practical work carried out and tasks presented during the classes; ii) seminar, in which students will present a scientific article in the area; iii) presentation of a report of up to 2500 words on the work carried out in the practical and field classes. Each evaluation element will be graded with a score of 0-20 points. The final grade to the UC will be given by: (participation grade x 0.5) + (seminar grade x 0.1) + (report grade x 0.4).
Second chance assessment:
1. Continuous evaluation based on the presence and active participation in classes and fieldwork and tasks proposed throughout the course - 50%. – evaluation obtained during classes/fieldwork will be maintained.
2. Seminar in which students present a scientific article relevant to the topic - 10%
3. Evaluation of written report with about 2500 words (excluding graphs and bibliography) - 40%.

ECTS	Total number of hours (face-to-face)	Total number of hours (face-to-face + personal work)	Number of hours of lectures	Number of hours of tutorials	Number of hours of practical work
4	76	112	8 +4 seminar	12	Lab-40 FieldWork-12

Course Name Experimental project (field and/or laboratory)
Semester: 3 **Module:** 3.3

University: NOVA University of Lisbon
Coordinator(s): Carla Sousa
Position of Coordinators: Associated Professor

Goals and outline of the course:
In this curricular unit (CU), the objective is for students to attend and participate in the laboratory activities, from a research standpoint, under the work frame of the laboratories of Medical Entomology. Students are expected to rotate through different laboratories to engage with various laboratory procedures, methodologies, and fieldwork. A personalized internship will be designed for each student, considering the knowledge, skills, and competencies intended to be acquired by the student. Students will have access to the In Vivo Arthropod Security Facility.

Learning outcomes:
As individual projects with execution plans outlined according to the internship objectives, each student's tutor is responsible for ensuring that the learning objectives are achieved based on the experimental project's programmatic content.

Syllabus:
These laboratory internships will last for 10 working days, with a daily schedule of three (3) hours, supplemented by four tutorial guidance sessions lasting 2 hours each. At the end of the curricular unit, a seminar lasting 3+3 hours will take place, allowing each student to orally present their project. The working schedule will vary according to laboratorial protocols and research needs. Integrated into a research team, the students should familiarize themselves with the research methodologies to be developed. Consequently, the internship's programmatic content will depend on the laboratories where students will intern and the subjects that interest the student the most. To this end, the internship plan, concerning its objectives, content, and methodologies, will be collaboratively developed by the student and the tutor.

Assessment:
Approval in the curricular will be obtained if total attendance of the scheduled internship is observed, and the final grade is equal to or higher than 10 points, on a scale of 0-20 points. The final grade will be calculated considering the grades obtained in 1) the continuous evaluation by the internship tutor; 2) the written report at the end of the internship; 3) the oral presentation of the internship, according to the following formula: Final CU grade = (tutors' grade x 0.4) + (written report grade x 0.3) + (internship presentation grade x 0.3).

Second chance assessment: Identical to the first evaluation season.

ECTS	Total number of hours (face-to-face)	Total number of hours (face-to-face + personal work)	Number of hours of lectures	Number of hours of tutorials	Number of hours of practical work
4	44	112	Seminar-6	8	30

Course Name Vector-pathogen interactions
Semester: 3 **Module:** 3.4

University: NOVA University of Lisbon
Coordinator(s): Henrique Silveira
Position of Coordinators: Full Professor

Goals and outline of the course:
The dynamics of vector-borne diseases are influenced by a variety of factors. Transmission depends on intrinsic factors such as vector immunity, feeding behaviour, and the microbiome, as well as extrinsic and environmental factors. Additionally, many of these factors can be manipulated by the pathogens themselves. Significant progress has been made in understanding specific interactions, such as the transmission of malaria parasites or arboviruses by mosquitoes. However, fundamental questions with broad, generalizable implications remain challenging. Addressing these questions requires data from various vector-pathogens, and the ability to integrate this complex biological information into new knowledge and applications, which depends, above all on highly trained professionals.

Learning outcomes:
At the end of the course, students should have acquired the knowledge and skills to:

1. Understand the importance of the digestive, reproductive and immunological systems of the vectors and the development of pathogens;
2. To know the relation of the microbiota with the pathogens and insect vectors and how to use them in the control and prevention of the transmission of pathogens;
3. To know how to perform the diagnosis of pathogens in field insects and corelate with the developmental cycles of the different pathogens in their vectors;
4. Analyse the factors that affect vector competence. To identify the main factors related to the interaction between the different pathogens and their vectors and to recognize potential factors that can be investigated in order to control and prevent the transmission of pathogens by their vectors;
5. Reflect critically on published studies in the area of pathogen-vector interactions and formulate new scientific hypotheses.

