

Agricultural Engineering

MSc in AGROECOLOGY



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30/03/2022

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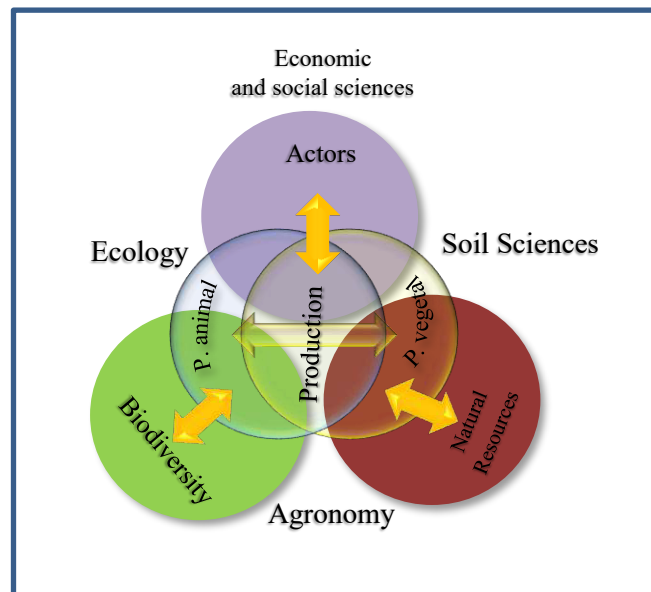
Professional context and issues, expected integration, employers and targeted jobs:

Today's agriculture must adapt to the many challenges for maintaining production, reducing environmental impacts (water and air quality), preserving soil and enhancing biodiversity. Action drivers are available to better conciliate agriculture and biodiversity, to better adapt agro-ecosystems to natural resources and the balance of territories, in a sometimes-uncertain economic context. Different actors through agro-ecological agricultural projects mobilize these levers. Thus, new missions and new scientific questions emerge and require the mobilization of knowledge at the interfaces between disciplines (agronomy, animal Science, ecology, environmental sciences, and human sciences).

The originality of the specialization "Agroecology" is to cover teachings based on the concept of the optimization of services between the different components of the agro-ecosystems that are the vegetable productions, animal production, environments, biodiversity, human societies (Fig.) at the interface of which it is located. Based on a federation of disciplines (ecology, economics, social sciences, vegetal sciences, animal sciences, soil sciences), this specialization focuses on **agricultural production systems based on crop/livestock associations that value and preserve biodiversity.**

The teaching in this course largely inspired from the recent results of the research, thus enabling students -who wish- to move into the research.

Emphasis is given to the integration of disciplines focusing on crop-livestock integrated systems that value and preserve biodiversity.



In this context, the aim is to propose levers of action optimizing at best the services provided by the various components. To this end, the objectives are to form engineers who are able to:

- › conduct a comprehensive, integrated and strategic analysis of the socio-economic and environmental issues of these production systems
- › mobilize knowledge on processes on the interfaces between agricultural practices and livestock, natural habitat and biodiversity practices, in order to contribute to the improvement of production systems,
- › Propose appropriate levers of action, in consultation with experts in each discipline.

- evaluate the environmental, economic, social and societal consequences of these levers at different spatial and temporal scales of action through multicriteria analyzes in order to objectify their performance,
- Conduct research aimed at combining natural regulations and human interventions, in order to conciliate production and environmental requirements.
- Support the transition into agroecology by using the methods and approaches of advice and accompaniment.

Accessibility

For Agrocampus Ouest students: There are no prerequisites for this specialization. The choice of the S8 UEs as well as the end study thesis make it possible to personalize the course by deepening certain disciplines involved in the specialization or on the contrary by maintaining an opening towards several disciplines. However, it is unnecessary to follow the UE "Agroecology".

For students coming from other institutions, it is necessary to have acquired in the disciplines covered in the course. An English audition is conducted for non-English speaking students.

Structuring and content of S9

The Teaching Units (TU) that structure the program are under the responsibility of professors attached to different departments of Agrocampus-Ouest. They bring their skills through the pooling of certain TUs with the other specializations, and the construction of specific TUs.

To promote openness to the world, the courses are entirely in English.

The content is built to meet the needs of Research & Development around issues:

- Identification of new socio-economic expectations of agroecosystems in agroecology
- Integration of the disciplines Agronomy and Ecology for the valorization of biotic interactions and their control factors
- Integrating biodiversity into agro-ecosystem assessment
- Optimization of the C, N and P biogeochemical cycles
- Optimizing the efficiency of the Cultures-Livestock-Medium ring

Teaching Staff:

Plant Sciences Applied to Agriculture & Horticulture (SVAH)	S. Menasseri, E. Le Cadre, O. Godinot, A. Laperche, M. Carof & M. M. Manzanares-Dauleux
Physical Environment, Landscape Architecture & Territorial Development (Milppat)	G. Pérès, C. Darrot, Ph. Boudes, A. Jaffrezic, C. Walter, B. Lemercier & Z. Thomas
Ecology	M. Plantegenest, F. Val, A. Le Ralec, J. Haury, Ch. Le May, D. Barloy,
Animal and Food Sciences (P3AN)	A.L. Jacquot, J. Flament & Y. Le Colzer,
Economics, Management & Society (EGS)	A. Carpentier, C. Laidin, A. Rdier
Statistic & Informatique	M. Emily & M. Plantegenest

