



Ph.D. IN AGRICULTURAL, FOOD AND ENVIRONMENTAL SCIENCES

XLI EDITION

ACCADEMIC YEAR 2025/26

ORGANIZATION, ASSESSMENT AND DIDACTIC PLAN

List and course programs scheduled for the Academic Year 2025-2026

N.	Title	TEACHER	Hours
OFFERTA DIDATTICA COMUNE DI ATENEO			
1	La proprietà intellettuale Intellectual property rights	Prof.ssa Erika Giorgini	8
2	Principi fondamentali di etica ed integrità Fundamental principles of Ethics and Integrity	Prof.ssa Luisa Borgia	8
3	Innovazione e Traferimento Tecnologico Technology Transfer and Innovation	Prof. Donato Iacobucci	16
4	Progettare la ricerca: i progetti Europei Design of research: European Projects	Prof. Gian Marco Revel	24
OFFERTA DIDATTICA INTERDISCIPLINARE DEL DIPARTIMENTO D3A			
5	From experimental design to the writing of a scientific paper and research evaluation / Dall'impostazione della prova sperimentale alla pubblicazione e valutazione della ricerca	Prof. Cianci Michele	12
6	Advancing Circular Economy in the Agri-Food Sector: Innovations for Sustainable Food Systems	Dott.ssa Giulia Chiaraluce	8
7	La ristorazione collettiva e il rischio legato alla presenza di patogeni alimentari - Mass catering and risks related to the presence of food borne pathogens	Prof. Andrea Osimani	12
8	Radicali liberi ed antiossidanti / Free radicals and antioxidants	Prof.ssa Patricia Carloni	12
9	Valutazione di sostenibilità energetica e ambientale mediante Life Cycle Assessment	Prof. Daniele Duca	12
10	Allevamento, benessere animale e qualità della carne Livestock, animal welfare and meat quality	Prof.ssa Maria Federica Trombetta	12
11	Crop Genetic Resources, plant breeding, seed production and intellectual properties	Prof Roberto PAPA and Dr Serena Mariani (UniMC)	15
12	Crops and man: the history of crop domestication	Prof.ssa Laura Nanni	12
13	Machine Learning and Deep Learning: Methods and Applications in Bioinformatics	Dott. Michele Bernardini	18
14	Plant genetic resources conservation, characterization and use for sustainable agriculture	Prof.ssa Elena Bitocchi	12
15	Python for advanced data analysis	Dott. Daniele Berardini	16
16	Advanced methods of gene discovery	Dott.ssa Alice Pieri	6

17	The molecular bases of crop domestication	Dott. Valerio Di Vittori	6
18	“Il fenomeno dell’antibiotico resistenza in ambito alimentare ed ambientale” - “ <i>The antibiotic resistance issue in the food and environmental ecosystems</i> ”.	Prof.ssa Cristiana Garofalo	12
19	Seedborne pathogens of agricultural crops: transmission, detection and management.	Dott.ssa. Marwa Moumni	12
20	Dietary micronutrients and polyphenols: their effects on cellular metabolism.	Dott..Massimiliano Gasparrini	9
21	PLF in reducing the environmental impact of livestock farming / Zootecnia di Precisione, nuove strategie per ridurre l’impatto ambientale degli allevamenti	Prof.ssa Marina Pasquini	12
22	Contaminazione ed ecotossicologia nel suolo	Dott.ssa Arianna De Bernardi	12
23	Efficient interview and questionnaire design in agricultural, food and environmental sciences / Progettazione efficiente di interviste e questionari nel campo delle scienze agrarie, alimentari e ambientali	Prof.ssa Emilia Cubero Dudinskaya	12
24	Biologia di <i>Apis mellifera</i> e tutela della biodiversità - Honey bee biology and biodiversity protection	Prof.ssa Sara Ruschioni	12
25	Introduzione all'analisi multivariata dei dati e spettroscopia NIR / Introduction to multivariate data analysis and NIR spectroscopy	Dott.ssa Manuela Mancini	24
26	Genetics, Biotechnology and Biosafety for plant genetic improvement	Prof. Bruno Mezzetti	12
27	Basics of the GEOBIA Approach in Remote-sensing Data Analysis on eCognition and Applications on forestry and agriculture	Dott. Md Abdul Mueed Choudhury	12
28	Cambiamento climatico: mitigazione e adattamento nelle colture arboree/Climate change: mitigation and adaptation in tree crops	Prof.ssa Vania Lanari	12
29	Analisi delle radici delle piante: sfide e opportunità per la ricerca in ecofisiologia <i>Analysis of plant roots: challenges and opportunities for research in ecophysiology</i>	Prof.ssa Veronica Giorgi	6
30	Elementi di Politica agricola e azioni di sviluppo rurale per zone svantaggiate e con vincoli naturali	Dott. Giacomo Staffolani	8
31	Progettazione e verifica della Shelf-life dei prodotti alimentari <i>Design and Assessment of the Shelf-life of Foods</i>	Prof. Pasquale M.Falcone	12
32	Physiologically-Based Models supporting the management of insect pests	Dott. Giorgio Sperandio	12
33	Enzymes in agri-food waste valorization	Prof.ssa Nadia Raffaelli	12

34	Exploit Information from Data: Introduction to Linear Regression and Multivariate Statistics	Prof. Danilo Gambelli	12
35	Management and conservation of animal biodiversity / Gestione e conservazione della biodiversità animale	Prof. Simone Ceccobelli	12
36	Experimental design, data collection and data analysis	Dott. Matteo Francioni	24
37	Food industrial waste as starting material for producing innovative food packaging and functional foods	Prof.ssa Deborah Pacetti	12
38	Emerging technologies for food safety and preservation	Prof. Massimo Mozzon	12
39	EFSA and QPS approach	Prof.ssa Lucia Aquilanti	12
40	Systematic Literature Reviewing in Research	Prof.ssa Giuseppina Migliore	8
	Total teaching hours (equal to 61.5 CFU – 1 CFU=8 hours)		492

CONTATTI:

D3A

RICCIOTTI ROSITA

Personale Tecnico Amministrativo

Ufficio Nucleo Didattico Agraria

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OFFERTA DIDATTICA COMUNE DI ATENEIO

1

Titolo del corso: Innovazione e trasferimento tecnologico

Docente: Prof. Donato Iacobucci

Total hours and Credits / Ore Totali e CFU:

18 hours = 2,1 CFU

Obiettivi formativi

Acquisire conoscenze sulle principali modalità di trasferimento tecnologico in ambito universitario. Acquisire strumenti di analisi e gestione dei processi di valorizzazione dei risultati della ricerca con specifico riferimento all'avvio di nuove imprese. Conoscere i servizi e le strutture di supporto ai processi di trasferimento tecnologico nell'Ateneo e in ambito regionale e nazionale.

Programma

La costituzione di spin-off accademici e di start-up: iter di costituzione, modalità di avvio e di gestione, fattori che ne favoriscono lo sviluppo.

I brevetti: condizioni di brevettabilità, iter di concessione dei brevetti in ambito nazionale e internazionale, valorizzazione sul mercato.

I contratti di collaborazione tra università e impresa: forme di relazione fra università e imprese nelle attività di ricerca condivisa e su commessa.

Metodologia didattica

Il corso è svolto attraverso lezioni frontali, seminari con esperti e lavori di gruppo.

Modalità di iscrizione

L'iscrizione al Corso potrà essere effettuata attraverso il servizio "LEARN service", pertanto si invitano i dottorandi interessati ad effettuare la registrazione al seguente link:

- [LEARN service](#)

Rilevazione presenze

Se possibile, per facilitare l'operazione di rilevazione delle presenze, si chiede cortesemente di scaricare sul proprio smartphone l'applicazione [MyUnivpm Agenda](#).

Orario Lezioni dal 3 marzo 2026 al 21 aprile 2026, vedi link:

https://www.univpm.it/Entra/Corso_Innovazione_e_trasferimento_tecnologico

2

Titolo del corso: La proprietà intellettuale Intellectual property rights

Docente: Prof. Erika Giorgini

Total hours and Credits / Ore Totali e CFU:

8 hours = 1 CFU

Obiettivi formativi

Il modulo si propone di esaminare la disciplina della proprietà intellettuale nel sistema italo-europeo delle fonti, al fine di contribuire alla formazione dei dottorandi sotto il profilo dell'acquisizione di conoscenze approfondite sulla tutela delle invenzioni e di metodi e concetti utili per lo svolgimento di attività di ricerca scientifica in questo ambito. Lo studio di problematiche di questo tipo diviene, infatti, dirimente in un'epoca

come quella odierna ove l'attività di impresa è sempre più strettamente commessa alla effettività della tutela della proprietà intellettuale e industriale.

Programma

Nell'ambito del modulo saranno trattati in modo critico ed in prospettiva interdisciplinare i principali temi e problemi al diritto della proprietà intellettuale e al strettamente connesso tema dei "dati".