Syllabus:

1. Physiology: Digestive system; Digestion and interaction with pathogens; Reproductive system
2. Immunity: Signalling pathways; Cellular and humoral responses; Immunity from Mosquito to *Plasmodium*, Triatomines to *Trypanosoma*, Mosquito to Viruses and Ticks
3. Microbioma of insects: Importance of microbiota for insects; Interaction among insect vector, pathogen and microbiota; Intestinal microbiota and use in paratransgenic insects
4. Diagnosis of pathogens in insect vectors. Protozoa and viruses
5. Vector competence and its determinants: mosquito and virus; triatomine and trypanosome; *Anopheles* and *Plasmodium*; phlebotomines and Leishmania; Ticks and pathogens
6. Applications for control: Transmission blocking vaccines and drugs; genetic transformation

Assessment:
The evaluation of the students will consist of three different processes: exercises applied in each stage of the UC; presentation of a project prepared by the student using one of the topics of the programmatic content; critical analysis of an article provided by teachers and its presentation in a seminar. Each evaluation element will be graded with a score of 0-20 values. The final classification of the UC will consist of the average of the notes of the exercises, the seminar of presentation of the project and the critical evaluation of an article.

Second chance assessment:
Students who do not obtain a classification higher than 10, take a final exam which will cover the entire subject (practical and theoretical).

ECTS	Total number of hours (face-to-face)	Total number of hours (face-to-face + personal work)	Number of hours of lectures	Number of hours of tutorials	Number of hours of practical work
3	84	29	9 + 6 seminar	8	6

Course Name Surveillance and vector control
Semester: 3 **Module:** 3.5

University: NOVA University of Lisbon
Coordinator(s): João Pinto
Position of Coordinators: Associate Professor

Goals and outline of the course:
The course focus on the most innovative and effective strategies currently used or in development for the surveillance and control of disease vectors.

Learning outcomes:
At the end of the course, students should have acquired the knowledge and skills to:
1. Describe the basic organizational and operational components of vector surveillance and control programs.
2. Apply currently available tools for control and monitoring of insect vector populations.
3. Study the presence of insecticide resistance and analyse mechanisms of resistance in natural insect vector populations, including their molecular, ecological and behavioural components.
4. Propose best practices for insecticide resistance management in the context of vector control programs.
5.Reflect on novel monitoring and control strategies under development.

Syllabus:

1. Vector-borne disease control programs: organization and integration in the healthcare system.
2. Vector control: concept, methods and application.
    - Chemical control: insecticides for public health, formulations and application.
    - Biological control: predators, microorganisms.
    - Physical control: larval source reduction, house screening.
    - Evaluating the efficacy of control methods.
    - Integrated vector management.
2. Monitoring insecticide resistance in insect vectors.
    - Concepts of susceptibility, tolerance and resistance.
    - Methods for detecting resistance in natural vector populations.
    - Mechanisms and molecular basis of insecticide resistance.
    - Insecticide resistance management.
2. Innovative solutions for vector monitoring and control.
    - GIS-based risk analysis of vector-borne diseases.
    - Intelligent mosquito traps for sentinel monitoring.
    - Genetically engineered mosquitoes.
    - Ecological control: mass trapping, autodissemination and push-pull strategies.

Assessment:
The evaluation of the CU will have two components: i) a theoretical online exam with 40 multiple choice questions and four medium development questions; ii) a seminar, in which the students will present a scientific article on a topic of the UC. Each evaluation element will be graded with a score of 0-20 values. The final classification of UC will be given by: (grade of the theoretical exam x 0.5) + (seminar grade x 0.5).

Second chance assessment:
Theoretical online exam with 40 multiple choice questions and four medium development questions.

ECTS	Total number of hours (face-to-face)	Total number of hours (face-to-face + personal work)	Number of hours of lectures	Number of hours of tutorials	Number of hours of practical work
5	48	140	Lec-12 TeoPra-14 Seminar-4 Evaluation -2	4	12

Course Name Ecoepidemiology of vector-borne diseases in a global changing environment
Semester: 3 **Module:** 3.6

University: NOVA University of Lisbon
Coordinator(s): Carla A. Sousa
Position of Coordinators: Associated Professor

Goals and outline of the course:
The aim of the course is to empower students to develop activities under the work frame of vector-borne diseases epidemiology, an increasing challenge due to the current environmental (climate but not only) changes. With the student has central element of individual knowledge search, teachers will promote and guide the learning process implementing different learning resources (e.g. flipped learning classes, gaming strategies). Practical classes developed in collaborative and problem-based learning with discussion of subjects and concepts will train students on different activities needed for those willing to develop their professional or academic careers associated to the epidemiology of vector-borne diseases.