Detailed program

Teaching Unit (TUs)	Unit of Courses (UCs)
TU1. The challenges of Agroecology (2 ECTS), <i>Supp. Depts. SVAH, MILPPAT, Ecology</i>	UC1. The challenges of Agroecology & Bibliographical Report
TU2. Global Socio-economical Analysis (3 ECTS), <i>Supp. Depts. EGS, MILPPAT</i>	UC21. Social movements and scientific concepts UC22. Agroecology: economic approach and public policies
TU 3. Theoretical basis of agroecosystem functioning (6 ECTS), <i>Supp. Depts. MILPPAT, SVAH, ECOLOGIE, P3AN</i>	UC31. Biodiversity in agroecosystems UC32. Soil quality and ecosystem services CU33. Landscape management and biogeochemical flows. UC34. Basics on animal science and livestock farming. UC35. Ecological theories and biodiversity measurement.
TU4. Sustainability analysis of Agroecological agroecosystems (2 ECTS), <i>Supp. Depts. MILPPAT, EGS</i>	CU41. Farming systems sustainability assessment.
TU5. Agroecosystem Management Levers in Agroecology (6 ECTS), <i>Supp. Depts. MILPPT, ECOLOGIE, P3AN, SVAH</i>	UC51. Agroecological management of forage resources. UC52. Agroecological management of soil quality UC53. Agroecological management of plant health. UC54. Plant breeding in agroecosystems.
TU6. Plant, Soil, Animal Interactions (4 ECTS) <i>Supp. Depts. SVAH, MILPPAT, P3AN</i>	UC61. Plant, soil, animals interactions analysis. UC62. Pasture model and scenarisation. UC63. Agroecology consultancy.
TU7. Statistical and spatial engineering tools (3 ECTS) <i>Supp. Depts. Ecologie, MILPPAT</i>	UC71. Statistical tools for data processing. UC72. Spatial analysis and GIS. UC73. Modelling applied to agroecology.
TU8. Professional Project (2 ECTS)	UC8. Project • Implementation of the knowledge acquired on the 4 components (production, society, resource-environments, biodiversity) in order to setup a culture system conducted in agroecology.
TU9. Language (2 ECTS)	UC. English UC. German, Spanish, Italian, ...

Traineeship of the end study

Students of the specialization can apply in the Professional and Research Structures.

Partnerships (research and professional), external stakeholders

- National scientific partners (INRA, CNRS) and international (Teagasc Irelande ; Univ. Wageningen Pays-Bas ; Univ. Goettingen Germany)



- Professional in the agricultural sector (Chambre d'Agriculture, Chaire AEI, Réseaux Mixtes Technologique, Réseaux professionnels : instituts techniques avec projets communs (ARVALIS, Terre inovia, Idele, IFIP), ITAB , FRAB, AgroBio 35 ; association : BASE)



This partnership builds on :

- National and European research programs
- Network of devices for illustration: educational platform conducted in agroecology on the AO campus, experimental devices ranging from agronomic testing to landscape, farmer networks

Fiche N°1. UE1, UC1. The challenges of Agroecology & Bibliographical work (2 ECTS)

Module code :	RM2E-1	Course level:	Master degree M2 (semester 9)								
Module title	The challenges of Agroecology										
Course title	UC1. Introduction to Agroecology & Bibliographical Report										
ECTS points	2		Key words:	Agroecology, ecology, agronomy							
Course volume In hours	20 h		Language of instruction	English	Minimum number:						
					Maximum number:						
CM :	9	TD :	2	TP	3	Visits/Travel	6	Project :	3	Assessment methods:	P
Coordinators :	S. Menasseri, Dpt. SVAH G. Pérès, Dpt. MiLPPAT M. plantegenest Dpt. Ecology										
<u>Participating teachers (AO):</u> G. Pérès, S. Menasseri-Aubry, M. Carof, C. Vandenkoornhuysse & M. Plantegenest											
<u>External participating's:</u> -Patrice Cotinet (CRAB) -Gilles Simoneaux (Agriculteur) -Ambroise Garnier (Cosalidée) -Cécile Claveirole (CESE) -Thierry Caquet (INRA) -Didier Maroy (DRAAF Bretagne)											
<u>Purpose of the course and skills :</u> Create a cohesive group, grasp the stakes of specialization, and share an agro-ecological culture.											
<u>Course description :</u> <ul style="list-style-type: none"> • General Introduction • Ice-Breaker : experimental site and farm visits • Reminders on the agronomic concepts of agroecology and the different forms of agroecology • Introduction to ecology – agroecology • Agroecology stakes at the various nested scales : Talks and debates in the framework of major global issues (Ex climate change), taking into account the vision of French citizens (CESE), and the administrative supports at regional scale 											
<u>Assessment methods:</u> To be defined											

Fiche N°2: UE2, UC21. Social movements and scientific concepts (1 ECTS),

Module code :		RM2E-2		Course level:		Master degree M2 (semester 9)					
Module title		Global socio-economical analysis									
Courses title		UC 21. Social movements and scientific concepts									
ECTS points		1		Key words:		Agroecology, sociology, practice					
Course volume In hours		22 h		Language of instruction		English		Minimum number:			
								Maximum number:			
CM :	12h 30	TD :	9h 30	TP	0	Visits/Travel	0	Project :		Assessment methods:	O+R
Coordinators :		Boudes Philippe & Darrot Catherine, Dpt. MILPPaT, UP: SHT									
<u>Participating teachers (AO) :</u>											
Boudes Philippe & Darrot Catherine, Dpt. MILPPaT											
<u>External participating's:</u>											
<ul style="list-style-type: none"> - Claire Lamine (INRA) - C. Le Rouhellec (Région BZH) - M. Girard, Univ. Orléans 											
<u>Objectives and skills:</u>											
<ul style="list-style-type: none"> - Deconstructing a unique normative vision of Agroecology, - Access to the variety of socio-political positions related to Agroecology; Knowledge of the actors who carry these positions, - To know the stages of the political and historical construction of this notion - First approach of other models at national scale. 											
<u>Course description:</u>											
<p>-Measures to be discussed as CM, participative student work, presentations, workshops, reading materials, and external speakers (in relation with specialty).</p> <p>4 themes of 6 h which take up this part - therefore 8h CM, 8h TD, 8h Ext / works.</p> <ul style="list-style-type: none"> - Social and political construction of the concept of agroecology: Emergence, publicity, controversy (political and social movements: syndicates, different Agroecological references and which brings them to the public field). -Variability of the positions of the countries of the European Union (and the countries of the world) in their perception of agroecology /2nd pillar (history of structures on the one hand, public priorities on the other) at scale, Social and institutional movements in France (and even regions), -Links and interferences with the related concepts: sustainable agriculture, multifunctionality, ecosystem services, organic farming, permaculture, TCS - what alliances, what aid is being sought; Link between technique, social and political movement, from the point of view of the politician, the farmer, the adviser, the point of the scientists (different points of view). - Agroecology in different latitudes: examples of models in different countries. 											
<u>Assessment methods:</u>											
Presentation from personal and reading works (to be defined according to the balance of the evaluation models in the specialty).											