Particolare attenzione sarà rivolta, anche mediante l'esame di casi giurisprudenziali, all'analisi e al confronto alle diverse tecniche rimediali poste a protezione delle invenzioni e delle opere dell'ingegno*. Nel dettaglio, costituiranno oggetto di approfondimento: i segni distintivi dell'impresa; i brevetti e i diritti connessi; le varietà vegetali; il diritto d'autore; la disciplina del mercato e la tutela della concorrenza; i segreti commerciali.

Metodologia didattica

Il corso è svolto attraverso lezioni frontali – Facoltà di Economia

Modalità di iscrizione

L'iscrizione al Corso potrà essere effettuata attraverso il servizio "LEARN service", pertanto si invitano i dottorandi interessati ad effettuare la registrazione al seguente link:

- [LEARN service](#)

Rilevazione presenze

Se possibile, per facilitare l'operazione di rilevazione delle presenze, si chiede cortesemente di scaricare sul proprio smartphone l'applicazione [MyUnivpm Agenda](#).

Orario Lezioni dal 11 giugno 2026 al 02 luglio 2026, vedi link:

[https://www.univpm.it/Entra/Corso Innovazione e trasferimento tecnologico/Didattica comune/La proprieta intellettuale](https://www.univpm.it/Entra/Corso_Innovazione_e_trasferimento_tecnologico/Didattica_comune/La_proprieta_intellettuale)

3

Titolo del corso: Principi fondamentali di etica ed integrità Fundamental principles of Ethics and Integrity

Docente: Dott.ssa Luisa Borgia

Total hours and Credits / Ore Totali e CFU:

8 hours = 1 CFU

Obiettivi formativi

Integrità e onestà sono valori fondamentali sanciti sia dal Codice Etico dell'Ateneo che dal suo Codice etico per l'Integrità della Ricerca. Obiettivo della formazione è consentire alle studentesse e agli studenti di interiorizzare regole e standard di comportamento a presidio dell'integrità della ricerca e dello sviluppo della loro carriera, fornendo gli strumenti teorici per essere in grado di affrontare correttamente i conflitti e i dilemmi etici.

Programma

Nell'ambito del modulo verranno illustrati i principi e i modelli che guidano la valutazione etica e bioetica nelle situazioni di criticità e che garantiscono l'integrità della ricerca, con un particolare focus al principio di precauzione, alle problematiche etiche della brevettabilità e ai fondamenti etici della sperimentazione preclinica e clinica.

Metodologia didattica

Il corso è svolto attraverso lezioni frontali.

Modalità di iscrizione

L'iscrizione al Corso potrà essere effettuata attraverso il servizio "LEARN service", pertanto si invitano i dottorandi interessati ad effettuare la registrazione al seguente link:

- LEARN service

Rilevazione presenze

Se possibile, per facilitare l'operazione di rilevazione delle presenze, si chiede cortesemente di scaricare sul proprio smartphone l'applicazione MyUnivpm Agenda.

Orario Lezioni dal 1 dicembre 2025 al 9 gennaio 2025, vedi link:

https://www.univpm.it/Entra/Corso_Innovazione_e_trasferimento_tecnologico/Didattica_comune/Principi_fondamentali_di_etica_ed_integrita

Modalità di svolgimento: In presenza Aula azzurra

4

Titolo del corso: Progettare la Ricerca: i progetti Europei Design of research: European projects

Docente: Prof. Gian Marco Revel

Total hours and Credits / Ore Totali e CFU:

16 hours = 2 CFU

Programma

1. Introduzione agli strumenti e alle agenzie di finanziamento della ricerca.
2. La ricerca europea: programmi Quadro (Horizon Europe); gli strumenti di finanziamento alla ricerca.
3. Il ruolo dell'industria nei Programmi Quadro. Le piattaforme tecnologiche, le Public Private Partnerships.
4. I passi nella preparazione di un progetto: analisi della Call e del Workprogramme; definizione degli obiettivi; definizione del partenariato; definizione dell'impatto; il programma di lavoro; stato dell'arte; il budget e le risorse.
5. La valutazione dei progetti.
6. Le azioni per la Mobilità dei ricercatori (Marie Curie actions).
7. La conduzione, il progresso e la rendicontazione scientifica del progetto. (Meeting di progetto, deliverables, reports, ecc.).
8. La gestione amministrativa/finanziaria: la rendicontazione finanziaria; l'audit.
9. Esempi di progetti.
10. Tutorial sessions.

Modalità di iscrizione

L'iscrizione al Corso potrà essere effettuata attraverso il servizio "LEARN service", pertanto si invitano i dottorandi interessati ad effettuare la registrazione al seguente link:

- LEARN service

Rilevazione presenze

Se possibile, per facilitare l'operazione di rilevazione delle presenze, si chiede cortesemente di scaricare sul proprio smartphone l'applicazione MyUnivpm Agenda.

Modalità di svolgimento: In presenza Aula Azzurra

Orario Lezioni dal 13 gennaio 2026 al 13 febbraio 2026, vedi link:

https://www.univpm.it/Entra/Corso_Innovazione_e_trasferimento_tecnologico/Didattica_comune/Corso_Progettare_la_ricerca_i_progetti_europei

Programmi dei Corsi

OFFERTA DIDATTICA INTERDISCIPLINARE DEL DIPARTIMENTO D3A

5

Titolo del Corso: From experimental design to the writing of a scientific paper and research evaluation / Dall'impostazione della prova sperimentale alla pubblicazione e valutazione della ricerca

Docente: Prof. Michele Cianci

Total hours and Credits / Ore Totali e CFU:

12 hours = 1,5 CFU

Lingua/Language: English

Programma/Program:

1. Importance of research quality at University;
2. Planning of a research activity: aims, literature search, experimental design, data elaboration;
3. The scientific method;
4. Structure and writing of a scientific paper;
5. Plagiarism; ChatGPT; Gemini; Evaluation of quality of a paper, Individual and aggregate evaluation of research quality;
6. How to improve the presentation skills of PhD students.

The aim of the course is to give the students an overview of the scientific process from planning of a research activity to publishing and presenting research results. Time is given to open discussion of the topics presented.

Course enrolment: interested PhD students should contact the lecturer by 01.06.2025 by e-mail: m.cianci@univpm.it;

Course material: available on <https://learn.univpm.it/>

Course delivery: in presence and/or via TEAMS

Time recording: by signature

Calendario/schedule:

- in presence (room to be defined), from 16:30 to 18:30
- June 2026: Monday - Wednesday 22nd/23rd/24th
- June 2026: Monday - Wednesday 29th/30th/31st

6

Titolo del corso: Advancing Circular Economy in the Agri-Food Sector: Innovations for Sustainable Food Systems

Docente: Dott.ssa Giulia Chiaraluca

Total hours and Credits / Ore Totali e CFU:

8 hours = 1 CFU

Language: English

Program:

1. Understand Sustainability and Circular Economy Concepts: Provide students with a deep understanding of the key principles of sustainability and the circular economy model, with a focus on reducing waste and enhancing resource efficiency in the agri-food sector – 2h
 2. Examine European Policy Frameworks: Introduce students to the basic European policies supporting the transition to a circular economy, particularly within the context of agriculture and food supply chains – 2h
 3. Circular Innovation and Assessment Tools for Sustainable Agri-Food Systems: Introduce students to key technological innovations (e.g. digitalization, precision agriculture, biobased solutions) and analytical tools (e.g. LCA, circularity indicators) that support and evaluate the transition towards circular and sustainable agri-food systems – 2h
 4. Analyze Real-World Case Studies: Engage students in analyzing successful examples and case studies from the agri-food supply chain, illustrating how circular economy practices can be applied to improve environmental, social, and economic outcomes – 2h
- This course aims to equip PhD students with a comprehensive understanding of the circular economy principles and their application within the agri-food sector. By exploring the intersection of sustainability, European policy frameworks, and practical case studies, students will gain the knowledge and tools to foster innovation and enhance sustainability in food systems.

Course enrolment: per e-mail: g.chiaraluce@staff.univpm.it

Course material: available from the lecturer upon request

Course delivery: in presence (Room to be defined)

Time recording: with signature

Schedule: Classes are currently scheduled for the following days (with the possibility of rescheduling based on the commitments of the lecturer and PhD students): - 18 June 2026 15-17; 25 June 2026 15-17; 2 July 2026 15-17; 9 July 15-17 (Interested PhD students should contact the lecturer by 11.05.2026)

7

Titolo del Corso: ‘La ristorazione collettiva e il rischio legato alla presenza di patogeni alimentari - Mass catering and risks related to the presence of food borne pathogens’

Docente: Prof. Andrea Osimani

Total hours and Credits / Ore Totali e CFU:

12 hours = 1,5 CFU

Obiettivo

Il corso illustrerà i principali Regolamenti Comunitari in materia di sicurezza alimentare focalizzando l'attenzione sulla ristorazione collettiva e sulle problematiche legate alla diffusione di zoonosi di origine alimentare con particolare riferimento ai principali patogeni alimentari (*Salmonella* spp. *Listeria monocytogenes* e *Campylobacter*). Verranno inoltre analizzati casi studio riportati nella letteratura scientifica.

