COURSE DETAILS

"ROBOTICS "

DEGREE PROGRAMME: PRECISION LIVESTOCK FARMING

ACADEMIC YEAR 2025-2026

GENERAL INFORMATION – TEACHER REFERENCES

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GENERAL INFORMATION ABOUT THE COURSE

INTEGRATED COURSE (IF APPLICABLE): INFORMATION TECHNOLOGY FOR PRECISION LIVESTOCK FARMING
MODULE (IF APPLICABLE): ROBOTICS
SSD OF THE MODULE (IF APPLICABLE): IINF-04/A
TEACHING LANGUAGE: ENGLISH
CHANNEL (IF APPLICABLE):
YEAR OF THE DEGREE PROGRAMME (I, II, III): I
SEMESTER (I, II, ANNUAL): II
CFU: 4

REQUIRED PRELIMINARY COURSES (IF MENTIONED IN THE COURSE STRUCTURE "REGOLAMENTO")

None.

PREREQUISITES (IF APPLICABLE)

None.

LEARNING GOALS

Informing and training the students on the founding concepts of measurement theory and on the main measurement methodologies and procedures for analyzing signals in the time domain and in the amplitude domain. Providing the practical competencies for the use of sensors and transducers, basic measurement instruments, as well as of devices for automatically controlling them.

Moreover, the course aims to provide students with advanced notions related to automation and robotics, with particular attention to applications in the PLF context, and to convey practical skills for the use and management of specific control systems for robotic applications in this field.

EXPECTED LEARNING OUTCOMES (DUBLIN DESCRIPTORS)

Knowledge and understanding

The course provides students with knowledge and basic methodological tools needed to analyze the functioning of a robotic system used in PLF applications. Such tools may allow the student to grasp the causal connections among the different components that make up a robotic system in the PLF field, including sensors, control units, interface devices and manipulator, and to understand the implications of a particular design choice of these components to guarantee the correct execution of the operations envisaged by the robotic system for the particular need of the PLF domain in which it operates.

Applying knowledge and understanding

The course delivers the ability and tools needed to apply knowledge in practice, favoring the ability to use methodological tools to identify the most suitable robotic system for a specific application in the PLF context. Furthermore, it allows the students to apply methodological tools to correctly interpret the outputs of an automated system and to adopt, if necessary, the appropriate countermeasures to adapt its operation to specific needs of the PLF task at hand, that is, to solve problems related to unexpected behaviors of the robotic system.

COURSE CONTENT/SYLLABUS

LECTURES — HOURS

- **Introduction to automation and robotics — 1 hours**
- **Sensors for robotic applications — 7 hours**
  - Level sensors — 1 hour
  - Pressure sensors — 1 hour
  - Temperature sensors — 1 hour
  - Force sensors — 1 hour
  - Position sensors — 1 hour
  - Distance sensors — 1 hours
  - Vision sensors — 1 hour
- **Control systems — 7 hours**
  - Definition of a control problem — 1 hour
  - Structure and operation of a programmable logic controller (PLC) — 2 hours
  - PLC programming using State Functional Chart — 3 hours
  - SCADA systems (Supervisory Control and Data Acquisition) — 1 hour
- **Robotics — 9 hours**
  - Main kinematic structures of fixed-base manipulators — 1 hours
  - Definition of the pose of a rigid body in Cartesian space — 1 hour
  - Forward and inverse kinematics of a manipulator — 1 hour

- Taxonomy of fixed-base manipulators — 1 hour
- Kinematic structures of wheeled mobile robots — 2 hours
- Taxonomy of mobile robots: wheeled, aerial, marine, and legged robots — 1 hour
- Robotic applications in the PLF sector: milking manipulators, wheeled robots for forage distribution and automated cleaning — 2 hours

Total lecture hours: 24

PRACTICAL EXERCISES — HOURS

- **Selection of the most suitable sensors for specific robotic applications in the PLF sector — 5 hours**
- **Simulation of PLC programming using the State Functional Chart — 6 hours**
- **Identification of the most appropriate robotic kinematic structures for different tasks in PLF applications — 5 hours**

Total practical exercise hours: 16

READINGS/BIBLIOGRAPHY

Handouts provided by the teacher.

TEACHING METHODS

The teacher will use: a) lectures for approx. 60% of total hours, supported by multimedia tools (such as videos) when helpful to enhance understanding and explore the topics discussed; b) practical exercises for approx. 40% of total hours. The teacher will use a student-centered method; tutorials; practical lessons, learning by doing method. The lessons will be supported by multimedia teaching material available to students on the teacher's website, after registering for the course.

EXAMINATION/EVALUATION CRITERIA

The grade obtained contributes 50% to the final evaluation of the entire integrated course.

a) Exam type:

*For **integrated courses**, there should be one exam.*

Exam type	
written and oral	
only written	
only oral	
project discussion	
Other Three intermediate assessments are planned to be held at the beginning, middle, and end of the course, respectively. The first assessment aims to evaluate the knowledge acquired on sensors used in robotics; the second focuses on understanding control systems; and the third assesses general robotics knowledge as well as knowledge of robotics applications to PLF. Each assessment contributes one-third to the final grade. If students are unable to take one or more of the intermediate assessments, each missed assessment will be replaced by an oral examination to be scheduled after the end of the course.	x

In case of a written exam, questions refer	**Multiple choice answers**	

to: (*)	**Open answers**	
	Numerical exercises	

(*) multiple options are possible

b) Evaluation pattern:

Each intermediate assessment consists of two, open answers, questions. All assessments carry the same weight, each contributing one-third to the overall final evaluation.

The final grade is determined by the average of the scores achieved in these activities. The grade obtained contributes 50% to the final evaluation of the entire integrated course (50% INSTRUMENTATION AND MEASUREMENTS FOR LIVESTOCK FARMING and 50% ROBOTICS).

For the evaluation, the "Regulation for Guidelines_for_exams_management" approved by the Didactic Coordination Committee of the Master Degree in Precision Livestock Farming will be considered.