Fiche N°3. UE2, UC22. Agroecology: economic approach and public policies (2 ECTS),

Module code :	RM2E-2	Course level:	Master degree M2 (semester 9)				
Module title	Global socio-economic analysis						
Courses title	UC 22. Agroecology: economic approach and public policies						
ECTS points	2	Key words:	Agroecology, Transition, policy				
Course volume In hours	20 h	Language of instruction	English	Minimum number:			
				Maximum number:			
CM :	20	TD		TP	Visits/Travel	Project :	Evaluation écrite :
Coordinator (s) :	Carpentier Alain, UMR. SMART, INRA, A. Ridier Depart. EGS						
<p><u>Participating teachers (AO) :</u> - Alain Carpentier UMR. SMART, INRA -Aude Ridier Depart. EGS</p> <p><u>External participating's:</u></p>							
<p><u>Objectives and skills:</u> The aim here is to present:</p> <p>(i) The economic issues of the agro-ecological transition for the society (examination of the views of the different types of actors, discussion of the notion of locking),</p> <p>(ii) An overview of the types of public intervention possible (how to intervene, which actors to target, how to interfere at what pace, presentation of innovation mechanisms induced, economic incentives: advantages and limitations, why and how to combine different intervention instruments public).</p> <p>(iii) The possible objectives and possible forms of a policy for agro-ecological transition will be discussed here.</p>							
<p><u>Course description:</u> Part 1. Agro-ecological transition: an economist's point of view Part 2. Reminders of public economy: economic stakes of public intervention Part 3. Strengths and weaknesses of the various policy instruments available to public decision-makers Part 4. Long-term logic: induce technological and institutional innovations through public intervention.</p>							
<p><u>Assessment methods:</u> To define</p>							

Fiche N°4: UE3, UC31. Biodiversity in agroecosystems (1 ECTS),

Module code :	RM2E-3	Course level:	Master degree M2 (semester 9)						
Module title	Theoretical bases of agroecosystem functioning								
Courses title	UC31. Biodiversity in agroecosystems								
ECTS points	1	Key words:	Practice, biodiversity, wildlife, fauna						
Course volume In hours	28 h	Language of instruction	English	Minimum number:					
				Maximum number:					
CM :	9	TD :	7	TP	12	Visits/Travel	Project :	Assessment methods:	w
Responsables :	G. Pérès, Dpt. MILPPaT M. plantegenest, Dpt. Ecology								
<u>Participating teachers (AO) :</u>									
- F. Val, J. Haury, M. Plantegenest, A. Le Ralec, G. Pérès & C. Le May,									
<u>External participating's:</u>									
- Elsa Canard, INRA									
<u>Objectives and skills:</u>									
The main objectives of this UC is to improve the knowledge (theory, practice) on the biodiversity of agroecosystems. Based on lab and field approaches, this UC will assess the plant diversity (cultivated or natural) and the fauna diversity (invertebrates).									
<u>Course description:</u>									
* Discovery of weed and cultivated plants,									
* Discovery of wildlife in agriculture,									
* Discovery of plant pathology,									
* Synthesis and restitution (1 day) (all teachers): ½ day laboratory lab, formatting observations. ½ day presentation / discussion.									
<u>Assessment methods:</u>									

Fiche N°5: UE3, UC32. Soil quality and ecosystem services (1.5 ETCS),

Module code :	RM2E-3	Course level:	Master degree M2 (semestre 9)								
Module title	Theoretical bases of agroecosystem functioning										
Courses title	UC32. Soil quality and ecosystem services										
ECTS points	1.5	Key words:	Soil, Ecosystems, elements								
Course volume In hours	24 h	Language of instruction	English	Minimum number:							
				Maximum number:							
CM :	14	TD :	6	TP	4	Visits/Travel	0	Project :		Assessment methods:	w
Coordinator :	E. Le Cadre, Dpt. SVAH										
<p><u>Participating teachers, AO :</u> - E. Le Cadre, S. Menasseri, C. Walter, G. Pérès, A. Jaffrezic & Peter VanDerKoornhuysse</p> <p><u>External participating's:</u></p>											
<p><u>Objectives and skills:</u> Soils are a non-renewable resource, and essential for crop development. It is necessary to understand how agricultural practices can modify their functioning in order to adopt sustainable practices. During this module, students will complete their knowledge on soil functioning to embrace the concept of soil quality in its various meanings. At the end of the module, students will be able to discuss about the integration of soil quality into the actual discussions on the benefits provided by Ecosystems (and Agro ecosystems) to Humankind.</p>											
<p><u>Course description:</u> 1) Introduction 2) Analysis of soil functions and contributions to ecosystem services 2.1 Comparative analysis of the nitrogen (N), phosphorus (P) and potassium (K) cycle and specific issues addressed by each element (fertilization & environment). a) Identification of key variables controlling bio-availability, mobility of elements b) Applications to P and K fertilization. 2.3 Roles of microbes in Ecosystem functioning, 2.4 Soil organic matter turnover and water/air quality regulation services, 3) Soil natural capita and monetary evaluation of soil ecosystems services, Tutorials on case studies dealing with impact analysis of agricultural practices on soil quality - Tutorial 1 : perenne based agricultural systems (agroforestry and vineyard), - Tutorial 2 : annual based agricultural systems, Practical exercises : Soil profile analysis to understand the limitation of crop performances (root development, soil compaction, ...) Documents resources</p>											
<u>Assessment methods:</u>											

Fiche N°6. UE3, UC33. Landscape management and biogeochemical flows (1.5 ECTS),.

Module code :	RM2E-3	Course level:	Master degree M2 (semester 9)								
Module title	Theoretical bases of agroecosystem functioning										
Courses title	CU33. Landscape management and biogeochemical flows										
ECTS points	1.5	Key words:	Landscape, ecology, biogeochemical flows								
Course volume In hours	25h	Language of instruction	English	Minimum number:							
				Maximum number:							
CM :	13	TD :	5	TP		Visits/Travel		Project :	7	Assessment methods:	o
Coordinator :	Olivier Godinot, Dpt. SVAH										
<u>Participating teachers AO:</u>											
O. Godinot, E. Le Cadre, H. Daniel & C. Laidin											
<u>External participants:</u>											
P. Durand, UMR, SAS. INRA											
<u>Purpose of the course and skills :</u>											
<ul style="list-style-type: none"> • Understand the functioning of biogeochemical flows at the landscape scale • Know several tools and methods to study these flows and act on them 											
<u>Course description :</u>											
<ul style="list-style-type: none"> • Introduction: the territory, a polysemic concept: study of various documents and articles on the organization of biophysical, social and economic territories, • Methods and tools of landscape agronomy, • Water and nutrient fluxes in watersheds, • CNP coupling and dynamics in landscapes, • Landscape ecology concepts, • Territorial management, politics and economy, • Group project: multiscale and multidisciplinary approach of the management of a biogeochemical flow in a defined landscape. 											
<u>Assessment Pattern:</u>											
Evaluation of the group oral restitution											

