Course Title: Statistics

COMPULSORY COURSE

Teacher: Prof. Francesco Cappelli – cappelli.francesco@unitus.it

Program: The course will cover the following topics: (I) Introduction to Machine Learning for statistics; (ii) Machine Learning for Science; (iii) Supervised Machine Learning; (iv) Random Forest (v) Presentation of the Machine Learning Model in R; (vi) Case Study in R; (vii) Interpretability concept; (viii) Model-Agnostic Methods; (ix) Importance Measures.

Schedule

	Day1	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**	**Day 7**
Day	15/01/26	15/01/26	16/01/26	29/01/26	29/01/26	30/01/26	23/02/26
Time	9-13	16-19	08:30 – 11:30	9-13	16-19	08:30 – 11:30	9-13
Room	F6	F5	F5	F5	F5	F5	TBD

Course Title: Valorization and dissemination of results, intellectual property and open access to research data and products

COMPULSORY COURSE

Teacher: Prof. Antoine Harfouche – aharfouche@unitus.it

Program: The course aims to provide students with the technical, linguistic, and cultural tools necessary to disseminate research results as effectively as possible. Therefore, the course is not limited to language use but includes:

- the ability to organize and finalize a paper (bibliography, text organization, quality of text and figures, choice of journal or communication channel)
- the ability to correctly and clearly represent results and methodologies, both analytically and through descriptive figures;
- the ability to organize a presentation in different contexts (scientific conference, grant application/defense, industrial project)
- Principles of open data and open science
- intellectual property.

Day1	Day 2	Day 3	Day 4	Day 5	Day 6
Day	TBD	TBD	TBD	TBD	TBD
Time					

Course Title: Scientific English

COMPULSORY COURSE

Teacher: Prof. Julie Hobson – jhobson@unitus.it

Program: Proper knowledge of technical English is an essential tool for the professional figure that the doctoral program aims to train. The English language course aims to align all students in the doctoral program in Engineering for Energy and Environment to at least a C1 level in technical and scientific English. The course is mandatory for all students in both majors and focuses on written, compression, and oral presentation skills.

Schedule: The course will be scheduled by the CLA and will be held between February and May 2026.

Course Title: Advanced Experimental Methods

ELECTIVE COURSE

Teacher: Prof. Ines Delfino – delfino@unitus.it e Prof Luca Molinaro luca.molinaro@unitus.it (eventually Prof. Juri Taborri juri.taborri@unitus.it)

Program:

Part A-Title: Optical spectroscopy techniques Summary: Some optical spectroscopy techniques (namely, vibrational spectroscopy methods) will be introduced and the theoretical basis and instrumentations will be presented along with an overview of sensing applications. Details about the related data analysis methods and applications of interest of the students will be discussed during the (7.5h-) course.

Part B-Title: Metrological rigor in data acquisition and AI biomechanics application Summary: The lesson (6 h) deals with metrological aspects associated with sensor systems for gathering measurements and their importance for the application of artificial intelligence. An overview of measurement applications in biomechanics will be also provided.

Schedule

	Day1	**Day 2**	**Day 3**	**Day 4**
Day	7/07	8/07	13/7	14/7
Time	14-17	14-17	10-13	10-13
Room	F5	F5	F5	F5

Course Title: Land Governance and Rural Landscape. Elements of Planning.

ELECTIVE COURSE

Teacher: Prof. Stefano Bigiotti – stefano.bigiotti@unitus.it

Program: The course aims to promote the consolidation of general knowledge on urban planning legislation, as well as determine specific critical-interpretative and professional skills on environmental governance in general, such as to convey the necessary foundations to determine sustainable management and planning of the territory and landscape, with specific reference to rural and peri-urban space, to natural areas, including those subject to special protection, to public and private green areas, to the environment itself. The course thus aims to deepen the issues of planning with regard to the issues of the enhancement and use of the available material heritage (whether directly or indirectly restricted), paying specific attention to the analysis of the typical structure of fringe areas and more generally to the protection of the territory, to the possible building transformations that can be authorised in the "E" zones of the general regulatory instrument.