The main European Regulation regarding food safety will be explained, with a focus on mass catering concerns towards the diffusion of food-borne zoonoses. In more detail, the risks concerning Salmonella spp., Listeria monocytogenes e Campylobacter will be analyzed. Moreover, case studies reported in the available scientific literature will be discussed.

Programma

- L'approccio alla sicurezza alimentare nell'Unione Europea
- La ristorazione collettiva
- Il rischio *Salmonella* spp. nella ristorazione collettiva
- Il rischio *Listeria monocytogenes* nella ristorazione collettiva
- Il rischio di specie termo tolleranti di *Campylobacter* nella ristorazione collettiva
- Casi studio

Program

- The food safety approach in the European Union

- Mass catering
- The risk of *Salmonella* spp. in mass catering
- The risk of *Listeria monocytogenes* in mass catering
- The risk of thermotolerant *Campylobacter* species in mass catering
- Case studies

Calendario/schedule:

29 Giugno 2026 martedì dalle 11 alle 13 (2h) - aula da decidere
 6 Luglio 2026 giovedì dalle 11 alle 13 (2h) - aula da decidere
 13 Luglio 2026 martedì dalle 11 alle 13 (2h) - aula da decidere
 20 Luglio 2026 giovedì dalle 9 alle 13 (4h) - aula da decidere
 27 Luglio 2026 venerdì dalle 11 alle 13 (2h) - aula da decidere

8

Titolo del Corso: Radicali liberi ed antiossidanti / Free radicals and antioxidants

Docente: Prof.ssa **Patricia Carloni**

Total hours and Credits / Ore Totali e CFU:

12 hours = 1,5 CFU

Programma:

I radicali liberi (4 ore); Le principali classi di antiossidanti ed i loro meccanismi di azione (4 ore); Metodi per la determinazione dell'attività antiossidante negli alimenti (4 ore).

Calendario:

12 Maggio 2026, ore 9.30-13.30 (4h);
 14 Maggio 2026, ore 9.30-13.30 (4h);
 19 Maggio 2026, ore 9.30-13.30 (4h);

Importante

Si chiede cortesemente ai dottorandi che intendono partecipare al corso di comunicarlo mediante email a p.carloni@univpm.it entro una settimana dall'inizio schedato delle lezioni.

Modalità di svolgimento: Teams o D3A c/o SIMAU Ingegneria Edificio 2 Belluschi Quota 165

Program:

Reactivity of radical species

Free Radicals (Property of radical species)
 Radicals formations (Generality of radical reactions and initiation reactions)
 Radicals reactivity (Propagation and Termination Reactions)
 Persistent radicals (Persistent radicals and factors influencing their life time)

Antioxidants and the oxidation stress

ROS & RNS (Reactive Oxygen Species in details: production and reactivity)
 Antioxidant Mechanisms (Mechanisms of action of antioxidant)
 Food antioxidants (Main antioxidants in foods)

Review of methods to determine antioxidant activity in food

Antioxidant activity of Foods (Requirements for the use of methods to measure the antioxidant activity)
 DIRECT Methods (Kinetic analysis of the lipid peroxidation process)
 DIRECT COMPETITION Methods (Methods based on studying the kinetics of non-chain processes)
 INDIRECT Methods (Study of the ability of antioxidant to react with a model species)

Schedule:

May 12, 2026, 9.30-13.30 (4h);
 May 14, 2026, 9.30-13.30 (4h);
 May 19, 2026, 9.30-13.30 (4h);

Note

PhD students who intend to participate in the course are kindly requested to communicate this via email to p.carloni@univpm.it within one week of the scheduled start of the lessons.

Room: Teams or D3A c/o SIMAU Ingegneria Edificio 2 Belluschi Quota 165

9

Titolo del Corso: Valutazione di sostenibilità energetica e ambientale mediante Life Cycle Assessment

Docente: Prof. Daniele Duca

Total hours and Credits / Ore Totali e CFU:

12 hours = 1,5 CFU

Programma:

Sostenibilità (definizioni, aspetti considerati, iniziative nazionali e internazionali). Utilizzo di risorse e impatto ambientale. Consumi energetici per settori produttivi. Analisi del ciclo di vita e relative norme ISO. Struttura dell'analisi, unità funzionali, confini di sistema, inventario, calcolo dell'impatto, problemi di allocazione. Indicatori usati per valutare l'impatto delle produzioni. Etichette ambientali. Analisi di articoli scientifici su casi di valutazioni LCA applicate in ambito agrario e agroalimentare.

Date:

- giovedì 18 giugno ore 10:00-13:00;
- venerdì 19 giugno ore 10:00-13:00;
- giovedì 25 giugno ore 10:00-13:00;
- venerdì 26 giugno ore 10:00-13:00.

Modalità di svolgimento: in presenza e su Teams.

10

Titolo del Corso: Allevamento, benessere animale e qualità della carne Livestock, animal welfare and meat quality

Docente: Prof.ssa Maria Federica Trombetta

Total hours and Credits / Ore Totali e CFU:

12 hours = 1,5 CFU

Allevamento, benessere animale e qualità della carne

Verranno illustrate le principali tecniche di allevamento e alimentazione per la produzione di carne, saranno prese in considerazione le normative comunitarie in materia di benessere animale, trasporto e macellazione, e saranno descritti i parametri per valutare la qualità della carne.

1. Tecniche di allevamento e alimentazione
2. Normativa comunitaria in materia di benessere animale, trasporto e macellazione
3. Principali parametri per la determinazione della qualità della carne
4. Visita all'allevamento/macello

Livestock, animal welfare and meat quality

The main breeding and feeding techniques for meat production will be illustrated, the community regulations on animal welfare, transport and slaughter will be considered, the parameters to evaluate the meat quality will be described.

1. Breeding and feeding techniques
2. Community regulation on animal welfare, transport and slaughter
3. Principal parameters for meat quality determination

4. Visit to farm/slaughterhouse

Date proposte: il Corso verrà svolto nelle seguenti date:

9 luglio 2026

16 luglio 2026

23 luglio 2026.

L'orario verrà programmato in base alle eventuali manifestazioni di interesse

11

Titolo del Corso: Crop Genetic Resources, plant breeding, seed production and intellectual properties

Docente: Prof **Roberto Papa** and Dott.ssa **Serena Mariani (UniMC)**

Total hours and Credits / Ore Totali e CFU:

16 hours = 2 CFU

Program

The course will illustrate the importance of the plant genetic resources and their utilization in the plant breeding and the different steps of a plant breeding programme, describing the different strategies with a brief analysis of different approaches, tools and outcomes (e.g. varieties). The second part will describe the main aspect of seed productions and the procedures of variety registration. The third part will offer an overview of the different systems of intellectual property over plants (PBR and Patents), and the legal framework at national, European and international level (e.g. UPOV, ITPGRFA), with a specific focus on emerging issues (e.g. open source solutions; essential derivation). The fourth part will be devoted to a discussion and to a critical analysis on how the different systems interact and affect the innovation in agriculture and benefit farmers and citizen worldwide.

Objectives of the course

General knowledge of the key relations between IP systems and the seeds value chain and develop a critical knowledge in relation to the future of agriculture under a climate crisis.

Prerequisite: Agricultural Genetics and Plant breeding

Room: to be defined

Course schedule: approximately in September 2026

12

Titolo del Corso: Crops and man: the history of crop domestication

Docente: Prof.ssa **Laura Nanni**

Total hours and Credits / Ore Totali e CFU:

12 hours = 1,5 CFU

Program

Agriculture is one of the greatest inventions of humanity. It has had marked biological, societal, and ecological consequences, which perdure to this day and will do so for many years to come.

The course will provide an overview on crop domestication and the consequences of domestication on the genetic diversity and on the genome. We will discuss some of the modern analytical tools that have allowed plant biologists and archaeologists to learn more about the evolution of crop, whose spread was human mediated.

Objectives of the course

- General knowledge on crop and human co-evolution

Prerequisite: Basic knowledge of Genetics, Plant biology and botany.

Room: to be defined or online

Course schedule: approximately in March 2026.