Fiche N°7. UE3, UC34. Basics on animal science and livestock farming (0.5 ECTS),

Module code :	RM2E-3	Course level:	Master degree M2 (semester 9)				
Module title	Theoretical bases of agroecosystem functioning						
Courses title	UC34. Basics on animal science and livestock farming						
ECTS points	0.5	Key words:	livestock farming, production, PLF				
Course volume In hours	5 ou 7 h	Language of instruction	English	Minimum number:			
				Maximum number:			
CM :		TD :	2	TP		Visits/Travel	
					Project :	5	Assessment methods:
Coordinator :	Yannick Le COLZER, Anne Lise Jaquot, Dpt. P3AN						
<u>Participating teachers (AO):</u>							
- Yannick Le Colzer, Anne-Lise Jaquot & Pierre-Guy Marnet							
<u>External participants:</u>							
<u>Purpose of the course and skills :</u>							
<ul style="list-style-type: none"> - Discover and/or update knowledge in animal science, livestock farming, the production chains - Understand the interaction between animal, farmers, LFS and chains - Introducing Precision Livestock Farming (PLF) - Identity the main components on animal production chain concerning by PLF concepts and value creation 							
<u>Course description :</u>							
<ul style="list-style-type: none"> - What is Livestock farming systems? - Basics principles of farm animal physiology, health and behavior, <ul style="list-style-type: none"> oHow feed is used by animal organism and what are animal requirements? <ul style="list-style-type: none"> - How to favor animal health and welfare? - Which housing conditions and evaluation of environmental impacts? - Observe and analyze animal production and response to environment : performances, productivity health and behavior indicators -Farmer's objectives and jobs : <ul style="list-style-type: none"> - What are the principle stake evolutions for livestock farming and for farmers' job? - How can we define "work" for farmers? - Can PLF be a part of the solutions? -Animal production chains and their concerns: <ul style="list-style-type: none"> - Which stakeholders and their concerns in an animal production chain? - What are the chain value creation? What are the different strategies applied to maintain diversity along the chain? - How to analyze one animal production chain? - How to evaluate the impact of animal production chain? -General and global discussion: (To go further: General course on Precision Livestock 							
<u>Assessment Pattern:</u>							

Fiche N° 8. UE3, UC35. Ecological theories and biodiversity measurement (1.5 ECTS),

Module description N°8. Ecological theories and biodiversity measurement											
Module code		RM2E-3		Niveau du cours :			Master degree M2 (semester 9)				
Module title		Theoretical bases of agroecosystem functioning									
Courses title		UC 35: Ecological theories and biodiversity measurement									
ECTS points		1.5		Key words:			Agroecosystems, biodiversity, ecology				
Course volume In hours		24 h		Language of instruction			English		Minimum number:		
									Maximum number:		
CM :	20	TD :		TP :		Visits/Travel		Project :	4	Assessment methods:	
Coordinator :		Manuel Plantegenest & Guenola Pérès , Dpt. Ecologie, Dpt. Milppat									
<u>Participating teachers (AO):</u>											
- Manuel Plantegenest, Dominique Barloy & Guénola Pérès											
<u>External participants:</u>											
- Elsa Canard – INRA, IGEPP, Intervenants extérieurs (chercheurs INRA)											
<u>Purpose of the course and skills :</u>											
This UE aims at providing concepts, theory and methods to help understanding and studying the role of biodiversity in the functioning of agroecosystems at the functional scale of interaction networks and at various spatial scales from the field to the landscape.											
<u>Course description :</u>											
<ul style="list-style-type: none"> - Ecological bases of agroecology, - Biodiversity, stability, regulation, - Molecular tools for studying biodiversity, - Building and analyzing interaction networks, - Agroecology and landscape ecology, - Soil and biodiversity, - Role and importance of microbial communities in agroecology, 											
<u>Assessment Pattern:</u>											

Fiche N°9. UE4, UC41. Farming systems sustainability assessment (2 ECTS),

Module code :	RM2E-4	Course level:	Master degree M2 (semester 9) (mutualized with Génie de l'Environnement/ADT)								
Module title	Sustainability of agroecological systems										
Courses title	CU41. Farming systems sustainability assessment										
ECTS points	2	Key words:	farming systems, sustainability, Analysis								
Course volume In hours	32h	Language of instruction	English	Minimum number:							
				Maximum number:							
CM :	4	TD :	12	TP :		Visits/Travel	4	Project :	12	Assessment methods:	oral
Coordinator :	Olivier Godinot, Dpt. SVAH & Catherine DARROT Dpt. MILPPaT										
<u>Participating teachers (AO):</u>											
- Olivier Godinot, Catherine Darrot,											
<u>External participants:</u>											
- Marion Diaz											
<u>Purpose of the course and skills:</u>											
<ul style="list-style-type: none"> • Master the systems approach of farming systems • Know how to use indicators in agriculture • Know several sustainability evaluation methods • Know how to mobilize a set of indicators to answer a question in a farm 											
<u>Course description:</u>											
<ul style="list-style-type: none"> • Systems approach of farming systems and multicriteria Assessment Methods, • Analysis of several sustainability assessment methods, • Preparation of the visit : Survey methods, survey guide, indicator choice, • Farm visit with teachers, • Debriefing and analysis of the visit, • Farm visit in autonomy by each group, • Analysis of the visit, choice and calculation of indicators, poster preparation, • Group poster presentation, 											
<u>Assessment Pattern:</u>											
Oral presentation of sustainability assessment method, evaluation of posters and oral presentation											

Fiche N° 10. UE5, UC51. Agroecological management of forage resources (1.5 ECTS),

