

**1. General information****Course:** PROGRAMMING MOBILE ROBOTS**Type:** ELECTIVE**Degree:** 352 - UNDERGRADUATE DEGREE PROGRAMME IN MECHANICAL ENGINEERING (AB)**Center:** 605 - SCHOOL OF INDUSTRIAL ENGINEERS. AB**Year:** 4**Main language:** English**Use of additional languages:****Web site:****Code:** 56345**ECTS credits:** 6**Academic year:** 2021-22**Group(s):** 11**Duration:** C2**Second language:****English Friendly:** N**Bilingual:** Y**Lecturer:** ANTONIO FERNANDEZ CABALLERO - Group(s): 11

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2. Pre-Requisites**Pre-requisites**

The student must have prior basic knowledge of computers and programming.

Therefore, and to properly follow this course, it is recommended that students have previously studied the subject 'Computer Fundamentals'.

3. Justification in the curriculum, relation to other subjects and to the profession**Justification in the study plan, and relation with other courses and the profession**

The concepts and skills provided in this course are part of the reference MECHATRONICS and thus complement the fourth year electives called 'Pneumatic Systems', 'Sensors and Actuators', 'Virtual Instrumentation' and 'Mechanics of Robots and Manipulators'.

The course is initially based on the programming concepts learned in the subject of 'Computer Basics' as well as some of Robotics concepts seen on the subject 'Industrial Robotics'.

This course provides the concepts and basic skills that an Industrial Engineer specializing in Mechanics requires in relation to the programming of sensors, actuators and control of mobile robots.

4. Degree competences achieved in this course**Course competences**

Code	Description
A07	Knowledge of Information Technology and Communication (ITC).
A12	Knowledge of basic materials and technologies that assist the learning of new methods and theories and enable versatility to adapt to new situations.
F25	Knowledge of the fundamentals of mobile robotics and their models of reasoning with the objective of knowing how to use specific techniques in terms of the problem to be resolved.

5. Objectives or Learning Outcomes**Course learning outcomes**

Description

Programming of a simulator for mobile robots and a real mobile robot, fundamentally in the aspects related to autonomous navigation

Additional outcomes

Knowledge of the internal workings of mobile robots (sensors, actuators and control).

Ability in the handling of computer libraries.

Ability in oral and written communication.

Ability in teamwork.

6. Units / Contents

Unit 1: Mobile Robots

Unit 2: Mobile Robot Architectures

Unit 3: Robot Behaviours

Unit 4: Robot Locomotion

Unit 5: Robot Sensing

Unit 6: Robot Vision

Unit 7: Motion Planning

Unit 8: Localisation and Mapping
Unit 9: Robot Navigation
Unit 10: Learning in Mobile Robots
Unit 11: Multi-Robot Systems
Unit 12: Human-Robot Interaction

7. Activities, Units/Modules and Methodology							
Training Activity	Methodology	Related Competences (only degrees before RD 822/2021)	ECTS	Hours	As	Com	Description
Class Attendance (theory) [ON-SITE]	Lectures	A07 A12 F25	0.96	24	Y	N	The teacher will focus on the topic and explain its fundamental contents.
Computer room practice [ON-SITE]	Practical or hands-on activities	A07 A12 F25	0.48	12	Y	N	It consists in the realization, in small groups, of practical exercises and simulations with specific software.
Project or Topic Presentations [ON-SITE]	Group Work	A07 A12 F25	0.24	6	Y	N	It will consist of the exposition of the works carried out in the practices.
Progress test [ON-SITE]	Assessment tests	A07 A12 F25	0.4	10	Y	N	They will consist of tests related to both theoretical aspects and practical application.
Final test [ON-SITE]	Assessment tests	A07 A12 F25	0.16	4	Y	Y	It will deal with the whole subject evaluating its theoretical and practical aspects.
Workshops or seminars [ON-SITE]	Workshops and Seminars	A07 A12 F25	0.16	4	Y	N	It will consist of two seminars for describing the software tools necessary to undertake the practices.
Study and Exam Preparation [OFF-SITE]	Self-study	A07 A12 F25	3.6	90	Y	N	
Total:			6	150			
Total credits of in-class work: 2.4				Total class time hours: 60			
Total credits of out of class work: 3.6				Total hours of out of class work: 90			

As: Assessable training activity

Com: Training activity of compulsory overcoming (It will be essential to overcome both continuous and non-continuous assessment).