Online Operating methods: Teams or Zoom

13

Titolo del Corso: Machine Learning and Deep Learning: Methods and Applications in Bioinformatics

Docente: Dott. Michele Bernardini

Total hours and Credits / Ore Totali e CFU:

20 hours = 2,5 CFU

Program: Over the past years, machine-learning and feature-based tools were developed with the aim of learning bioinformatics characteristics. In general, the learning process of these algorithms can either be supervised or unsupervised, depending on the data being used to feed the algorithms. These technologies offer exciting new ways to tackle real-world challenges. However, after moving into the era of multimedia big data, machine-learning approaches have evolved into deep learning approaches, which are a more powerful and efficient way of dealing with the massive amounts of data generated from modern approaches and coping with the complexities of understanding real problems. Deep learning has taken key features of the machine learning model and has even taken it one step further by constantly teaching itself new abilities and adjusting existing ones. In this course, the foundations of Machine Learning and Deep Learning will be presented. How to extract and identify useful features that best represent your data, a few of the most important machine learning algorithms, and how to evaluate the performance of your machine learning algorithms will be the key core of the programme. Moreover, how to build neural networks and how to lead successful machine learning projects will be described. PhD students will work on case studies from bioinformatics. They will master not only the theory, but also see how it is applied. They will practice all these ideas in Python. This course includes 18 hours of lessons (2 hours each session).

Lecture 1 – Introduction to Python

- Learn basics of programming with Python (Variables, Operators, Logic...)
- Develop Python Modules to Create Re-Usable Code
- Learn Object Oriented Python Programming Concepts
- Learn how to process images & videos using OpenCV
- Examples and exercises.

Lecture 2 - Introduction to Machine Learning

- Introduction in Machine Learning. Statistical Foundations.
- Supervised learning techniques for regression and classification
- Unsupervised learning techniques for data modeling and analysis
- Probabilistic versus non-probabilistic viewpoints
- Examples and exercises.

Lecture 3 – Data analysis with Machine Learning

- Learning parameters from data for various machine learning methods
- Optimization and inference algorithms for model learning
- Classify data using K-Means clustering, Support Vector Machines (SVM), KNN, Decision Trees, Naïve Bayes, and PCA

- Make predictions using linear regression, polynomial regression, and multivariate regression
- Data Visualization with Matplotlib and Seaborn
- Use train/test and K-Fold cross validation to choose and tune your models
- Examples and exercises.

Lecture 4 - GWAS data analysis

- GWAS data analysis
- Testing various combinations of feature selection methods, data reduction techniques, training algorithms and classifier types using the data provided.
- Examples and exercises.

Lecture 5 – Introduction to Neural Networks

- The basics of neural networks including how to train them (e.g. back propagation).
- Examples and exercises.

Lecture 6 – Introduction to Deep Learning

- From features based to deep learning approaches
- Introduction to convolutional neural networks
- Introduction to Recurrent Neural Networks
- Examples and exercises.

Lecture 7 – Deep Learning Frameworks

- Use of popular Deep Learning libraries such as Keras, PyTorch, and Tensorflow applied to bioinformatics problems.
- Training and applying convolutional and recurrent neural networks for image analysis.
- Utilizing data augmentation and other preprocessing steps to further improve the generalization.
- Examples and exercises.

Lecture 8 –Deep Learning for bioinformatics applications

- Application of Deep Learning to real-world scenarios such as object recognition and Computer Vision, image and video processing, text analytics, Natural Language Processing, recommender systems, and other types of classifiers.
- Examples and exercises.

Lecture 9 – Generative Adversarial Networks

- Advanced topics: Generative Adversarial Networks, Deep Reinforcement Learning, Adversarial Attacks.
- Example and exercises.

Course schedule: approximatively June/ July 2026

Room: Teams or face to face lectures

14

Titolo del Corso: Plant genetic resources conservation, characterization and use for sustainable agriculture

Docente: Prof.ssa Elena Bitocchi

Total hours and Credits / Ore Totali e CFU:

12 hours = 1,5 CFU

Program

The course will be held in English. This course will provide students a large overview on plant genetic resources (PGR) use, management, conservation and exploitation, focusing on wild and domesticated forms, and on traditional landraces and modern varieties. The phenotypic and genotypic characterization of plant

genetic resources is crucial to use the genetic diversity available for crop breeding. The course will propose different case studies related to the utilization of plant genetic resources in pre-breeding projects and programs.

Objectives of the course

- to acquire knowledge on plant genetic resources, how to characterize them and their use in breeding to improve varieties for agronomic and nutritional quality traits.

Prerequisite: Basic knowledge of genetics, biology and statistics.

Course schedule:

- 13 gennaio 2026 – 9:30-12:30 Aula C
- 16 gennaio 2026 – 9:30-12:30 Aula B
- 22 gennaio 2026 – 9:30-12:30 Aula B
- 23 gennaio 2026 – 9:30-12:30 Aula B

Room: Face to face lectures or on line

15

Titolo del Corso: Python for advanced data analysis

Docente: Dott. Daniele Berardini (Dipartimento di Ingegneria dell'Informazione, DII, Univpm)
d.berardini@staff.univpm.it

Total hours and Credits / Ore Totali e CFU:

16 hours = 2 CFU

Program:

Block #1 – Recall of programming foundations

Recall of python programming language (3h)

Data Structure (list, tuple, set, dictionary) (1h)

Block #2 – Libraries for data representation

Numpy (1h)

Pandas (3h)

Block #3 – Data analysis (scikit-learn)

Pre-processing (1h)

Dimensionality Reduction (1h)

Brief introduction to clustering (1h)

Brief introduction to regression (2h)

Brief introduction to classification (3h)

Objectives of the course

General knowledge of the basic concepts of data manipulation / processing using Python

General knowledge of libraries / modules to apply machine learning techniques using Python

Prerequisite: basic elements of programming in Python; **for new users it is mandatory to previously follow, at least, one of these online courses:**

- *Fondamenti di Informatica (in Italian)* helded by Prof. Adriano Mancini (DII, Università Politecnica delle Marche; a.mancini@staff.univpm.it)

Registrazioni:

- *Introduction to Python (In English)*

<https://www.datacamp.com/courses/intro-to-python-for-data-science>

Course schedule: approximately June / July 2026

Room: Teams or face to face lectures

Titolo del Corso: Advanced methods of gene discovery

Docente: Dott.ssa Alice Pieri

Total hours and Credits / Ore Totali e CFU:

8 hours = 1 CFU

Program

The course will be held in English. It will introduce the basis of bioinformatic analysis. Topics will cover sequencing techniques, gene annotation and transcriptomics. A focus will be given to Next Generation Sequencing (NGS) and gene expression analysis with case studies and practical classes on RNA-seq analysis workflow.

Objectives of the course

To acquire knowledge on how to deal with NGS data and get familiar with basic bioinformatic tools for RNA-seq analysis.

Prerequisite: Basic knowledge of molecular biology and genetics.

Room: Teams or face to face lectures.

Course schedule: approximately in June-July 2026, 3 different days, 2 hours each.

Titolo del Corso: The molecular bases of crop domestication

Docente: Dott. Valerio Di Vittori

Total hours and Credits / Ore Totali e CFU:

8 hours = 1 CFU

Program

Domestication is a quite recent, and still ongoing, process that leads constantly to significant changes in the morphology, physiology and molecular aspects of plants. Indeed, domesticated plants differ significantly from their wild progenitor for several traits, that together constitute the “domestication syndrome”.

These traits are often shared between different and phylogenetically distant species; starting from wild species sharing similar features (e.g., the ability to disperse seeds) domestication provided domesticated crops that underwent similar modifications (e.g., the resistance to the loss of seeds) which fall under the definition of “parallel evolution”. The course aims to provide knowledge on several aspects of the domestication, such as;

- Which are the main modifications at the molecular level that overall occurred during the domestication of several crops, and how these modifications reflected in changes on the plant physiology and phenotypes?;
- Did the molecular pathways/genes involved in the main phenotypic traits of the domestications conserve their function across different species?; and is the parallel phenotypic evolution that we observed in the domesticated species the result of a parallel evolution at the molecular level across different species (i.e., did the selection during domestication acted on the same loci/genes in different species to provide similar phenotypes)?

The course will provide an overview on the recent advances and gain in knowledge in the domestication topic, to provide a general picture on the domestication processes and on its effect on the genetic and phenotypic architecture of crop plants.

The course will be held in English.

Objectives of the course:

- To acquire general knowledge on the main effects and mechanisms at the basis of the crop domestication process, both at molecular and physiological levels;
- To acquire knowledge on the molecular and phenotypic bases of the most relevant traits of the “domestication syndrome” in model crops, and on the parallel evolution process that characterizes the domestication.

Prerequisite: Basic knowledge of genetics and plant biology.

Online Operating methods: Face to face and online (TEAMS).

Room: to be defined.

Course schedule: approximately in February-March 2026, 3 different days, 2 hours each.

18

Titolo del Corso: “Il fenomeno dell’antibiotico resistenza in ambito alimentare ed ambientale” - “The antibiotic resistance issue in the food and environmental ecosystems”.

