Universidad de Alcalá

TEACHING GUIDE

Intelligent Vehicles

Master in
Telecommunication Engineering

Universidad de Alcalá

Academic Year 2021/2022

2nd Year - 1st and 2nd Semester

Approved by the School Board on July 6, 2021

TEACHING GUIDE

Course Name:	**Intelligent Vehicles**
Code:	**201837**
Master in:	**Telecommunication Engineering**
Department and area:	**Automática** **Automation and Systems Engineering**
Type:	**Optional (Specialized)**
ECTS Credits:	**6.0**
Year and semester:	**2nd Year, 1st and 2nd Semester**
Teachers:	Check on http://www.aut.uah.es
Tutoring schedule:	To be announced on the first day
Language:	Spanish / English Friendly

1. COURSE SUMMARY

The aim of the Intelligent Vehicles course is to capacitate the student in the basic principles of modelling and control for autonomous vehicles or highly advanced driving assistance systems that require to control the vehicle's trajectory (stability control, park assistance, avoidance maneouvres, etc.)

This subject promotes the study and understanding of basic concepts about modelling and design of control systems for vehicles. The main topics will be: Lateral control systems, longitudinal control systems and their integration.

Lateral control systems: Introduction to dynamics, control and modelling of the lateral movement of a vehicle. The components that determine the lateral movement of a vehicle will be described (basic concepts about wheels, springs, steering). Finally some controllers will be described.

Longitudinal control systems: Sensors, requirements, control variables and kinds of longitudinal controllers will be studied. Finally the most used models and control strategies will be presented.

For a good academic performance, it is advisable medium programming skills on C/C++ on Linux and a basic level on control.

2. SKILLS

Basic, Generic and Cross Curricular Skills.

This course contributes to acquire the following generic skills, which are defined in the Section 3 of the Annex to the Orden CIN/355/2009:

en_CGT1 - Skill of analysis and synthesis.

en_CGT2 - Skill of organization and planning.

en_CGT4 - Skill to make decisions.

en_CGT5 - Skill to adapt to new situations.

en_CB6 - To have and understand knowledges that provide a basis or opportunity to be original in the development and/or application of ideas, often in a research context

en_CB7 - That students know how to apply the acquired knowledge and problem-solving abilities in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their area of study.

en_CB8 - That students be able to integrate knowledge and face the complexity of making judgements based on incomplete or limited information that includes reflections on the social and ethical responsibilities linked to the application of their knowledge and judgements.

en_CB9 - That students be able to communicate their findings and the ultimate knowledge and reasons behind them to specialized and non-specialized audiences in a clear and unambiguous manner.

en_CT1 - Troubleshooting skill

en_CT6 - Ability to integrate knowledge from different scientific areas

Learning Outcomes

After succeeding in this subject the students will be able to:

RA1. Understanding of the design of a controller for an autonomous vehicle, its components, types and basic concepts.

RA2. Capacity to analyze control systems for autonomous vehicles, including sensors.

RA3. Capacity to write code for some of the modules of an autonomous vehicle controller.

3. CONTENTS

Contents Blocks	Total number of hours
Introduction to intelligent vehicles	2 hours
Vehicle modelling: kinematic and dynamic models. Introduction to control.	10 hours
Probabilistic robotics. Gaussian Filters: Kalman, Extended Kalman, Unscented Kalman. Non-Gaussian Filters: Particle Filter.	15 hours
Introduction to Deep Learning: NN, CNN. Common Achitectures.	15 hours
Deep Learning applications: RNN, LSTM, NLP, GANs, Transformers, Reinforcement Learning.	18 hours

4. TEACHING - LEARNING METHODOLOGIES. FORMATIVE ACTIVITIES.

4.1. Credits Distribution

Number of on-site hours:	60 hours
Number of hours of student work:	90
Total hours	150

4.2. Methodological strategies, teaching materials and resources

Lectures	Methodology: Master classes with theory and practical examples. Student involvement in the class will be encouraged. Resources: blackboard, audiovisual media, Internet, bibliography.
Practical exercises resolution	Methodology: Master classes and team work on practical exercises resolution. Small groups problem discussion. Oral and writen exposition. Resources: blackboard, audiovisual media, Internet, bibliography.
Laboratory	Methodology: Work in up to 2 people groups with the laboratory equipement. Exposition and discussion of practical examples. Common resolution/approach to the problem. Group implementation and defence in a presentation. Resources: blackboard, audiovisual media, Internet, bibliography.
Tutorial Sesions	Individual/Group tutorial sessions.
Non-presential activities	Exercises resolution, bibliography search,etc.