Schedule

	Day1	**Day 2**	**Day 3**	**Day 4**
Day	13 January	20 January	27 January	3 February
Time	16:00-19:00	16:00-19:00	16:00-19:00	16:00-19:00
Room	F5	F6	F6	F6

Course Title: Artificial intelligence

ELECTIVE COURSE

Teacher: Prof. Andrea Zingoni – andrea.zingoni@unitus.it

Program: Artificial intelligence and machine learning are cutting-edge and transdisciplinary technologies that allow enormous results in many fields of research. Energy systems and environmental health are no exception. On one hand, these methodologies allow us to analyze quantitative degrees of
data with great effectiveness, on the other hand they allow us to develop intelligent technologies that
can adapt autonomously in an extremely dynamic environment such as that of energy distribution networks. The course aims to provide the basis relating to machine learning and artificial intelligence methodologies (e.g. neural networks, complexity reduction methods, online learning) that students can
apply to the specific fields of research characterizing the doctoral course.

Schedule

	Day1	**Day 2**	**Day 3**	**Day 4**
Day	20/01	10/02	13/02	16/02
Time	14.30-18-30	14.30-18-30	14.30-18-30	10.00 - 13.00
Room	F5	F5	F5	F5

Course Title: Data Integrity in Industrial Systems: From Theory to Practice

ELECTIVE COURSE

Teacher: Prof. Diego Pennino – diego.pennino@unitus.it

Program: The PhD course "Data Integrity in Industrial Systems: From Theory to Practice" is designed for mechanical and industrial engineers who wish to improve their skills on the concept of data integrity, improving their awareness of the various industrial risks that it entails. The first part of the course will focus on the fundamental concepts of software security. We will start from the basics, learning to read reports and documentation on security vulnerabilities and study their life cycle. The main types of attacks that can hit software will then be analyzed and we will see practical examples of how these threats can compromise industrial systems. We will learn to use advanced hacking tools to identify and mitigate the various types of vulnerabilities. The second half of the course will be focused on verifying the integrity of the data, starting again from the basics, we will learn cryptography concepts that we unknowingly use every day. Thanks to this new knowledge we will address the concept of authenticated data structure, which is today the most widespread and effective means to guarantee the integrity of the data. The course will conclude with an overview of a sort of evolution/application of these authenticated data structures, namely the Blockchain. We will learn why the blockchain is gaining ground in industry 4.0 The course does not require any prerequisites, all the concepts will be addressed starting from the basics.

Schedule

	Day1	**Day 2**	**Day 3**	**Day 4**
Day	03/06/2026	04/06/2026	10/06/2026	11/06/2026
Time	08:00-11:00	08:00-11:00	08:00-11:00	08:00-11:00
Room	F5	F5	F5	F5

Course Title: Security in research infrastructure

ELECTIVE COURSE

Teacher: Prof. Andrea Colantoni– colantoni@unitus.it

Program: The development and organization of research are based on a system of increasingly complex and multifaceted infrastructures. These infrastructures can be subject to critical events of various kinds that can directly or indirectly compromise the safety of university students and researchers. The definition of infrastructures includes chemical, biological, and physical laboratories,
and all those facilities supporting research. This course aims to provide the technical and scientific elements to assess the potential risks associated with the safety of researchers and students within these
infrastructure.

Schedule

	Day1	**Day 2**	**Day 3**	**Day 4**
Day	15/02	16/02	18/02	
Time	TBD	TBD	TBD	
Room				

Course Title: Environmental Wellness

Teacher: Prof. Massimo Cecchini– cecchini@unitus.it

ELECTIVE COURSE

Program: The aim of the training module is to address the main risk factors for human health due to exposure to the main physical agents present in the living environment (living environment, outdoor environment, etc.) and work environment: from noise to vibrations, from lighting to the microclimate in different thermal environments. Each topic will be addressed with reference to the latest regulations
and knowledge and will be developed with a view not only to risk reduction, but also to achieving the best conditions of well-being. Particular attention will be paid to describing possible research developments in the field.