Docente: Prof.ssa **Cristiana Garofalo**

Total hours and Credits / Ore Totali e CFU:

12 hours = 1,5 CFU

Objectives of the course

The antibiotic resistance issue will be explained, with a focus on the main transmission routes of antibiotic-resistant bacteria and antibiotic resistance genes. In detail, the resistance to carbapenems, new generation antibiotics considered the latest therapeutic line against infections by Gram-bacteria will be treated. The main reservoirs of these resistances in the food and environmental ecosystems will be identified with a specific focus to the animal supply chain. Moreover, case studies reported in the available scientific literature will be discussed.

Ore complessive: 12 = 2 CFU

Program

- *What is the antibiotic resistance?*
- *Carbapenem resistant bacteria and carbapenem resistance genes*
- *The main reservoirs and mechanisms of diffusion of antibiotic resistance*
- *The spread of antibiotic-resistant bacteria and resistance genes in the animal supply chain*
- *Case studies*

Course schedule:

lunedì 15 giugno 2026 11.00-13.00 (in presenza)

lunedì 22 giugno 2026 11.00-13.00 (in presenza)

lunedì 29 giugno 2026 11.00-13.00 (in presenza)

lunedì 6 luglio 2026 11.00-13.00 (in presenza)

lunedì 13 luglio 2026 9.00-13.00 (in presenza)

Titolo del Corso: Seedborne pathogens of agricultural crops: transmission, detection and management.

Docente: Dott.ssa **Marwa Moumni**

Total hours and Credits / Ore Totali e CFU:

12 hours = 1,5 CFU

Program

This course will be held in English.

Seeds play a crucial role in promoting food security and healthy foods, and almost 90% of the world's food crops is grown from seeds. Seeds are an important nutrient to survive pathogens in nature. The pathogens associated with seeds are considered one of the major means to disseminate diseases from infected to non-infected areas around the world by international trade. Seedborne pathogens limit production in many crops and can cause serious economic losses for growers. Therefore, sowing healthy seeds with high quality is essential to secure crop yields and food production. The use of seed certified to be disease-free or certified to have disease levels below a threshold is often recommended as the primary management strategy. Seed health testing to detect seedborne pathogens is a fundamental step in the management of crop diseases. Seed treatment is a crucial step in ensuring the production of high-quality seeds. Localization of pathogen in seed is a very important step for the success of seed treatments, to ensure seed quality and increased yields. Different kinds of treatments can be used, which will depend on where the pathogen is localized on or in the seed, and these can include seed disinfestation, disinfection and/or protection. Integrated pest management strategies can provide more environmentally sound and economically feasible alternatives for seedborne disease management. These strategies are needed to minimize the inoculum of potential pathogens on seeds, drawing on management components that are currently available to farmers, or can be made available in the near future.

This course will address both in theory and practice the classical and innovative tools for detecting fungal pathogens on seeds, with a special focus on biological control of seedborne pathogens.

The course will be divided between theory sessions and laboratory practice.

1. Seedborne diseases: contamination, transmission, and localization.
2. Conventional methods for seed health testing.
3. Innovative methods for seed health testing.
4. Seed treatment using fungicides and physical means.
5. Alternative methods to control seedborne pathogens.
6. Practical work in the laboratory. Performance of some experimental procedures for the conventional detection and identification of main seedborne fungi.
7. Practical work in the laboratory. Performance of some experimental procedures for the molecular tools for detection and identification of main seedborne fungi.

Objectives of the course

- The main aim of this course:

- (a) To acquire a general knowledge of the main seedborne pathogens (fungi, bacteria, and viruses) and seed transmission of fungal diseases.
- (b) To learn the different methods used for seed health testing, and seed treatment of agriculture crop.
- (c) To learn and practice some of the laboratory methods and protocols for the detection of seedborne fungi using conventional and molecular tools.

Prerequisite: Basic knowledge on plant pathology.

Room: to be defined

Course schedule: 01/04; 08/04; 10/04; 15/04; 17/04; 22/04; 24/04; 29/04. 2h/day (16 h total), 14:30 - 16:30

Titolo del Corso: Dietary micronutrients and polyphenols: their effects on cellular metabolism.

Docente: Dott. Massimiliano Gasparrini

Total hours and Credits / Ore Totali e CFU:

8 hours = 1 CFU

SSD: BIOS-07/A (Biochemistry)

Development of the course The course will be organized in frontal lectures and practical activities in the laboratory.

Aims

Lifestyle and diet are crucial factors for promoting and maintaining good health during the entire life course and preventing several chronic diseases. In this sense micronutrients (vitamins) and polyphenols naturally present in fruit and vegetables, represent precious allies for maintaining a good state of health. For these reasons the course will focus on the beneficial role of specific dietary bioactive compounds, highlighting their effect in cellular metabolism (in particular in inflammatory conditions) and deeply investigating the signalling pathways and the molecular mechanisms involved. In addition to frontal lectures, the course will be characterized by laboratories activities and demonstrations that will allow students to practice with cell cultures work and with the common laboratory techniques and assays related to it.

Program

- Micronutrients and polyphenols vs inflammatory conditions: state of the art.
- How different bioactive compound exert their effects? Molecular mechanisms and involved pathways.
- Cell cultures work: methodology and techniques.
- Practical application and demonstration in lab.

Objectives of the course

- ✓ to know the main dietary bioactive compounds and the functional foods involved in anti-inflammatory response;
- ✓ to know how investigate and study the molecular mechanisms and the pathways involved in bioactive compound response;
- ✓ to know and apply cell cultures techniques and assays to evaluate cellular metabolism, focusing on inflammatory conditions.

All the lessons will be attended in presence.

Proposal schedule:

May 18-19 2026, (4 h): room to define_FRONTAL LECTURES

May 20-21 2026, (5 h): D3A- Biochemistry laboratories_PRATICAL ACTIVITIES

Providing a laboratory part, interested students are invited to communicate their presence at the lessons by May 3, 2026 (m.gasparrini@staff.univpm.it).

**Titolo del Corso: PLF in reducing the environmental impact of livestock farming /
Zootecnia di Precisione, nuove strategie per ridurre l'impatto ambientale degli allevamenti**

Docente: Prof.ssa Marina Pasquini

Total hours and Credits / Ore Totali e CFU:

12 hours = 1,5 CFU

Objectives of the course / Obiettivi del corso:

The aim of the course is to provide knowledge about Precision Livestock Farming (PLF) and the main electronic tools for tracking and monitoring livestock to improve their sustainable production and reproduction, health, welfare, and reducing their impact on the environment.

L'obiettivo del corso è quello di fornire conoscenze sulla moderna Zootecnia di Precisione (PLF) e sui principali strumenti elettronici (sensori) per il tracciamento e il monitoraggio del bestiame per rendere più sostenibili la produzione e riproduzione, la salute ed il benessere del bestiame riducendo il loro impatto sull'ambiente.

Program - Main topics / Programma - Argomenti principali:

- Precision Livestock Farming (PLF)
Zootecnia di Precisione
- Environmental effects of livestock farming on soil, water, air, crops
Effetti degli allevamenti su suolo, acqua, aria, colture
- Technical improvement: On-Animal and Off-Animal Sensors/Devices
Nuovi sensori per la zootecnia: On-Animal and Off-Animal
- Precision Livestock Farming and feeding efficiency
Zootecnia di Precisione ed efficienza alimentare
- Precision Livestock Farming and climate changes
Zootecnia di Precisione e cambiamenti climatici
- Individual presentation of a case study by each PhD student
Presentazione e discussione di un caso di studio da parte di ciascun Dottorando

Course Schedule / Calendario:

Period of lectures: from 27 to 30 July 2026;

4 days (3 hours/day), including 1 day for PhD students case study reports.

Periodo delle lezioni: 27 - 30 luglio 2026;

4 giorni, (3 ore/giorno), di cui 1 giorno dedicato ai casi di studio presentati e discussi dai dottorandi.

Course Registration / Iscrizione al Corso:

Doctoral Students who would like to attend the course, are requested to communicate it via email to m.pasquini@staff.univpm.it no later than May 15, 2026.

Si chiede ai dottorandi che intendono partecipare al corso di comunicarlo mediante email a m.pasquini@staff.univpm.it entro e non oltre il 15 maggio 2026.

Room / Aula:

To be defined.

Da definire.

Operating methods / Modalità di erogazione del corso:

The program will consist of lectures in person with live streaming; for the last lesson of the course, each PhD Student will summarize and critically analyze a case study taken from the available scientific literature.

Il programma si articolerà in un ciclo di lezioni in presenza e in diretta streaming; nell'ultima lezione del corso, ciascun dottorando riassumerà e analizzerà criticamente un caso studio tratto dalla letteratura scientifica disponibile.