Module code :	RM2E-5	Course level:	Master degree M2 (semester 9)								
Module title	Agroecosystem Management Levers in Agroecology										
Courses title	UC51. Agroecological management of forage resources										
ECTS points	1.5		Key words:	Forage, management, grassland, system							
Course volume In hours	23 h		Language of instruction	English	Minimum number:						
					Maximum number:						
CM :	16	TD :		TP	3	Visits/Travel	4	Project :		Assessment methods:	oral
Coordinator :	Jocelyne Flament, Dpt. P3AN										
<u>Participating teachers AO:</u>											
- Jocelyne Flament, R. Guegan & Olivier Godinot											
<u>External participants:</u>											
- Luc Delaby (INRA), A. Michaud,											
<u>Purpose of the course and skills :</u>											
The objectives of this training session are to deepen students' knowledge of forage systems management, with a particular focus on grassland and grazing management. The aim is to help students to understand the need in decision tool development taking into account grazing specificities (needs to foresee, anticipate, decide, and analyze).											
<u>Course description :</u>											
<i>Lectures:</i>											
- Reasoning the evolution of the forage system,											
- Management of grazing for dairy cows: ensuring the regularity of the quantitative supply of quality grazing and ensuring the establishment of quality stocks for the winter period (at the scale of the grazing season and the herd-tools),											
- Grassland farming: interest of grassland in crop system (crop rotations),											
- Ecosystemic services of grassland,											
- Forages quality,											
<i>Visit:</i> grass-based dairy farms.											
<u>Assessment Pattern:</u>											
oral presentation of visits											

Fiche N° 11. UE5, UC52. Agroecological management of soil quality (1.5 ECTS),

Module code :	RM2E-5	Course level:	Master degree M2 (semester 9) (sharing : SEH)						
Module title	Agroecosystem Management Levers in Agroecology								
Courses title	UC 52. Agroecological management of soil quality								
ECTS points	1.5		Key words:	Soil, ecosystem, biodiversity, management					
Course volume In hours	25 h		Language of instruction	English	Minimum number:				
					Maximum number:				
CM :	11	TD :	10	TP	4	Visits/Travel	Project :	Assessment methods:	oral
Coordinator :	Pérès Guénola, Dpt. MilPPaT,								
<u>Participating teachers AO:</u>									
- Pérès Guénola, Jaffrézic Anne & Safya Menasseri									
<u>External participants:</u>									
- Professional outside worker (ex. farmer, representative of the Agriculture Chamber)									
<u>Purpose of the course and skills :</u>									
<p>Within this fundamental unit, based on the ecosystem services provided by the soil, it is necessary to identify agronomic levers allowing the agro-ecological management of soil fertility. In this UC, we mean agro-ecological management of soil fertility, agricultural management methods to ensure the supply of food and fiber (ecosystem service of supply) while preserving the environmental quality (quality of water, air, soil).</p> <p>This UE is the continuity of the previous UE, and is complemented by the knowledge already acquired, in particular in the EU "Soil fertility: description and functions", and "Biodiversity: identification and functions".</p> <p>This UC will be organized in two stages: based on concrete cases (intervention of a professional, combination of CM and TD), this stage will decline a set of agronomic levers allowing the agro-ecological management of fertility; the second step, through the implementation of an integrator tool, will enable us to evaluate the implementation of these levers.</p> <p>The selected examples will cover a wide range of agro-pedo-climatic contexts, covering soils with different properties and observed in contrasting climates, thus taking into account the complexity of the implementation of different agroecological management methods.</p>									
<u>Course description :</u>									
Step 1: agro-ecological levers									
<ul style="list-style-type: none"> - Concrete case of an operation in agroecology: Intervention of a farmer, - Impact of agro-ecological management methods on the chemical properties of soil (P, C, N), - Restoration of the biodiversity of the soil and its functions through the application of agro-ecological management methods, -Modification of the bio-physical properties of the soil (MO, porosity, stability) when implementing agro-ecological management methods, - Consequences of the implementation of agro-ecological management methods on the services of supply (plant production) and regulation (flow and water quality, emission of GES). 									
Step 2: Implementation									
<ul style="list-style-type: none"> - Evaluation by multicriteria analysis (physical, chemical and biological) of the implementation of agro-ecological management methods. This exercise will be based on concrete cases, either by using data previously acquired in different agrosystems, or by using data acquired during field trips. GP, SM, AJ 									
Field trip : The field trip will be the opportunity to either (i) combine a visit to a farm using an agro-ecological management method and measures of certain parameters, or (ii) visit two types of farms implementing modes different agro-ecological management systems.									
<u>Assessment Pattern:</u> Evaluation to think about (proposal: evaluation of the TD)									

Fiche N°12. UE5, UC53. Agroecological management of plant health (1.5 ECTS),

Module code :	RM2E-5	Course level:	Master degree M2 (semester 9) (sharing : SEH)								
Module title	Agroecosystem Management Levers in Agroecology										
Courses title	UC53. Agroecological management of plant health										
ECTS points	1.5	Key words:	Agroecological system, pests, management								
Course volume In hours	24 h	Language of instruction	English	Minimum number:							
				Maximum number:							
CM :	15	TD :	6	TP		Visits/Travel		Project :	3	Assessment methods:	P
Coordinator :	M. Plantegenest & Ch. Le May, Dpt. Ecologie,										
<u>Participating teachers (AO):</u>											
- Christophe Le May, Florence Val, Anne Le Ralec, Manuel Plantegenest, Jacques Haury & Safya Menasseri											
<u>External participants:</u>											
<u>Purpose of the course and skills :</u>											
This UC aims at providing a large overview of the lever that can be used to design an agroecological plant protection strategy against animal pests, diseases and weeds. It will present how those levers can be combined to produce a relevant agroecological system.											
<u>Course description :</u>											
<ul style="list-style-type: none"> - Agroecological management of airborne and soilborne plant diseases, - Agroecological management of animal pests, - Agroecological management of weeds, - Impact of agricultural practices on the pest and disease profile, - Diagnostic of the evolution of agroecological systems at field scale, - Impact of landscape shape on pest regulation. 											
<u>Assessment Pattern:</u>											
Oral presentation											

Fiche N°13. UE5, UC54. Plant breeding in agroecology (1.5 ECTS)