Learning outcomes:
At the end of the course unit students should:
1. Identify the main vector-borne diseases and know their ecoepidemiology in a changing environment. Malaria, arboviruses, leishmaniasis, tick-borne diseases, filariases, African (Sleeping Disease) and American (Chagas Disease) human trypanosomes: distribution, pathogens, transmission, hosts and life cycles.
2. Know historical aspects of vector-borne diseases.
3. Differentiate anthroponotic and zoonotic diseases, biotic, abiotic factors and the influence of environmental changes.
4. Understand concepts of endemic, epidemic, pandemic, outbreak, transmission, incidence and prevalence.
5. Know the clinical, laboratory, treatment and prevention of vector-borne diseases.
6. Understand the causes of neglected and (re) emerging diseases
7. Have a critical view of current world policies for these diseases and contextualize them in their reality.

Syllabus:
1. Epidemiological Concepts: endemic, epidemic, pandemic, outbreak, transmission, incidence, prevalence, zoonotic, anthroponoptic, neglected and (re) emerging diseases, transmitted by arthropod vectors.
2. Epidemiological estimators and models of transmission
3. Historical Aspects of vector-borne diseases.
4. Importance of diseases transmitted by arthropod vectors in Global Health and as causes of Neglected Diseases.
5. Ecoepidemiology of antroponoses and zoonoses: biotic, abiotic factors, influence of climate and environmental changes.
6. Ecoepidemiology, clinical and prevention of vector-borne diseases: arboviruses (Yellow Fever, dengue, Zika, chikungunya and West Nile), Malaria, Leishmaniasis, Chagas disease, Sleeping sickness, filariases, Human diseases caused by ticks - their distribution, pathogens, transmission, reservoirs, life cycles - vectors / humans, symptoms, clinical diagnosis, laboratory, treatment and prevention measures.

Assessment:
In this curricular unit it will be used a combination of methods to comprehensively evaluate students. It was considered the context of the course, learning objectives of the curricular unit, and the cultural diversity of students for selecting the following student's assessment methods. Thus, Evaluation will have three components.
- Theoretical exam with multiple choice and other types of questions, short answer and longer answer questions; this type of evaluation provides a systematic way to assess students' knowledge and understanding and allows standardized and objective grading.
- Practical laboratory quizzes that will assess application of knowledge and problem-solving skills.
- Continuous assessment/evaluation, concerning point tests and questions in the online Moodle platform; this will reflect the engagement and active involvement of the student in the learning process and provides insights into students' understanding of the material

Each evaluation element will be graded with a score of 0-20 points, in which the students need a 50% approval in each. The final mark is constituted by: (grade of the theoretical exam x 0.6) + (grade of practical quizzes x 0.2) + (grade of continuous evaluation x 0.2).

Second chance assessment: As above.

ECTS	Total number of hours (face-to-face)	Total number of hours (face-to-face + personal work)	Number of hours of lectures	Number of hours of tutorials	Number of hours of practical work
4	38	112	14	6	18

Course Name Portuguese language and culture
Semester: 3 **Module:** 3.7

University: NOVA University of Lisbon
Coordinator(s): João Pinto
Position of Coordinators: Associated Professor

Goals and outline of the course:
For students to reach the proposed learning objectives, activities implemented in the CU will focus on the development of 4 skills: speaking, listening, writing and reading. The proposed activities will favor intercultural exchanges and place the student in a real communication situation. Discussions in class, excursions and seminars will enable students to acquire linguistic and cultural skills in an interactive manner. The documentation and bibliography given to students will allow autonomous study and group work, aiming at obtaining the level A1 of the Common European Framework of Reference.

Learning outcomes:
Objective 1: By the end of the course the students will be able to use the Portuguese language to introduce and orientate themselves, as well as sustaining basic conversations about their family, friends, country, hobbies and everyday life.
Objective 2: Students will gain knowledge of essential aspects of the history and culture of Portugal, monuments and traditions.