22

Titolo del Corso: Contaminazione ed ecotossicologia nel suolo

Docente: Dott.ssa Arianna De Bernardi

Total hours and Credits / Ore Totali e CFU:

12 hours = 1,5 CFU

Date proposte: Da definire (giugno-settembre)

Programma:

Argomenti	Ore
1. Introduzione all'ecotossicologia ambientale, endpoint ecotossicologici e cenni di regolamentazioni europee. Organismi bioindicatori edafici, focus sui saggi ecotossicologici standard e tecniche innovative per la valutazione dello stato di salute del suolo.	3
2. Laboratorio – Valutazione dello stato di fertilità del suolo tramite saggi enzimatici	3
3. La contaminazione del suolo (principali contaminanti e fattori che ne influenzano la biodisponibilità concetti di accumulo nelle catene trofiche).	2
4. Laboratorio – Laboratorio – Valutazione dello stato di fertilità del suolo tramite saggi enzimatici	4

Modalità di svolgimento: Teams o in presenza per due lezioni frontali (argomenti 1 e 3), solo in presenza per le lezioni pratiche in laboratorio (argomento 2 e 4).

23

Titolo del Corso: Efficient interview and questionnaire design in agricultural, food and environmental sciences / Progettazione efficiente di interviste e questionari nel campo delle scienze agrarie, alimentari e ambientali

Docente: Dott.ssa Emilia Cubero Dudinskaya

Total hours and Credits / Ore Totali e CFU:

12 hours = 1,5 CFU

Lingua/Language: English/Italiano

Programma/Program:

1. Development of concepts and their measurement
2. Type of interviews
3. Interview guidelines
4. Designing a structured interview
5. Rules for designing questions
6. Conducting interviews

The course aims to give the students theoretical and practical knowledge of how to design and develop an interview or a questionnaire according to their own research objectives, optimising the data collection and the subsequent data analysis.

Modalità di iscrizione/Course enrolment: per e-mail: e.cubero@univpm.it

Materiale didattico/Course material: disponibile sulla piattaforma LEARN

Modalità di erogazione/Course delivery: in presence

Rilevazione presenze: with signature

Calendario/schedule: Da concordare con il docente (giugno/luglio 2026)

24

Titolo del corso: Biologia di *Apis mellifera* e tutela della biodiversità - Honey bee biology and biodiversity protection

Docente: Prof.ssa Sara Ruschioni

Total hours and Credits / Ore Totali e CFU:

12 hours = 1,5 CFU

Programma:

- Api ed impollinazione
- Morfologia e anatomia di *Apis mellifera*
- Biologia dell'alveare: sviluppo e compiti delle api
- Fisiologia sociale di *Apis mellifera*
- Cenni di apicoltura
- Importanza delle api per la tutela della biodiversità

Program:

- Bees and pollination
- Morphology and anatomy of *Apis mellifera*
- Hive biology
- Social physiology of *Apis mellifera*
- Basics of beekeeping
- Importance of bees for the protection of biodiversity

Modalità di svolgimento: in presenza (Aula e apiario didattico)

Date: Lessons in June 2026

25

Titolo del Corso: Introduzione all'analisi multivariata dei dati e spettroscopia NIR / Introduction to multivariate data analysis and NIR spectroscopy

Docente: Dott.ssa Manuela Mancini

Total hours and Credits / Ore Totali e CFU:

24 hours = 3 CFU

Course aim: The purpose of the course is to give an introduction to some of the common methods in multivariate data analysis and give the students tools and knowledge to understand and perform PCA data analysis on their own data. The course is designed also to provide theoretical and practical knowledge of near-infrared spectroscopy (NIRS) and its possible applications.

Learning outcomes and competences:

At the end of the course the students should be able to: describe the principles of NIR spectroscopy as well as to summarize its possible applications. They will be able to perform lab analysis on samples using NIRS

sensor. They will arrange data in a matrix appropriate for PCA. They will obtain theoretical knowledge about the principals of PCA (exploration) and apply PCA on new data and analyze the results.

Program:

The course will cover the following topics:

1. Fundamentals of NIRS
2. Instrumentation: theory and hands-on experience
3. Introduction to the chemometric methods, Principal Component Analysis (PCA), including common data pre-processing
4. Computer exercises

Course schedule:

The students will participate to class lectures (ca. 12 hours) and group work based on hands-on laboratory and computer assignments (ca. 12 hours).

Schedule:

The course is taking place on Spring 2026 from 9:00 to 13:00 or from 14:00 to 18:00 based on the room availability.

Course enrolment: enroll to Manuela Mancini (manuela.mancini@staff.univpm.it) Jul 30th at the latest.

Room: tbd based on the number of PhD students

26

Titolo del Corso: Genetics, Biotechnology and Biosafety for plant genetic improvement

Docente: Prof. Bruno Mezzetti

Total hours and Credits / Ore Totali e CFU:

12 hours = 1,5 CFU

Date: January 27th, 28th and February 2nd, 3rd 2026, from 9:00 to 12:00, meeting room of the fruit biotechnology lab.

Themes:

- Traditional breeding
- Mutation technology
- Biotechnology applications in horticultural crops
- Biosafety rules on plant biotechnology and methods of study
- Case studies

Course schedule:

The students will participate to class lectures (ca. 12 hours) and group work based on hands-on laboratory and computer assignments (ca. 12 hours).

27

Titolo del Corso: Basics of the GEOBIA Approach in Remote-sensing Data Analysis on eCognition and Applications on forestry and agriculture

Docente: Dott. MD Abdul Mueed Choudhury

Total hours and Credits / Ore Totali e CFU:

12 hours = 1,5 CFU

Program: The course will primarily concentrate on the Geographic Object-Based Image Analysis (GEOBIA) methodology, specifically in the context of territorial analysis for the mapping and estimations of ecosystem services provided with sustainable landscape planning. It will introduce participants to the Trimble eCognition platform, which will serve as the foundation for applying the basic principles and techniques of GEOBIA.

These include image segmentation, object characteristics, as well as supervised and rule-based classification methods. Overall, the program will be provided with the following features:

- Introduction to eCognition and case studies on GEOBIA;
- Object features, i.e., vegetative and non-vegetative (LCLU) indices;
- Intro to ruleset development and algorithms;
- Segmentation i.e., types, uses, applications;
- Classification based on data properties (Thematic and Raster);
- Accuracy assessment, validation, and export results;
- Rule-set Development for land cover and vegetation (Plant health, ecosystem services) analysis.

Objectives of the course:

Upon completion, attendees ought to grasp the fundamental concepts of GEOBIA and possess the capability to execute a GEOBIA workflow using the eCognition remote sensing software package.

Prerequisites: Basic computer applications and physics.

Course schedule: Approximately in September 2026.

Room: To be updated.

N.B. The medium of instruction will be in English for the entire course. Materials could be available in Italian on request.

28

Titolo del Corso: Cambiamento climatico: mitigazione e adattamento nelle colture arboree/Climate change: mitigation and adaptation in tree crops.

Docente: Prof.ssa Vania Lanari

Total hours and Credits / Ore Totali e CFU:

12 hours = 1,5 CFU

Obiettivo del corso:

Il corso consente agli studenti di acquisire conoscenze sul cambio climatico e sulle ripercussioni in arboricoltura, sulle azioni di intervento e strategie innovative per l'adattamento delle varie colture all'attuale condizione climatica. Il corso intende, inoltre, fornire agli studenti le capacità di gestire i dati meteo e di interpretare i risultati. In fine, saranno esaminati alcuni casi di studio.

Course objective:

The course allows students to acquire knowledge on climate change and the effects in arboriculture, on intervention actions and innovative strategies for the adaptation of the various crops to the actual climatic condition. The course also aims to provide students the ability to manage weather data and to interpret results. Finally, some case studies will be examined.

Programma:

1. Cambio climatico e impatto in arboricoltura.

Trend del cambio climatico. Impatto del cambiamento climatico sulle fasi fenologiche (anticipo delle principali fasi e problematiche connesse), fisiologia delle piante (aspetti relativi a fotoinibizioni e riduzione dell'efficienza fotochimica) e sugli areali di coltivazione.

2. Strategie di adattamento e mitigazione al cambiamento climatico.

Strategie di adattamento a breve e lungo termine ed interventi di mitigazione in arboricoltura.

3. Approccio nell'elaborazione e presentazione dei dati.

Acquisizione e gestione dei dati meteo, elaborazione dei dati e rappresentazione grafica.

4. Casi di studio

Program:

1. Climate change and impact in tree crops.

Climate change trend. Climate change effects on the phenological phases (advance of the main phenological phases and problems), plants physiology (aspects related to photoinhibition and reduction of the photochemical efficiency) and the cultivation areas.

2. Adaptation and mitigation strategies for climate change.

Adaptation strategies in short and long-term and mitigation interventions in arboriculture.

3. Approach in data processing and presentation. Acquisition and management of weather data, data processing and graphical representation.