Module code :	RM2E-5	Course level:	Master degree M2 (semester 9) sharing Agronome_SIV_GAP_S9 ; Horticole_SIV_GAP_S9							
Module title	Agroecosystem Management Levers in Agroecology									
Courses title	UC54. Plant breeding in agroecology									
ECTS points	1.5	Key words:	Breeding, diversity, ecosystem, plant							
Course volume In hours	24 h	Language of instruction	English	Minimum number:						
				Maximum number:						
CM :	20	TD :	4	TP	Visits/Travel	N	Project :	N	Assessment methods:	oral
Coordinators :	A. Laperche & E. Le cadre, Dpt. SVAH,									
<u>Participating teachers (AO):</u>										
- Mélanie Jubault, Anne Laperche, Edith Le Cadre & Maria Manzaneres-Dauleux										
<u>External participating's :</u>										
- Isabelle Litrico (INRA, Lusignan), Jérôme Enjalbert (INRA, Le Moulon)										
- Nathalie Moutier (INRA, IGEPP),										
- Matthieu Barre (INRA, Angers)										
<u>Purpose of the course and skills :</u>										
<p>Students should be able to consider the contribution of plant breeding to agroecological systems. This contribution relies both on the remobilization of concepts and knowledge already applied in breeding, but also integrate the cutting edges concepts dealing with plant functioning in complex environments. Different points should be clearly identified:</p> <ul style="list-style-type: none"> - The understanding of the different environmental conditions/interactions to which the plant would be confronted under agroecological conditions; either above-ground or below-ground and along the whole crop cycle. - The notion of diversity-oriented breeding programs and its implications in terms of ideotype(s) definition and breeding goals (diversification of species, emergence of new traits of interest, fitness vs productivity) - The understanding of mechanisms underlying the “agro-ecological” traits, for instance the phytobiome, plant plasticity, the response to stress combinations, the ability to live and perform with others. Identify and understanding breeding goals in terms of trade-offs between services/ dyservices - To use new varieties/genotypes in order to scale up diversity associated with cultivated crops (planified Vs Associated Diversity) in order to sustain Ecosystem services - Which breeding schemes to propose such ideotypes? (How to select a mixture of genotypes or species in combination for their ability under mixture cropping systems). How far can ecological concepts be included into breeding strategies? 										
<u>Course description:</u>										
<p>A set of lectures will draw an overview of the points presented in the « Objectives » parts; conferences/practical exercises will illustrate those approaches.</p> <ol style="list-style-type: none"> 1. Contextualization and main issues of Agroecology addressed to plant breeding, 2. Above-ground interactions (biotic and abiotic) for plant breeding, 3. Below-ground interactions and their interest for plant breeding, 4. How to breed wheat for its ability to be grown in mixture with pea? 5. Interactions within the spermosphere and their implications for seeds improvement and production, 6. Management of intra and inter-specific diversity within plant breeding programs for agroecological systems, 7. Participatory breeding: an example of utilization of agroecological concepts, <p>Global discussion and conclusions.</p>										
<u>Assessment Pattern:</u>										
Oral restitution										

Fiche N°14. UE6, UC61. Plant, soil, animals interactions analysis (1.5 ECTS),

Module code :	RM2E-6	Course level:	Master degree M2 (semester 9)		
Module title	Plant, Soil, Animal interactions				
Courses title	UC61. plant, soil, animals interactions analysis				
ECTS points	1.5	Key words:	Soil, plant, interaction, animal		
Course volume In hours	21 h	Language of instruction	English	Minimum number:	
				Maximum number:	
CM :	13	TD :	8 - 4	TP	
			Visits/Travel		Project :
					Assessment methods:
Coordinators :	Edith Le Cadre, Dpt. SVAH Jaffrezic Anne , Dpt. MilPPaT				
<u>Participating teachers (AO):</u> - Edith Le Cadre, S. Menasseri, Guenola Pérès, Anne Jaffrézic & Anne Lise Jacquot					
<u>External participants:</u>					
<u>Purpose of the course and skills :</u> This module presents the ecological principles unifying above and below ground relationships of an agro-ecosystem. The aim of the module is to complete knowledge of agro ecosystems functioning taking explicitly account of the roles of animals including vertebrates in Ecosystem Services at different scales (plot to landscape – annual to pluriannual). The students will be encouraged to describe the interactions between plants soils and animals as a pre requisite to identify bottlenecks and drivers, triggers but also consequences of management changes. The module will be divided in three parts (UC 6.1, 6.2, and 6.3). This particular UC 6.1 will lay the theoretical backgrounds in order to conceptualize in diverse situations the relationships between animals and plants with particular emphasis on soils.					
<u>Course description :</u> A) General introduction to the module B) Theoretical backgrounds 1) Above and below ground diversity : a carbon flow story, 2) Herbivore-mediated linkages between above and below ground communities, Physical and chemical modifications of soils (water and O ₂) by grazing and related consequences on chemical speciation and biology), nutrient loadings and soil stability, 4) Animal, herd and grassland management to optimize grass utilization in grass-based system. C) Conceptualization 1) The conceptualization step in modelling: structural and dynamic representation of a problem in box and arrow, 2) Practical exercise (autonomy) to collect different approach to conceptualize a problem, article readings, 3) Practical exercise (autonomy) to apply (and compare) the different approach on selected videos proposed by teachers,					
<u>Assessment Pattern:</u> Part 61 Final examination on table (or during student restitution)					

Fiche N°15. UE6, UC62. Pasture model and scenarisation (1 ECTS),

Module code :	RM2E-6	Course level:	Master degree M2 (semester 9)								
Module title	Plant, Soil, Animal interactions										
Courses title	UC 62. Pasture model and scenarisation										
ECTS points	1		Key words:	agro-ecosystem, pasture, management							
Course volume In hours	19 h		Language of instruction	English	Minimum number:						
					Maximum number:						
CM :	7	TD :	12	TP		Visits/Travel		Project :		Assessment methods:	Rap
Coordinators :	E. Le Cadre, Dpt. SVAH A. Lise Jacquot, Dpt. P3AN										
<u>Participating teachers (AO):</u> - Edith Le Cadre, Jaffrézic Anne, Anne Lise Jacquot & Guenola Pérès,											
<u>External participants:</u>											
<u>Purpose of the course and skills :</u> This module presents the ecological principles unifying above and below ground relationships of an agro-ecosystem. The aim of the module is to complete knowledge of agro ecosystems functioning taking explicitly account of the roles of animals including vertebrates in Ecosystem Services at different scales (plot to landscape – annual to pluriannual). The students will be encouraged to describe the interactions between plants soils and animals as a pre requisite to identify bottlenecks and drivers, triggers but also consequences of management changes. The module will be divided in three parts (UC 6.1, 6.2, and 6.3). This particular UC 6.3 will be the final step of the module. In this part, students will interview farmers who have a particular questioning about agroecology transition. As an issue of the visit, the students will propose strategies taking into account the objectives of the farmers and the agroecological processes detailed previously in this module. To help students in this activity, methodology dealing with consultancy will be used.											
<u>Course description :</u> <p>A) Conceptualization of the pasture agrosystem Introductory lecture on model conceptualization in a grass based farm,</p> <p>B) Utilization of the conceptual model and feedback tutored by lecturers, Each forcing variable will be introduced by an introductory conference completed with a case studies to decipher the mainstream of adaptations of the conceptual model. A list of text books and articles will be provided to complete some points of the conference and guide students</p> <ol style="list-style-type: none"> 1) Climatic change (attenuation and adaptation), Impacts of climatic changes on grassland ecosystems, 2) Scarcity of resources (phosphorus, soil, water), Scarcity of resources in a changing world <p><i>*Extra thematic questions can be addressed in function of group size</i></p> <p>C) Report redaction and oral presentation.</p>											
<u>Assessment Pattern:</u> UC Part 62 will be analyse with UC 63 based on a report given by students											

