National University of Engineering (UNI)
School of Computer Science
Syllabus 2027-I

1. COURSE

AI363. Autonomous Systems (Elective)

2. GENERAL INFORMATION

2.1 Course	:	AI363. Autonomous Systems
2.2 Cycle	:	CS300 Cycle.
2.3 Credits	:	4
2.4 Hours	:	2 HT; 4 HP;
2.5 Duration of the period	:	16 weeks
2.6 Type of course	:	Elective
2.7 Learning modality	:	Face to face
2.8 Prerrequisites	:	AI264. Deep Learning. (7^{th} Sem)

3. PROFESSORS

Meetings after coordination with the professor

4. INTRODUCTION TO THE COURSE

This course covers principles of autonomous systems capable of independent perception, decision-making and action, including decision architectures, autonomous navigation, and safety-critical considerations.

5. GOALS

- Implement perception-decision-action pipelines
- Design motion planning systems
- Evaluate risks in safety-critical autonomous systems

6. COMPETENCES

AG-C02) Ethics: Applies ethical principles and commits to professional ethics and the standards of professional computing practice. (Usage)

AG-C09) Design and Development of Solutions: Designs, implements, and evaluates solutions for complex computing problems. (Assessment)

AG-C12) Uses systemic approaches to select, develop, apply, integrate, and manage secure computing technologies to achieve user objectives. (Assessment)

7. TOPICS

Unit 1: Autonomy Fundamentals (12 hours)	
Competences Expected: AG-C09	
Topics	**Learning Outcomes**
• Control architectures (sense-plan-act vs behavior-based) • Simultaneous Localization and Mapping (SLAM) • Bayesian filters (Kalman, Particle)	• Implement localization filters [Usar] • Evaluate control architectures [Evaluar]
Readings : [TBF05]	

Unit 2: Autonomous Decision-Making (24 hours)	
Competences Expected: AG-C09	
Topics	**Learning Outcomes**
• End-to-end neural control • Path planning (A*, RRT*) • Reinforcement learning in robotics	• Train vehicular control networks [Usar] • Design hybrid logic-AI systems [Evaluar]
Readings : [Boj+16]	

Unit 3: Safety & Ethics (8 hours)	
Competences Expected: AG-C09	
Topics	**Learning Outcomes**
• Cascading failures in autonomous systems • Ethical "kill switch" mechanisms • Regulations for autonomous vehicles	• Analyze critical failure cases [Familiarizarse] • Implement basic safeguards [Usar]
Readings : [Amo+16]	

8. WORKPLAN

8.1 Methodology

Individual and team participation is encouraged to present their ideas, motivating them with additional points in the different stages of the course evaluation.

8.2 Theory Sessions

The theory sessions are held in master classes with activities including active learning and roleplay to allow students to internalize the concepts.

8.3 Practical Sessions

The practical sessions are held in class where a series of exercises and/or practical concepts are developed through problem solving, problem solving, specific exercises and/or in application contexts.

9. EVALUATION SYSTEM

Theory Sessions:
The theory sessions are held in master classes with activities including active learning and roleplay to allow students to internalize the concepts.

Lab Sessions:
In order to verify their competences, several activities including active learning and roleplay will be developed during lab sessions.

Oral Presentations:
Individual and team participation is encouraged to present their ideas, motivating them with additional points in the different stages of the course evaluation.

Reading:
Throughout the course different readings are provided, which are evaluated. The average of the notes in the readings is considered as the mark of a qualified practice. The use of our virtual campus allows each student to access the course information, and interact outside the classroom with the teacher and with the other students.

The final grade NF depends on the following grades:

- PE: Partial Exam.
- FE: Final Exam.
- P: Permanent Evaluation (Average of practical work and graded assignments).

The final grade NF is calculated as follows:

$$NF = \frac{PE + FE + P}{3}$$

10. BASIC BIBLIOGRAPHY

[TBF05] Sebastian Thrun, Wolfram Burgard, and Dieter Fox. *Probabilistic Robotics*. MIT Press, 2005.

[Amo+16] Dario Amodei et al. "Concrete Problems in AI Safety". In: *NeurIPS*. 2016.

[Boj+16] Mariusz Bojarski et al. "End to End Learning for Self-Driving Cars". In: *arXiv:1604.07316* (2016).