Schedule

	Day1	**Day 2**	**Day 3**	**Day 4**
Day	21/04/2026	23/04/2026	28/04/2026	30/04/2026
Time	11:00-13:00	11:00-13:00	11:00-13:00	11:00-13:00
Room	15:00-17:00	15:00-17:00	15:00-17:00	15:00-17:00

Course Title: Advanced Modeling in Energy Systems

Teacher: Prof. Marco Maggini– marco.maggini@unitus.it

ELECTIVE COURSE

Program: Modeling complex energy systems is a fundamental element of the doctoral program in Engineering for Energy and Environment. Indeed, numerical modeling methodologies allow the development of innovative technologies at a lower cost and faster than experimental investigation. The
course has the dual objective of:

- Providing students with the ability to describe an energy conversion process through a mathematical model characterized by the correct balance between complexity, mathematical tractability, and accuracy.
- Providing students with numerical and computer science tools for solving such models (e.g., CFD methodologies, solution of multiphysics models).

The topics that will be addressed concern the thermochemical modeling of complex energy systems (e.g., fuel cells) and the thermofluidynamic modeling of energy conversion systems/processes.

Schedule

	Day1	**Day 2**	**Day 3**	**Day 4**
Day	21/04	22/04	28/04	29/04
Time	16:00 – 19:00	16:00 – 19:00	16:00 – 19:00	16:00 – 19:00
Room				

Course Title: Advanced Modeling in Mechanical Systems

ELECTIVE COURSE

Teacher: Prof. Christian Iandiorio – christian.iandiorio@unitus.it e Prof. Emanuele Mingione – emanuele.mingione@unitus.it

Program: Modeling mechanical systems is a fundamental element even in a course primarily dedicated to energy and the environment. In fact, energy conversion systems very often present significant issues from the perspective of materials development and thermo-mechanical aspects. Consider, for example, the enormous complexities generated by thermal and electromagnetic loads in thermonuclear fusion reactors. The course aims to

- provide students with the ability to describe a mechanical system through a mathematical model characterized by the correct balance between complexity, mathematical tractability, and accuracy.
- Provide students with the numerical and computer tools for solving such models with particular reference to thermo-structural, fluid-structural, and electromechanical analysis.

Schedule

	Day1	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**
Day	17 Dec. 2025	18 Dec. 2025	19 Dec. 2025	12 Jan. 2026	19 Jan 2026	26 Jan 2026
Time	16.00 -18.00	16.00 -18.00	16.00 -18.00	14.30 – 16.30	14.30 – 16.30	14.30 – 16.30
Room				Computer Lab.	Computer Lab.	Computer Lab.

Course Title: Non invasive measurements in Environment

ELECTIVE COURSE

Teacher: Prof. Stefano Meloni – stefano.meloni@unitus.it

Program: Environmental measurements are of fundamental importance for monitoring the quality of our environment and for creating an environment that is increasingly resilient to disturbances and contamination introduced by human activities. The use of remote and non-invasive measurements allows the development of permanent, large-scale monitoring networks that guarantee highly valuable scientific observations. The measurement methodologies, in addition to ensuring quality data, must not
in turn constitute elements of further environmental deterioration. The course therefore aims to provide students with the knowledge necessary to develop networks and methodologies for non-invasive environmental measurements capable of effectively monitoring both air and water quality and the safety of waterways.

Schedule

	Day1	**Day 2**	**Day 3**	**Day 4**	**Day 5**	**Day 6**
Day	13/05/2025	14/05/2025	20/05/2025	21/05/2025	27/05/205	28/05/2025
Time	11:00-13:00	11:00-13:00	11:00-13:00	11:00-13:00	11:00-13:00	11:00-13:00
Room	TBD	TBD	TBD	TBD	TBD	TBD