Fiche N°16. UE6, UC63. Agroecology consultancy (1.5 ACTS),

Module code :	RM2E-6	Course level:	Master degree M2 (semester 9)								
Module title	Plant, Soil, Animal interactions										
Courses title	UC63. Agroecology consultancy										
ECTS points	1.5	Key words:	Farmers, consultancy, development								
Course volume In hours	24 h	Language of instruction	English	Minimum number:							
				Maximum number:							
CM :	7h30	TD :	10h30	TP	6	Visits/Travel		Project :		Assessment methods:	Rap
Coordinators :	Edith Le Cadre Dpt. SVAH Anne-Lise Jacquot Dpt. P3AN										
<u>Participating teachers AO:</u>											
- Anne Lise Jacquot, Safya Menasseri & Christine Van Denkoornhuysse											
<u>External participants:</u>											
- Ambroise Garnier, JF Garnier Bernard Rolland, Martine Verdier											
<u>Purpose of the course and skills :</u>											
In this UC, students will interview farmers who have a particular questioning about agroecology transition. As an issue of the visit, the students will propose strategies taking into account the objectives of the farmers and the agroecological processes detailed previously in this module. To help students in this activity, methodology dealing with consultancy will be used.											
<u>Course description :</u>											
Introduction to consultancy : The introduction of the module will be focused on farming consultancy (the main issues for consultancy, presentation of the different way to advise farmers, different aspects of being farm consultants...): discussion with consultants on their daily job aspects)											
Methods developed to conceptualize the farmer strategies:											
Theory and practise : the student will also prepare an interview be presented to the students in order to prepare a farm survey - On site evaluation : the students will the interview of the farmers, in order to collect any information needed to realize the conceptual functioning of this farm Back to the campus, the student will prepare an oral presentation											
<u>Assessment Pattern:</u>											
UC Part 62 will be analyse with UC 6.3 based on a report given by students											

Fiche N°17. UE7, UC71. Statistical tools for data processing (0.5 ECTS),

Module code :	RM2E-7	Course level:	Master degree M2 (semester 9)								
Module title	Statistical, modeling and spatial engineering tools										
Courses title	UC71. Statistical tools for data processing										
ECTS points	1	Key words:	R, statistical modeling, agroecology								
Course volume In hours	Heures 21	Language of instruction	English	Minimum number:							
				Maximum number:							
CM :	15	TD :	6	TP		Visits/Travel		Project :	3	Assessment methods:	
Coordinator :	M. EMILY Dept. Statistique et Informatique M. Plantegenest, Dept. Ecologie										
<u>Participating teachers AO :</u>											
- Mathieu EMILY & M. Plantegenest,											
<u>External participants:</u>											
<u>Purpose of the course and skills:</u>											
<p>One challenge in agroecology is to put heterogeneous data in a single pipeline of analysis. Appropriate statistical approach is therefore required to conduct reliable and efficient data science analysis.</p> <p>The objective of the module is to acquire skills in (1) conducting statistical modeling dealing with various data types and (2) estimating and interpreting statistical models with R.</p>											
<u>Course description:</u>											
<p>The module aims at introducing the various steps of a statistical approach in AgroEcology starting from simple linear models to more complex extensions such as generalized linear models and linear mixed models. Based on a large amount of illustrations, courses aim at providing the mathematical basics of the statistical models.</p> <ul style="list-style-type: none"> - Part 1: Introduction and complement on the statistical software R - Part 2 : Principles of linear modeling - Part 3 : Introduction to generalized linear modeling - Part 4.: Introduction to mixed models 											
<u>Assessment Pattern:</u>											
UC 71 will be evaluated based on a report of a project.											

Fiche N°18. UE7, UC72. Spatial analysis and GIS (1.5 ECTS),

Module code :	RM2E-7	Course level:	Master degree M2 (semester 9)								
Module title	Statistical, modeling and spatial engineering tools										
Courses title	UC72. Spatial analysis and GIS										
ECTS points	1.5	Key words:	GIS, management, practice, resources								
Course volume In hours	18 h	Language of instruction	English	Minimum number:							
				Maximum number:							
CM :		TD :	19	TP		Visits/Travel		Project :		Assessment methods:	R
Coordinator :	Christian Walter, Dpt. MILPPaT										
<p><u>Participating teachers (AO) :</u> - B. Lemerrier, C. Walter & P. Pichelin</p> <p><u>External participants:</u></p>											
<p><u>Purpose of the course and skills:</u> Agroecology and management of natural resources increasingly require reliable spatial information, e.g. on land use, crop monitoring, topography, soil variability, etc. This unit focuses on the proper use of GIS techniques within projects where geo-information plays an important role. Students will develop practical skills for analysing, visualising and synthesising spatial data, and the principles for applying these skills to real-world issues.</p>											
<p><u>Course description:</u> The unit will be based solely on practical teaching and supposes prerequisites on general concepts on spatial analysis and GIS. Teaching intends first to make students familiar with Geographical information Systems (GIS) techniques and progressively, through problem solving approaches, to make them able to plan and implement spatial analysis tools to real-world problems linked to agroecology.</p> <p>Day 1. Introduction to GIS techniques Data organization in GIS Data representation and mapping Spatial analysis tools</p> <p>Day 2. Interpolation and spatial modelling: spatial analysis of soil biodiversity data Geostatistical analysis of punctual data of soil biodiversity Regression analysis of soil biodiversity variation in space and spatial extrapolation</p> <p>Day 3. Data combination and decision support: land suitability for agricultural production, Combining spatial data Spatial Multiple Criteria Evaluation</p>											
<p><u>Assessment Pattern:</u> Evaluation will be based on the exercise resolved in day 3</p>											