Syllabus:
1. Introducing oneself
   - How to address someone
   - Figures and numbers
   - Weekdays/months/seasons/years
   - Name, gender and age
   - Date and place of birth

2. Family
   - Family and family situations
   - Speaking about life events
   - Describing someone

3. Hobbies and activities
   - Vocabulary concerning hobbies and free time
   - How to formulate a question and an invitation
   - Accepting/refusing a proposal

4. Everyday activities
   - Forms of communication (verbal, written, visual)
   - Asking directions and means of transportation
   - Asking for a meal or drink
   - Expression of time

5. History and culture of Portugal
   - Discovering Portuguese heritage: foundation, middle age, discoveries, constitutional monarchy, republic, contemporary history.
   - Monuments, museums and calendar of cultural events.
   - Gastronomy, music and folklore.
   - The overseas diaspora and the cultural melt-pot: Arabic, African, Asian and South American influence.
   - Getting around in Lisbon: map, public transportation and sites of interest.

Assessment:
Assessment will be made by means of an exam with listening, reading/speaking and writing components on a given topic.
Second chance assessment: As describe above.

ECTS	Total number of hours (face-to-face)	Total number of hours (face-to-face + personal work)	Number of hours of lectures	Number of hours of tutorials	Number of hours of practical work
3	28	84	TeoPra-12 Seminar-6	4	FieldWorK-6

SEMESTER 4 – Master thesis project at full or associated partner institutions

Course name: 6-month Master Thesis project

University: University of Tours, University of Orléans, KU Leuven, NOVA University of Lisbon
Coordinator(s): The selection committee will be involved in distribution of master thesis projects. Supervision of each student during the Master thesis project will be ensured by the co-promoter (from the institution/company proposing the project) and by a nominated promoter (staff from the ISSF consortium) relevant to the master thesis subject.
Position of Coordinators: Professors and associated professors from all four HEIs.

Goals and outline of the course:
The master thesis will last 6 months and can be performed worldwide in the public and private sectors in any full or associate partner institution. A joint list of Master thesis projects emanating from the member HEIs and associated partners will be approved and presented to the students before distribution of the projects. Supervision of each student during the Master thesis project will be ensured by the co-promoter (from the institution/company proposing the project) and by a nominated promoter (staff from the ISSF consortium) relevant to the master thesis subject. Evaluation of master thesis written reports and oral defences will be performed jointly with representatives of all HEIs present at the coordinator's campus (UT).
The master thesis will be written and defended in English.

Learning outcomes:
Graduates will be able to / will have the:
- Learn specialised knowledge within the insect science field including insight into relevant research, entrepreneurial and development work.
- Learn specialised knowledge of methods within the main field of study.
- Ability to contribute to research, entrepreneurial and development work.
- Ability to identify, formulate and manage complex problems in a critical, independent and creative manner.
- Ability to plan and use adequate methods to implement advanced tasks within given frameworks,
- Ability to create, analyse and critically evaluate different technical solutions.
- Ability to integrate knowledge in a critical and systematic manner.
- Ability to in writing clearly describe and discuss his or her conclusions in English, including the knowledge and arguments that form the basis of the conclusions.
- Ability to orally clearly describe and discuss his or her conclusions in English, including the knowledge and arguments that form the basis of the conclusions.
- Within the framework of the specific degree project, ability to identify which problems need to be addressed to observe sustainable development.
- Awareness of ethical aspects related to research and development work.
- Ability to work independently and to be able to collaborate with pairs.

ECTS – 30
Duration 6 months

Assessment of Master Thesis project:
The following evaluation matrix has been designed.

PROCESS **Name student:**

TOTAL

	outstanding	very good	good	satisfactory	sufficient	insufficient	weak	very weak
Approach and planning (research attitude, scientific approach, planning, work accurately, ...)								
Initiative and autonomy (independent study attitude, self-reliance, solving problems, transition from independent synthesis toward a final result, ...)								
Communication (interim reporting, internal team communication, …)								
Team spirit (social relations, consultation, responsibility, attention to context, handling of discussions and criticism, ….)								
Commitment and motivation (attitude, work ethic, perseverance, …)								

Process - work ethics **Mark**

Assignment analysis (focused analysis and limitation of the subject matter, adequate research questions, …)								
Information acquisition and processing (research efficiency, scientific approach to the process and interpretation, evaluating quality of sources, …)								
Attention for broader context (sustainability, social, ethical, economic aspects, security, …)								
Quality of the working methods (planning, design decisions and research methods, optimising and adjusting design/test methods, ...)								
End result quality (achievement of the objectives, is the job well-done, ...)								
Critical analysis (correct interpretation of the work and results, reflection on methods used, justification of choices and assumptions, ...)								
Personal contribution (creativity, personal share in the contribution to the experiments and/or research, …)								

Process - methodology & results **Mark**

The final marks for work ethics and methodology & results are not necessarily the weighted average of the assessment of the above indicators

Remarks evaluator

THESIS **Name student:**

TOTAL

	outstanding	very good	good	satisfactory	sufficient	insufficient	weak	very weak
Structure and design (logical structure and layout, clear and specific titles, employment and quality of figures and tables, ...)								
Language use (clear and correct sentence structure, spelling, ...)								
Scientific rigor (correct citation, accurate representation of results, active in personal writing style, correct references to figures and tables, ...)								