5. ASSESSMENT: procedures, evaluation and grading criteria

Preferably, students will be offered a continuous assessment model that has characteristics of formative assessment in a way that serves as feedback in the teaching-learning process.

5.1. PROCEDURES

The evaluation must be inspired by the criteria of continuous evaluation (Learning Assesment Guidelines, LAG, art 3). However, in compliance with the regulations of the University of Alcalá, an alternative process of final evaluation is made available to the student in accordance with the Learning Assesment Guidelines (last modified in the Governing Board of October 31, 2019) as indicated in Article 10, students will have a period of fifteen days from the start of the course to request in writing to the Director of the Polytechnic School their intention to take the non-continuous evaluation model adducing the reasons that they deem convenient. The evaluation of the learning process of all students who do not apply for it or are denied it will be done, by default, according to the continuous assessment model. The student has two calls to pass the subject, one ordinary and one extraordinary.

Ordinary Call

Continous Assessment:

In the ordinary call, all the students will be evaluated in countinuous evaluation. This will consist of two partial tests and the evaluation of the laboratory. Students following continuous evaluation that fail, can not attend to the final evaluation of the ordinary call. Students not attending to any of the partial tests or not delivering two or more of the proposed laboratory practices will be considered as no show.

Assessment through final exam:

In the first two weeks from the start of the course or from registration (whichever is last), those students with a justified cause can present a request to be evaluated through final evaluation to the Dean of the School. Upon approval of this request, these students will be evaluated in a final exam that will include

theorical and practical exercises.

Extraordinary Call

The procedure will be the same as that described for the assessment by means of a final exam in the ordinary call.

5.2. EVALUATION

EVALUATION CRITERIA

The assessment criteria measure the level in which the competences have been acquired by the student. For that purpose, the following are defined::

CE1. The student shows capacity and initiative to resolve practical problems in the area of control systems design for autonomous driving.

CE2. The student is able to implement an autonomous driving control module.

CE3. The student has acquired the different concepts about design, analysis and implementation of control systems for autonomous driving.

GRADING TOOLS

The work of the student is graded in terms of the assessment criteria above, through the following tools:

- Intermediate Evaluation Test (IET): Practical exercises resolution about control systems implementation.
- Laboratory works (LW): Practical problems resolution in the laboratory.
- Final Evaluation Test (FET): Practical exercises resolution about control systems implementation.

GRADING CRITERIA

In the ordinary call-continuous assessment the relationship between the competences, learning outcomes, criteria and evaluation instruments is as follows.

Skill	Learning Outcomes	Evaluation criteria	Grading Tool	Contribution to the final mark
CB6-10, CT1, CT4, CT6, CG1,CG2, CG4-5	RA1, RA2	CE1, CE3	IET	30%
CB6-10, CT1-6, CG1-5	RA3	CE2	LW	30%
CB6-10, CT1, CT4, CT6, CG1, CG2, CG4-5	RA1,RA2	CE1, CE3	FET	40%

In the ordinary call-final evaluation, the relationship between the competences, learning outcomes, criteria and evaluation instruments is as follows.

Skill	Learning Outcomes	Evaluation criteria	Grading Tool	Contribution to the final mark
CB6-10, CT1, CT4, CT6, CG1, CG2, CG4-5	RA1, RA2, RA3	CE1, CE2, CE3 CE6	FET	100%

Extraordinary call

In the case of the extraordinary call, the same percentages that have been established in the case of the evaluation by means of a final exam will be maintained, giving the option of making the PL or maintaining the mark obtained in the EL (continuous evaluation) or in the PEF (final evaluation), according to the student's decision. In any case, the PL will be made by those students who have not done it in the final exam option in the ordinary call.

6. BIBLIOGRAPHY

6.1. Basic Bibliography

- Learning material provided through blackboard.

6.2. Additional Bibliography

- Azim Eskandarian. Handbook of Intelligent Vehicles. Springer-Verlag London 2012.
- Neil Matthew and Richard Stones. Beginning Linux Programming, 4th Edition. Wiley.

Disclosure Note

The University of Alcalá guarantees to its students that, if due to health requirements the competent authorities do not allow the total or partial attendance of the teaching activities, the teaching plans will achieve their objectives through a teaching-learning and evaluation methodology in online format, which will return to the face-to-face mode as soon as these impediments cease.