4. Case studies

Date/schedule: Giugno 2026/June 2026

Operating methods / Modalità di erogazione del corso: Teams

29

Titolo del Corso: Analisi delle radici delle piante: sfide e opportunità per la ricerca in ecofisiologia / Analysis of plant roots: challenges and opportunities for research in ecophysiology

Docente: Dott.ssa Veronica Giorgi

Total hours and Credits / Ore Totali e CFU:

8 hours = 1 CFU

Obiettivo/Objective:

Lo studio dell'apparato radicale è fondamentale per comprendere l'ecofisiologia dell'intera pianta ma è ancora poco approfondito a causa di difficoltà oggettive nell'osservazione e nelle misurazioni. Il seminario inizierà con una panoramica dei principali metodi di analisi delle radici delle piante in campo e in condizioni controllate (laboratorio o serra), verranno esposti i pro e i contro, nonché le possibili applicazioni in diverse aree di ricerca. Saranno presentati alcuni esempi di studi di ricerca su diversi aspetti della crescita, della topografia e del ricambio radicale, e verrà descritta la risposta a input esterni. Verranno proposti input per implementare ulteriori ricerche sulla gestione degli alberi da frutto e degli ulivi in diversi sistemi di impianto.

Research on roots is pivotal to understand the ecophysiology of the whole plant system but it is still poorly investigated, due to objective difficulties in observation and measurements. The seminar will start with an overview of the main methods of plant root analysis in the field and in controlled conditions (lab or greenhouse), pros and cons will be exposed as well as possible applications in different research areas. Some examples of research studies on different aspects of root growth, topography and turnover will be presented and response to external inputs will be described. Inputs will be proposed to implement further research on fruit trees and olive management in different planting systems.

Programma/Program:

Visione sistemica della pianta, Funzioni dell'apparato radicale, Metodi di studio della radice, Output dello studio dell'apparato radicale, casi studio

Systemic view of tree, Plant root functions, Methods to study plant root, Output of root analysis, Case studies
4 ore

Laboratorio analisi radicale con metodo del carotaggio – utilizzo di software per l'analisi delle immagini radicali

Lab on root analysis with coring method – use of root image analysis software **2 ore**

Date/Schedule: Aprile – Maggio 2026/ April - May 2026

Titolo del corso: Elementi di Politica agricola e azioni di sviluppo rurale per zone svantaggiate e con vincoli naturali

Docente: Dott. Giacomo Staffolani

Total hours and Credits / Ore Totali e CFU:

8 hours = 1 CFU

Obiettivo del corso:

Il corso intende fornire una conoscenza base sulla Politica Agricola Comune (PAC) attuale 2023-2027. Inoltre, intende illustrare le opportunità offerte dal Piano Strategico Nazionale (PSN) per le aree svantaggiate e con vincoli naturali.

Programma:

- La PAC 2023-2027: introduzione, obiettivi e basi giuridiche;
- I punti chiave della riforma;
- Misure di sviluppo rurale (CSR) a sostegno delle zone svantaggiate e con vincoli naturali.

Date:

Marzo 2026 (9/03/2026, 16/03/2026, 23/03/2026, 30/03/2026)

Modalità di svolgimento:

in presenza e su Teams (su richiesta in Inglese)

Titolo del corso: Progettazione e verifica della Shelf-life dei prodotti alimentari
Design and Assessment of the Shelf-life of Foods

Docente: Prof. Pasquale M.Falcone

Total hours and Credits / Ore Totali e CFU:

12 hours = 1,5 CFU

Obiettivo del corso:

The food Shelf Life is a finite length of time during which the product keeps a quality acceptable. Food life results from the complex relationship between process, material properties, packaging performance, environment conditioning and acceptability requirements. Managing food Shelf Life by mastering this complex interplay will make the chain of supplying and distributing food products more efficient and sustainable for the environment and future generation. The course provides the essential skills for understanding challenges, pitfalls and rising challenges of the field of Shelf Life related issues, enlightening the methodologies of shelf life assessment as well as the design of tailored packaging solutions. The course brings together academic scientific excellence with experience in industrially relevant applications meeting a dynamic market demand.

The PhD students should have basic knowledge of food science and technology.

Programma:

- 1) Introduction to the Shelf Life: definition, basic concepts, and regulatory aspects
- 2) The Shelf Life Assessment Process: acceptability limit and critical indicators
- 3) Predictive modeling using critical indicators under expected storage conditions
- 4) Predictive modeling using critical indicators under accelerated shelf life tests
- 5) Design of tailored packaging solutions able to prolong the Shelf Life and/or inform consumers on the actual Shelf Life
- 6) Case-studies, relevant instrumental techniques and computer-aided exercises

Room: to be defined.

Course schedule: approximately in September - October 2026, 6 different days, 2 hours each.

Modalità di svolgimento:

The course is provided on TEAMS platform, with some experiences about the relevant instrumental techniques and computer-aided exercises, both requiring the presence of the students in the lab of Food Science and Technology of D3A.

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Titolo del corso: Physiologically-Based Models supporting the management of insect pests

Docente: Dott. Giorgio Sperandio

Total hours and Credits / Ore Totali e CFU:

12 hours = 1,5 CFU

Course aim:

The goal of this course is to provide essential knowledge about the development of Physiologically-Based Models emphasizing their role as decision-support tools in pest management. Students will have the opportunity to explore the principles of the physiologically-based approach, understand key steps of model development, and learn proper techniques for collecting and managing biological data used for model calibration and validation. The course will feature various case studies demonstrating how physiologically-based models are developed and applied for the management of insect pests across diverse contexts, from Pest Risk Analysis to Integrated Pest Management. Additionally, students will participate in a practical test involving the management of biological data and the development of a basic predictive model.

Program

- **Concepts of modelling applied to insect management:** definition of model and introduction to their use
- **The physiologically-based modelling approach:** principles of physiologically-based models in the context of insect pest management
- **Development of a model:** definition of the main steps of model development, and use of data for simulating the individual physiology and the population dynamics of insects
- **Case studies:** application of models in the context of pest management
- **Practical test:** development and application of a simple physiologically-based model

Course schedule:

09/06/2026: 10:00 – 13:00

11/06/2026: 10:00 – 13:00

16/06/2026: 10:00 – 13:00

18/06/2026: 10:00 – 13:00

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Titolo del corso: Enzymes in agri-food waste valorization

Docente: Prof.ssa Nadia Raffaelli

Total hours and Credits / Ore Totali e CFU:

12 hours = 1,5 CFU

Objective of the course:

The course aims to present the most recent research on the use of enzymatic catalysis for the transformation of agri-food waste into valuable bioactive compounds.

Program of the course:

- The potential of agrifood by-products: phytochemicals, bioactive peptides, dietary fibers and pigments

- Enzyme-assisted extraction
- Examples of enzymes' application in the valorization of food waste rich in lactose, lignocellulose, pectin, lipids and protein

Course schedule:

The course is held in person and consists of class lectures on the topic listed above (total 6 hours) and laboratory practices (total 6 hours) on the determination of the activity of ligninolytic enzymes secreted by fungi during fermentation of specific food-waste.

The course will be held from May 11 to May 15, 2026 (room for lectures to be defined; lab for practical activities in the Biochemistry area, Ingegneria, Edificio Belluschi n. 5, quota 150)

Course enrolment: Interested students should contact the lecturer by April 10, 2026 at n.raffaelli@staff.univpm.it

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Titolo del corso: Exploiting Information from Data: Introduction to Linear Regression and Multivariate Statistics

Docente: prof. Danilo Gambelli

Total hours and Credits / Ore Totali e CFU:

12 hours = 1,5 CFU

Course Aim: The course aims to introduce methods for analyzing relationships between variables and identifying common patterns in statistical data.

Course organization:

The course consists of 12 hours of instruction:

- 8 hours on fundamental data relationships, including correlation and linear regression models, with introductory elements of linear algebra.

- 4 hours on data reduction methods based on variable relationships.

Each session will combine theoretical discussion with practical applications using freeware and spreadsheet tools.

Program:

General Issues on Association Among Variables

- Understanding correlation and common misinterpretations
- Basic matrix algebra for linear regression modeling

Linear Regression: Main Concepts and Applications

- Properties of estimators: efficiency, consistency, unbiasedness; basic hypothesis testing
- Data transformations: logarithms, standardization, dummy variables
- Time series, cross-section, and panel data: practical sessions on basic linear regression and panel data estimation

Introduction to Multivariate Statistics

- Factor analysis
- Overview of alternative multivariate methods

Free statistical software (e.g., JAMOV, GRETL) and spreadsheet will be used for practical sessions. Students are encouraged to bring their own laptops.