Fiche N°19. UE7, UC73. Modeling applied to Agroecology (1 ECTS),

Module code :	RM2E-7	Course level:	Master degree M2 (semester 9)								
Module title	Statistical, modeling and spatial engineering tools										
Courses title	UC73. Modelling applied to agroecology										
ECTS points	0.5	Key words:	Modelling, agroecology, organic matter								
Course volume In hours	20 h	Language of instruction	English	Minimum number:							
				Maximum number:							
CM :		TD :	12	TP		Visits/Travel		Project :	8	Assessment methods:	
Coordinators :	S. Menasseri Dept. SVAH & M. Plantegenest, Dpt. Ecologie,										
<u>Participating teachers (AO):</u>											
- Manuel Plantegenest, Frédéric Hamelin, Safya Menasseri & Anne-Lise Jacquot											
<u>External participants:</u>											
- Valérie Viaud, INRA, UMR SAS											
<u>Purpose of the course and skills :</u>											
<p>This UE aims at evidencing, based on several examples drawn from various fields, the interest of modelling for the analysis of agroecological problems. Students will learn how translating an agroecological question into a mathematical model and the various ways that can be applied to study it. An analysis of literature will be carried out to present the diversity of approaches and questions that can be addressed by modelling.</p>											
<u>Course description :</u>											
<ul style="list-style-type: none"> - Model construction, - Qualitative analysis of dynamical models, - Dynamics of organic matter, <p>Understanding and presenting a scientific article dealing with modelling in agroecology,</p>											
<u>Assessment Pattern:</u>											
<p>Analysis of scientific article will be orally presented by small groups (2-3 students). This will be the basis for student evaluation.</p>											

Fiche N°20. UE8, UC8. Professional Project (2 ECTS),

Module code :	RM2E-8	Course level:	Master degree M2 (semester 9)								
Module title	Professional Project										
Courses title	UC8. Professional Project										
ECTS points	2	Key words:									
Course volume In hours	75 h	Language of instruction	English	Minimum number:							
				Maximum number:							
CM :		TD :		TP		Visits/Travel		Project :	75	Assessment methods:	
Coordinators :	Safya Menasseri, Dpt. SVAH & Guenola Pérès										
<u>Participating teachers (AO):</u>											
-											
<u>External participants:</u>											
-											
<u>Purpose of the course and skills :</u>											
<ul style="list-style-type: none"> - participate in the management of a project by getting involved in group work (reflection, debates, synthesis of exchanges and controversy) - implement professional methods and tools - innovate, invent and propose answers to a real question proposed by a professional partner. 											
<u>Description :</u>											
<p>This project is organized around an agroecological issue on the scale of a territory and in connection with agriculture,</p> <ul style="list-style-type: none"> - by nature complex and requiring a multidisciplinary approach; - by implementing simple methods and tools from the various disciplines taught in the core curriculum, and further developed in the various options; - over a limited period of time. <p>The project is divided into three stages:</p> <ul style="list-style-type: none"> - an initial joint diagnosis of data acquisition in the field, - an in-depth study of the issues dealt with by implementing methods specific to the options - a pooling of the results obtained and reasoned management proposals 											
<u>Course description :</u>											
TD, field and group work											
<u>Assessment Pattern:</u>											
Report, oral presentation											

Fiche N°21. UE9, UC9. UC. English (1 ECTS),

Module code :	RM2E-9	Course level:	Master degree M2 (semester 9)								
Module title	Language										
Courses title	UC8. Professional Project										
ECTS points	1	Key words:									
Course volume In hours	h	Language of instruction	English	Minimum number:							
				Maximum number:							
CM :		TD :		TP		Visits/Travel		Project :		Assessment methods:	
Coordinators :	Juliette UEBEL ,										
<u>Participating teachers (AO):</u>											
- Céline BEAUSEJOUR											
<u>Purpose of the course and skills :</u>											
Ability to communicate orally and in writing in general and professional fields in an international context. Acquire knowledge of other civilizations as well as intercultural skills.											
Be able to integrate and communicate in an international context											
<ul style="list-style-type: none"> • Communicate orally and in writing and be able to clearly present results in the form of tables and figures • Understand and react orally and in writing in a nuanced and precise manner in general and professional communication situations • Popularize / adapt to different audiences • Argue, justify your choices • Master the discipline and the tools of interpersonal dialogue (reformulation, active listening, capacity for consultation) • Facilitate meetings • Being able to listen, argue, reformulate 											
<u>Course description :</u>											
According to the level of the student: A , B, C, ...											
<u>Assessment Pattern:</u>											
<ul style="list-style-type: none"> • Written exam, oral exam (LV2) Presentation (LV2), • Evaluation(s) of self-learning/participation work 											

Fiche N°22. UE9, UC9. UC. German (1 ECTS) or UC. Spanish (1 ECTS),

Module code :	RM2E-9	Course level:	Master degree M2 (semester 9)								
Module title	Language										
Courses title	UC. German										
ECTS points	1	Key words:									
Course volume In hours	h	Language of instruction	German	Minimum number:							
				Maximum number:							
CM :		TD :		TP		Visits/Travel		Project :		Assessment methods:	
Coordinators :	ALLEMAND : Uta SCHMITT, ESPAGNOL : Armelle MONROY										
<u>Participating teachers (AO):</u>											
<ul style="list-style-type: none"> - ALLEMAND : Maëla LE CORRE - ESPAGNOL : Monica IGLESIAS 											
<u>Purpose of the course and skills :</u>											
<p>The objectives are defined according to level groups, based on the Common European Framework of Reference for Languages (see below). The linguistic and civilizational contents are decided by the teachers according to these objectives.</p> <ul style="list-style-type: none"> • General oral comprehension • General reading comprehension • General oral and written interaction • General oral and written production 											
<u>Course description :</u>											
According to the level of the student: A , B, C, ...											
<u>Assessment Pattern:</u>											
<ul style="list-style-type: none"> • Written exam, oral exam (LV2) Presentation (LV2), • Evaluation(s) of self-learning/participation work 											