Thesis - form **Mark**

Assignment analysis (assignment's context, targeted analysis and definition, correct and clear formulation of objectives and research, ...)								
Information processing (quantity and quality of sources employed, appropriate documentation of results, ...)								
Attention to the broader context (situation with respect to the literature and/or previous work, when relevant due attention to aspects such as ethics, economics, sustainability, security, ...)								
Quality of the work method (clear and accurate approach and method descriptions, effectiveness of the methods used, ...)								
End result quality (are the objectives achieved, clear and correct wording of the conclusion and requirements for further research, ...)								
Critical analysis (assessment of the quality of one's own work and results, reflection on methods used, justification of choices and assumptions, comparison with the literature and other results, ...)								
Personal contribution (creativity, own stake, experimental work/research, ...)								

Thesis - content & product **Mark**

The final marks for from and content & product are not necessarily the weighted average of the assessment of the above indicators

Remarks evaluator

PRESENTATION & DEFENCE **Name student:**

TOTAL

	outstanding	very good	good	satisfactory	sufficient	insufficient	weak	very weak
Structure and design (logical structure and build-up, use and quality of figures and illustrations, ample space for presentation of own work, …)								
Language (employment of correct terminology, clarity and purpose, the use of standard English, speech rate proficiency and articulation, …)								
Attitude & Timing (public interaction, confidence and maturity, politeness during questions and answers, respecting time limitations, …)								

Presentation & defence - form **Mark**

Clear and correct formulation of the problem and research questions, of the approach and working methods employed, and of the conclusions								
Insight and mastery of the subject matter (quality of the proposed work, accuracy and factual nature of the answers given during the defence, …)								
Maturity and resilience at the defence (control of his/her level of nervousness, reacting appropriately and constructively to questions, …)								
Critical analysis (accurate quality assessment of their own work and results, reflection on their chosen methods and models, …)								

Presentation & defence - content & product **Mark**

The final marks for form and content & product are not necessarily the weighted average of the assessment of the above indicators

Remarks evaluator

20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5
Greatest distinction			Great distinction		Distinction		Satisfactory				Insufficient		Very insufficient (not compensable)		
At least some indicators are of outstanding quality and the others are very good.			Most indicators are of outstanding quality or very good and the others are good.		Most indicators are good, very good or of outstanding quality and the others are at least sufficient.		Some indicators are good, very good or of outstanding quality and the others are at least sufficient.		Most indicators are at least sufficient, the gaps in the others are not fundamental.		Most indicators are at least sufficient, the gaps in the others are fundamental but can be compensated when the total result suffices.		Most indicators are insufficient, weak or very weak, there are fundamental gaps in various areas that cannot be compensated.		Most indicators are evaluated as very weak. The few positive elements are coincidental.

The marks in the above table are a guideline for the evaluators.
The total results for work ethic/form and for methodology & results/content & product are not necessarily the (weighted) average of the evaluation of the different indicators.