8. Evaluation criteria and Grading System			
Evaluation System	Continuous assessment	Non-continuous evaluation*	Description
Oral presentations assessment	10.00%	10.00%	The effort made by the student in exhibiting the work done in the internship will be valued.
Assessment of activities done in the computer labs	25.00%	25.00%	The work carried out by the student during the practices will be valued on the basis of a demonstration of the functioning of the programs and the documentation delivered in the written reports.
Practicum and practical activities reports assessment	15.00%	15.00%	Both the content of the work presented and the clarity of the written expression will be valued.
Test	50.00%	50.00%	Up to four progress tests will be taken. Each of these progress tests must be passed with at least 4 out of 10. It is essential to obtain an average of 4 out of 10 or more in all the progress tests.
Total:	100.00%	100.00%	

According to art. 4 of the UCLM Student Evaluation Regulations, it must be provided to students who cannot regularly attend face-to-face training activities the passing of the subject, having the right (art. 12.2) to be globally graded, in 2 annual calls per subject, an ordinary and an extraordinary one (evaluating 100% of the competences).

Evaluation criteria for the final exam:

Continuous assessment:

The final exam includes all the subjects not passed during the course.

Non-continuous evaluation:

The final exam includes all the subjects of the course.

Specifications for the resit/retake exam:

The retake exam consists of a final exam that covers the whole subject.

No note is kept of the activities carried out during the course.

Specifications for the second resit / retake exam:

The second retake exam consists of a final exam that covers the whole subject.

No note is kept of the activities carried out during any previous course.

9. Assignments, course calendar and important dates	
Not related to the syllabus/contents	
Hours	hours

Computer room practice [PRESENCIAL][Practical or hands-on activities]	12
Project or Topic Presentations [PRESENCIAL][Group Work]	6
Progress test [PRESENCIAL][Assessment tests]	10
Final test [PRESENCIAL][Assessment tests]	4
Workshops or seminars [PRESENCIAL][Workshops and Seminars]	90
Study and Exam Preparation [AUTÓNOMA][Self-study]	4
Unit 1 (de 12): Mobile Robots	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	2
Unit 2 (de 12): Mobile Robot Architectures	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	2
Unit 3 (de 12): Robot Behaviours	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	2
Unit 4 (de 12): Robot Locomotion	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	2
Unit 5 (de 12): Robot Sensing	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	2
Unit 6 (de 12): Robot Vision	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	2
Unit 7 (de 12): Motion Planning	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	2
Unit 8 (de 12): Localisation and Mapping	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	2
Unit 9 (de 12): Robot Navigation	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	2
Unit 10 (de 12): Learning in Mobile Robots	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	2
Unit 11 (de 12): Multi-Robot Systems	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	2
Unit 12 (de 12): Human-Robot Interaction	
Activities	Hours
Class Attendance (theory) [PRESENCIAL][Lectures]	2
Global activity	
Activities	hours
Workshops or seminars [PRESENCIAL][Workshops and Seminars]	90
Final test [PRESENCIAL][Assessment tests]	4
Project or Topic Presentations [PRESENCIAL][Group Work]	6
Computer room practice [PRESENCIAL][Practical or hands-on activities]	12
Progress test [PRESENCIAL][Assessment tests]	10
Class Attendance (theory) [PRESENCIAL][Lectures]	24
Study and Exam Preparation [AUTÓNOMA][Self-study]	4
Total horas: 150	

10. Bibliography and Sources						
Author(s)	Title/Link	Publishing house	Citv	ISBN	Year	Description
H. Choset, K.M. Lynch, S. Hutchinson, G. Kantor, W. Burgard, L.E. Kavraki, S. Thrun	Principles of Robot Motion: Theory, Algorithms, and Implementations	The MIT Press		978-0-272-03327-5	2005	
A. Ollero	Robótica: Manipuladores y Robots Móviles	Marcombo		978-8-426-71313-1	2005	Chapters 2 and 7-12
B. Siciliano, L. Scavico, L. Villani, G. Oriolo	Robotics: Modelling, Planning and Control	Springer		978-1-84628-641-4	2009	Chapters 5 and 11-12
F. Fahimi	Autonomous Robots: Modeling, Path Planning, and Control	Springer		978-0-387-09537-0	2009	Chapter 6
F. Torres, J. Pomares, P. Gil, S.T. Puente, R. Aracil	Robots y Sistemas Sensoriales	Prentice Hall		84-205-3574-5	2002	Chapters 6-7, 11 and 14
	http://journalfieldrobotics.org/Home.html					
	http://www.elsevier.com/wps/find/journaldescription.cws_home/505622/description					
S. Thrun, W. Burghard, D. Fox	Probabilistic Robotics	The MIT Press		978-0-262-20162-9	2005	Chapters 2 and 7-12