Schedule: January 26, 28, and 30, 2026

Room: room A - 9:00 – 13:00

Teaching mode: In-person

Enrolment:

To enrol, please contact the lecturer at: d.gambelli@univpm.it

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Titolo del Corso: Management and conservation of animal biodiversity / Gestione e conservazione della biodiversità animale

Docente: Prof. Simone Ceccobelli

Total hours and Credits / Ore Totali e CFU:

12 hours = 1,5 CFU

Objectives of the course / Obiettivi del corso:

The course aims to provide students with a solid understanding of the fundamental concepts of animal biodiversity, genetic resources, and the main *in situ* and *ex situ* conservation strategies. Particular emphasis will be placed on the regulatory framework governing the use of genetic resources and promoting their safeguarding, in order to equip students with the tools for responsible and informed management. Furthermore, the course is designed to develop practical skills for the rational use of genetic resources in breeding and research programs, as well as planning and implementing conservation activities *in situ* and *ex situ*.

Il corso si propone di fornire agli studenti una solida conoscenza dei concetti fondamentali relativi alla biodiversità animale, alle risorse genetiche e ai principali metodi di conservazione in situ ed ex situ. Particolare attenzione sarà dedicata al quadro normativo che disciplina l'utilizzo delle risorse genetiche e ne tutela la salvaguardia, così da fornire strumenti utili per una gestione consapevole e responsabile. Inoltre, il corso intende sviluppare competenze applicative per l'impiego razionale delle risorse genetiche nei programmi di miglioramento genetico e di ricerca, nonché capacità progettuali e operative nella pianificazione e conduzione di attività di conservazione in situ ed ex situ.

Program - Main topics / Programma - Argomenti principali:

- What animal genetic diversity is.
Cos'è la diversità genetica animale.
- The importance of livestock biodiversity.
L'importanza della biodiversità zootecnica.
- Italian native breeds: cattle, horses, donkeys, sheep and goats, pigs, and poultry.
Le razze autoctone italiane: bovini, cavalli, asini, ovi-caprini, suini e avicoli.
- Methods and strategies for the conservation and valorization of animal genetic resources.
Metodi e strategie per la conservazione e valorizzazione delle risorse genetiche animali.
- National and international initiatives for the safeguarding of animal genetic resources.
Principali iniziative a livello nazionale e internazionale per la salvaguardia delle risorse genetiche animali.
- Individual presentation of a case study by each PhD student
Presentazione e discussione di un caso di studio da parte di ciascun Dottorando

Course Schedule / Calendario:

Period of lectures: from 27 to 30 July 2026;

4 days (3 hours/day), including 1 day for PhD students case study reports.

Periodo delle lezioni: 27 - 30 luglio 2026;

4 giorni (3 ore/giorno), di cui 1 giorno dedicato ai casi di studio presentati e discussi dai dottorandi.

Course Registration / Iscrizione al Corso:

Doctoral Students who would like to attend the course, are requested to communicate it via email to s.ceccobelli@staff.univpm.it no later than May 18, 2026.

Si chiede ai dottorandi che intendono partecipare al corso di comunicarlo mediante email a s.ceccobelli@staff.univpm.it entro e non oltre il 18 maggio 2026.

Room / Aula:

To be defined.

Da definire.

Operating methods / Modalità di erogazione del corso:

The program will consist of lectures (in presence or online by the TEAMS platform); for the last lesson of the course, each PhD Student will summarize and critically analyze a case study taken from the available scientific literature.

Il programma si articolerà in un ciclo di lezioni (in presenza o online tramite la piattaforma TEAMS); nell'ultima lezione del corso, ciascun dottorando riassumerà e analizzerà criticamente un caso studio tratto dalla letteratura scientifica disponibile.

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Titolo del Corso: Experimental design, data collection and data analysis

Docente: Dott. Matteo Francioni

Total hours and credits /Ore totali e CFU:

24 = 3 CFU

Language: English

Program:

1. Data collection [Do's and Don'ts]
2. Descriptive Statistics and Sampling Distributions: measures of central tendency and variability, frequency distributions, categorical vs. numerical variables, probability distributions (normal and standardized normal).
3. Graphical Representations: univariate and bivariate plots, histograms, visual exploration of data.
4. Statistical Inference: estimation of population parameters from samples; properties of estimators (bias, efficiency, consistency); hypothesis testing (null hypothesis, one- and two-tailed tests, significance level, errors I–III).
5. Correlation and Regression: Pearson and Spearman correlations, linear, non-linear, and multiple regression models.
6. Experimental Designs and Mean Comparisons: randomized, block, split-plot, Latin square designs; t-tests and ANOVA (one-, two-, and three-way); assumptions (normality, homogeneity of variance); post-hoc tests; non-parametric alternatives; generalized linear models.
7. Software Applications: use of basic tools (Excel, PAST) and advanced user-friendly platforms without scripting (JASP, JAMOV).

Course aim: This course introduces basic skills on how to collect data in the lab or in the field, organize databases, and analyse them. It is designed for PhD students in agricultural, food, and environmental sciences. The course provides the foundations of data analysis, starting with manual calculations, then moving to Microsoft Excel and finally to user-friendly software (JASP, JAMOV, PAST). To attend this course, only a basic knowledge of Excel is required. No programming skills or experience with script-based software (e.g., R) are needed.

Course enrolment: via e-mail: m.francioni@univpm.it Course material: available on LEARN platform

Course delivery: in presence and/or via TEAMS

Student presence: signature

Schedule: To be defined, tentatively in June (two days per week in the computer lab for four weeks)

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Titolo del Corso: Food industrial waste as starting material for producing innovative food packaging and functional foods

Docente: Prof.ssa Deborah Pacetti

Total hours and Credits / Ore Totali e CFU:

12 hours = 1,5 CFU

Program:

Methodologies to design functional food by using ingredients from vegetable industrial waste

Objectives of the course

The course aims to provide knowledge related to functional food design, to the most widespread functional ingredients and to the steps that food companies should take to ensure developing functional products.

Prerequisite: knowledge on food technologies

Course schedule: July 2025

Room: Teams lectures

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Titolo del Corso: Emerging technologies for food safety and preservation

Docente: Prof. Massimo Mozzon

Total hours and Credits / Ore Totali e CFU:

12 hours = 1,5 CFU

Main topics:

1. Basics of food safety and preservation
2. Electrothermal technologies: Ohmic and inductive heating; microwaves and radio frequencies heating.
3. Non-thermal preservation processes: High pressure processing; Pulsed electric fields; Cold atmospheric plasma.

Schedule: marzo-maggio 2026. Calendario da definire in base all'orario delle lezioni II semestre

Modalità di svolgimento: In presence

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Titolo del Corso: EFSA AND QPS APPROACH

Docente: Prof.ssa Lucia Aquilanti

Total hours and Credits / Ore Totali e CFU:

12 hours = 1,5 CFU

Program: This course provides PhD students with an overview of the role of the European Food Safety Authority (EFSA) in food and feed safety risk assessment, with a specific focus on the Qualified Presumption of Safety (QPS) approach. The course will introduce the scientific and regulatory principles underlying EFSA risk assessment, the criteria for inclusion of microorganisms in the QPS list, and the implications of QPS status for the authorization of microbial strains used in food, feed, and biotechnology. Case studies will be discussed to illustrate the application of the QPS framework and its relevance for research, innovation, and regulatory compliance.

Schedule: July-August 2026. Calendario da definire in base all'orario delle lezioni II semestre

Modalità di svolgimento: In distance

Prerequisite: knowledge on food microbiology

Course schedule: July – August 2026

Room: Teams lectures

Titolo del corso: Systematic Literature Reviewing in Research

Docente: Prof.ssa **Giuseppina Migliore (UNIPA)**

Total hours and Credits / Ore Totali e CFU:

8 hours = 1,0 CFU

January 28-30, 2026

Program:

- Methodological foundations of Systematic Literature Reviews (SLRs): overview of the stages involved in designing and conducting a systematic review.
- Developing a systematic review protocol: introduction to PRISMA guidelines and detailed examination of the PRISMA checklist items.
- Search strategies and algorithm development: constructing and applying search algorithms in Scopus and Web of Science.
- Synthesizing evidence: defining the procedures and techniques for systematically synthesizing and reporting SLR findings.
- Protocol registration: introduction to PROSPERO and guidelines for registering a Systematic Literature Review protocol.

AIMS: This course provides a structured and comprehensive introduction to conducting Systematic Literature Reviews (SLRs) in accordance with international standards. It covers all key stages of the review process, from protocol development to evidence synthesis, with a strong focus on PRISMA guidelines and checklist application. Participants learn to design effective search strategies, select appropriate databases, and apply rigorous, transparent methods for screening, extracting, and synthesizing evidence. By the end of the course, learners are equipped to critically evaluate literature, produce reproducible evidence syntheses, and register systematic review protocols on international platforms.

Modalità di svolgimento: in presenza (Aula)

Teaching methods: Lectures supported by multimedia materials, Analysis of successful and well-established published SLRs, Guided discussion.