2. Jointness of the ISSF Curriculum

Module	Semester 1 UT- UORL	Semester 2 KUL	Semester 3 UNL
Module 1 Insect Biology	**1.1 Insect Biology 1** Introduction to Sustainable Development Goals Overview of entire ISSF master program Insect life cycles Taxonomy and anatomy	**2.1 Insect Biology 2** Fundamental and applied knowledge on insect physiology: all aspects of insect physiology (except immunity)	**3.1 Insect Biology 3** Focus on biology of arthropod vectors of animal and human diseases
	Required for all the master program 2.1 Insect Biology 2 2.5 Insects in industry 3.1 Insect Biology 3 3.2 Fundamental skills 3	Follow-up of 1.1 Insect Biology 1 Required for 3.1 Insect Biology 3	Follow-up of 1.1 Insect Biology 1 2.1 Insect Biology 2
Module 2 Fundamental skills	**1.2 Fundamental skills 1** Fundamental skills applied to insects in: -Molecular biology and proteomics -Genetics and genomics -Population genetics -Behavioral and sensorial ecology	**2.2 Fundamental skills 2** Bioprocess engineering State of the art molecular techniques Unit operation in the food industry	**3.2 Fundamental skills 3** Medical entomology techniques in -Field work -Taxonomic identifications -Statistical analysis
	Required for 2.2 Fundamental skills 2 2.3 Project work on Insect production 3.2 Fundamental skills 3 3.3 Experimental field or lab project	Follow-up of 1.2 Fundamental skills 1	Follow-up of 1.2 Fundamental skills 1 1.3 Field project
Module 3 Immersive project	**1.3 Field Project** Experimental design & data collection Statistical analyses Literature search and writing skills	**2.3 Project Work in Insect Production** Rearing and processing of insects Biochemical and microbiological analyses	**3.3 Experimental field or laboratory project** Personalized internship in medical entomology in a field and/or laboratory setting
	Required for All master course 2.4 Experimental Design 3.2 Fundamental skills 2 3.3 Experimental field or lab project	Follow-up of 1.2 Fundamental skills 1 Required for 3.5 Surveillance and vector control	Follow-up of 1.2 Fundamental skills 1 1.3 Field project
Module 4 Specialty	**1.4 Insects and multitrophic interactions** Insects as pests of plants Insects as vectors of plant diseases Insects and pollination	**2.4 Experimental Design** Design of factorial experiments	**3.4 Vector-pathogen interactions** Insect immunity Insect-microbe interactions Vector competence
	Required for 2.5 Insects in industry 3.4 Vector-pathogen interactions	Follow-up of 1.3 Field project Required for 3.2 Fundamental skills 3 3.3 Experimental field or lab project	Follow-up of 1.4 Insects and multitrophic interactions 2.1 Insect Biology 2
Module 5 Specialty	**1.5 Integrated Pest management** Insects control by pesticides Alternative methods of pest regulation Current challenges for implementation	**2.5 Insects in Industry** Insects for food, feed, biotechnical applications, biocontrol and pollination -Industrial insect production and processing in practice	**3.5 Surveillance and vector control** Vector-borne disease control programs Monitoring insecticide resistance Innovative solutions for vector monitoring and control
	Required for 2.5 Insects in industry 3.5 Surveillance and vector control	Follow-up of 1.4 Insects and multitrophic interactions 1.5 Integrated pest management Required for 3.5 Surveillance and vector control	Follow-up of 1.5 Integrated pest management 2.5 Insects in industry
Module 6 Specialty	**1.6 Global change, adaptation, and conservation** Insect biodiversity under threat Insect responses to global change Insect conservation	**2.6 Innovation and Entrepreneurship** Entrepreneurship, innovation and the role of the engineer in a company	**3.6 Ecoepidemiology of vector-borne diseases in a global changing environment** Epidemiological Concepts Global Health Ecoepidemiology
	Required for 3.6 Ecoepidemiology of vector-borne diseases in a global changing environment	Required for all the master program for entrepreneurship culture	Follow-up of 1.6 Global change, adaptation and conservation
Module 7 Language and culture	**1.7 French Language and Culture in Loire Valley** Required for all the master program for intercultural awareness	**2.7 Dutch Language and Cultures** Required for all the master program for intercultural awareness	**3.7 Portuguese language and culture** Required for all the master program for intercultural awareness

3. Learning outcomes of the ISSF Curriculum

Global learning outcomes

- Mobilize and produce specialized knowledge
After a first cycle degree in life sciences or related fields students will be able to mobilize specialized knowledge in insect sciences, some of which is at the forefront of knowledge, and which can serve as the basis for original thinking. Critical thinking skills will be developed to be able to conduct reflective and distanced analysis of issues pertaining to insect sciences. Students will be able apply their knowledge and understanding, and problem-solving abilities in different environments within broad contexts related to insect sciences.

- Implement advanced and specialized uses of scientific tools
Students will be trained to use digital and statistical tools, together with specialized tools in the field of insect biology.

• Contribute to project work related to professional contexts
Students will have the ability, within a professional context, to integrate knowledge, conduct a project and manage complex, unpredictable professional or study contexts, while maintaining scientific integrity and rigour and respecting social, deontological and ethical issues related to the different domains of application in insect sciences.
Students will learn to work in collaboration with pairs and also in an independent manner. Students will have the learning skills to allow them to be employable or to continue to study (at PhD level) in a largely autonomous manner.

• Implement specialized communication for knowledge transfer
Students will learn to critically select and analyse a variety of specialized resources to document a topic and synthesize that data for use. They will be able to communicate clearly, orally and in writing, on the scientific context to specialist and non-specialist audiences.

Specific Learning outcomes for each Module

Modules S1	Learning outcomes – Graduates will be able to:
M1.1 Insect Biology 1	- Understand the importance of insects for Sustainable Development Goals. - Understand the basics of life cycle analyses for sustainability evaluation in agricultural and agri-food productions. - Understand developmental strategies and recognize Holometabolous/Hemimetabolous stages. - Dissect and understand the anatomy of insect models. - Prepare and recognize tissues and cells by microscopic techniques. - Link anatomy and function of organs.
M1.2 Fundamental skills 1	- Learn fundamental skills to study insects at an individual level. - Learn fundamental skills to study insects at the population level. - Learn fundamental skills study insect behaviour and sensory ecology.
M1.3 Immersive project 1 – Field project	- Acquire the basics of designing an experiment and understanding the importance of knowing how to identify what is a scientific question, a hypothesis, and a prediction. - Learn the fundamental tools needed to optimize the search for scientific literature. - Collect samples and data following precise and repeatable protocols. - Analyse the data generated using appropriate statistical approaches. - Reflect critically on their results and present their findings orally in a clear manner. - Present their findings in a written report and use current tools to cite literature. - Apprehend the principles of the peer-review system, the scientific publication process and the rules of Open Science.
M1.4 Insects and multitrophic interactions	- Identify the different roles played by insects in their interactions with plants, as pests of plants, vectors of plant diseases or plant pollinators. - Analyse mechanisms involved in the interactions of insects with their host plants, considering the role played by microorganisms in these interactions, as well as cascading effects on higher trophic levels. - Interpret the impact of abiotic and biotic stressors on insect-plant interactions, also in the context of global change. - Reflect critically on how fundamental knowledge on insect-plant interactions can help to mitigate risks linked to insects as pests or vectors. - Reflect critically on the causes and consequences of pollinator decline. - Evaluate the risks and opportunities provided by knowledge on plant multitrophic interactions for the development of innovative strategies in sustainable agriculture and/or conservation biology.
M1.5 Integrated Pest management	- Implement expertise in pesticides and biopesticides engineering, with a precise comprehension of the advantages & disadvantages of pesticides, of their mode of actions and the risks associated with their use.

	- Implement expertise in biocontrol to identify and critically compare the different types of biological control strategies, with a global understanding of the key biological mechanisms underlying their success or failure. - Critically evaluate and select the most suitable pest management strategy according to the local ecological and socio-economic context. - Develop critical thinking about the problematic of pest management, analyse scientific documents, produce a scientific experimental report.
M1.6 Global change, adaptation, and conservation	- Identify the different factors that threaten insects in their natural habitat in the context of global change. - Understand the concepts and methods that are used to predict the migration and distribution of insects at different spatial and temporal scales. - Understand and analyse the molecular, organismal and populational mechanisms by which insects can adapt and survive in a changing world. - Learn about challenges of insect conservation and the basic applied science involved. - Develop an integrative vision of the insect biodiversity. - Reflect critically on the causes and consequences of insect population decline
M1.7 French Language and Culture in Loire Valley	- Acquire basic French language skills (A1 level). - Gain knowledge on French and Loire Valley culture.

Modules S2	**Learning outcomes – Graduates will be able to:**
M2.1 Insect Biology 2	- Acquire knowledge in fundamental and applied aspects of the physiology of insects. - Learn the functional role and evolution of physiological mechanisms that allow insects to adapt to changes in their environment. - Develop practical skills and acquire insight in different research approaches that are followed in fundamental and applied insect physiology.
M2.2 Fundamental Skills 2	- Acquire knowledge on molecular innovative tools that are used in biotechnology and the advantages and disadvantages of these techniques. - Acquire knowledge to function as a beginning engineer in applied research or in the biotechnological sector. - Implement a strategy to perform cloning and manage and design a biotechnogical process. - Describe the basic principles of unit operations. - Discuss and compare different unit operations related to specific raw materials, intermediate and end products. - Describe the mode of operation of equipment used, in relation to the chemical, microbiological and biochemical prerequisites of a specific production process. - Apply the principles of unit operations on known (or new production processes.
M2.3 Immersive Project 2 - Project Work in Insect Production	- Master typical insect rearing, harvesting and stabilizing techniques. - Master chemical and microbial quality analyses on insects. - Be able to isolate fats, protein, chitin and other valuable compounds from insects.
M2.4 Experimental Design	- Implement an optimal experimental design approach with a focus on factorial experiments, i.e., experiments studying multiple treatment factors. - Learn the use of JMP software, which is state of the art for the optimal design of experiments.
M2.5 Insects in Industry	- Acquire knowledge on the use of insects in human food and animal feed from a broader societal perspective. - Acquire knowledge on legal and food safety aspects and issues, and interpret recent developments in these areas. - Able to describe the microbiological, chemical and physicochemical aspects of insect use, and explain any connections. - Able to describe and explain the necessary technological principles behind insect processing. - Able to describe, optimize and implement procedures for microbiological, chemical, physicochemical and sensory analyses where necessary.
M2.6 Innovation and Entrepreneurship	- Understands basic concepts of entrepreneurship and innovation. - Able to think critically, rationally and logically coherently about the role and responsibilities of entrepreneurs in a company. - Able to think in a critical, rational and logically coherent way about the functioning of companies in the different phases (start-up and growth of start-ups and the functioning within medium-sized and large companies). - Having insight into the innovation process, the different forms of innovation and the protection of innovation.

	- Understand the production process and quality control.
M2.7 Dutch Language and Cultures	- Acquire basic communicative skills in Dutch (level A1 of the Common European Framework). - Gain knowledge on Belgium culture with various lectures about Belgium.

Modules S3	**Learning outcomes – Graduates will be able to :**
M3.1 Insect Biology 3	- Define Medical Entomology in the context of Global Health. - Define arthropod vectors, describe and distinguish types and mechanisms of transmission of pathogens. - Describe the medical importance of vector arthropod groups.
M3.2 Fundamental skills 3	- Define the objectives of an entomological assessment and the respective fieldwork aimed at capturing the target species. - Plan and prepare fieldwork. - Execute fieldwork according to the defined objectives. - Process the captured material for sorting, labelling and long-term preservation or future laboratory processing. - Taxonomically identify and analyse the material according to the objectives. - Organize, digitize and analyse the results obtained. - Critically discuss the results obtained, the methodologies used and propose adaptations to them.
M3.3 Immersive Project 3 - Medical Entomology Techniques	- Define a scientific question based on arthropod vectors. - Design the protocol. - Implement the protocol in a specialized infrastructure. - Analyse results and reflect critically. - Present results in a clear and efficient way.
M3.4 Vector-pathogen interactions	- Understand the importance of the digestive, reproductive and immunological systems of the vectors and the development of pathogens. - Learn the relation of the microbiota with the pathogens and insect vectors and how to use them in the control and prevention of the transmission of pathogens. - Learn how to perform the diagnosis of pathogens in field insects and corelate with the developmental cycles of the different pathogens in their vectors. - Analyse the factors that affect vector competence and recognize factors that can be investigated in order to control and prevent the transmission of pathogens by their vectors. - Reflect critically on published studies in the area of pathogen-vector interactions and formulate new scientific hypotheses.
M3.5 Surveillance and vector control	- Describe the basic organizational and operational components of vector surveillance and control programs. - Apply currently available tools for control and monitoring of insect vector populations. - Study the presence of insecticide resistance and analyse mechanisms of resistance in natural insect vector populations. - Propose best practices for insecticide resistance management in the context of vector control programs. - Reflect on novel monitoring and control strategies under development.
M3.6 Ecoepidemiology of vector-borne diseases in a global changing environment	- Identify the main vector-borne diseases and know their ecoepidemiology in a changing environment. - Know historical aspects of vector-borne diseases. - Differentiate anthroponotic and zoonotic diseases, biotic, abiotic factors and the influence of environmental changes. -Understand concepts of endemic, epidemic, pandemic, outbreak, transmission, incidence and prevalence. - Know the clinical, laboratory, treatment and prevention of vector-borne diseases. - Understand the causes of neglected and (re) emerging diseases. - Have a critical view of current world policies for these diseases and contextualize them in their reality.
M1.7 Portuguese language and culture	- Acquire basic communicative skills in Portuguese (level A1 of the Common European Framework). - Gain knowledge on Portuguese culture.

Module S4	**Learning outcomes – Graduates will be able to:**
Master Thesis	- Learn specialised knowledge within the insect science field including insight into relevant research, entrepreneurial and development work. - Learn specialised knowledge of methods within the main field of study. - Ability to contribute to research, entrepreneurial and development work. - Ability to identify, formulate and manage complex problems in a critical, independent and creative manner.

	- Ability to plan and use adequate methods to implement advanced tasks within given frameworks. - Ability to create, analyse and critically evaluate different technical solutions. - Ability to integrate knowledge in a critical and systematic manner. - Ability to in writing clearly describe and discuss his or her conclusions in English, including the knowledge and arguments that form the basis of the conclusions. - Ability to orally clearly describe and discuss his or her conclusions in English, including the knowledge and arguments that form the basis of the conclusions. - Within the framework of the specific degree project, ability to identify which problems need to be addressed to observe sustainable development. - Awareness of ethical aspects related to research and development work. - Ability to work independently and to be able to collaborate with pairs.