Teaching Guide				
Identifying Data				2013/14
Subject (*)	Robótica		Code	614G01098
Study programme	Grao en Enxeñaría Informática			
Descriptors				
Cycle	Period	Year	Type	Credits
Graduate	2nd four-month period	Fourth	Optativa	6
Language	SpanishEnglish			
Prerequisites				
Department	Computación			
Coordinador	Santos Reyes, Jose	E-mail	jose.santos@udc.es	
Lecturers	Becerra Permuy, Jose Antonio Bellas Bouza, Francisco Javier Santos Reyes, Jose	E-mail	jose.antonio.becerra.permuy@udc.es francisco.bellas@udc.es jose.santos@udc.es	
Web				
General description	Na materia de Robótica estúdanse os principais conceptos de robótica autónoma, facendo énfase no deseño automático de estratexias de control. Para iso, o contido da materia parte das estratexias clásicas de control para chegar ás máis actuais baseadas en conceptos da intelixencia computacional, tales como as redes neuronais, os algoritmos evolutivos e a aprendizaxe por reforzo.			

Study programme competences	
Code	Study programme competences
A20	Coñecemento e aplicación dos principios fundamentais e técnicas básicas da programación paralela, concorrente, distribuída e de tempo real.
A21	Coñecemento e aplicación dos principios fundamentais e técnicas básicas dos sistemas intelixentes e a súa aplicación práctica.
A42	Capacidade para coñecer os fundamentos, paradigmas e técnicas propias dos sistemas intelixentes, e analizar, deseñar e construír sistemas, servizos e aplicacións informáticas que utilicen as ditas técnicas en calquera ámbito de aplicación.
A43	Capacidade para adquirir, obter, formalizar e representar o coñecemento humano nunha forma computable para a resolución de problemas mediante un sistema informático en calquera ámbito de aplicación, particularmente os relacionados con aspectos de computación, percepción e actuación en ambientes ou contornos intelixentes.
B1	Capacidade de resolución de problemas
B2	Traballo en equipo
B3	Capacidade de análise e síntese
B6	Toma de decisións
B7	Preocupación pola calidade
B9	Capacidade para xerar novas ideas (creatividade)
C6	Valorar criticamente o coñecemento, a tecnoloxía e a información dispoñible para resolver os problemas cos que deben enfrontarse.
C8	Valorar a importancia que ten a investigación, a innovación e o desenvolvemento tecnolóxico no avance socioeconómico e cultural da sociedade.

Learning outcomes			
Subject competencies (Learning outcomes)	Study programme competences		
Know the problems to tackle when an autonomous robotic control system is developed	A21 A42	B1 B3 B9	C8

Develop an autonomous control system for its operation in a real environment	A21 A42 A43	B1 B2 B6 B7 B9	C8
Know the problems of knowledge representation in autonomous robotics	A43	B9	C8
Know the problems of sensing and actuation in systems that operate in the real world and real time	A20	B1 B2 B6 B7	C8
Know the non-resolved problems in autonomous robotics	A21 A42	B9	C6 C8

Contents	
Topic	**Sub-topic**
Introduction to autonomous robotics	¿What is an autonomous robot? Classic control and cybernetics Artificial intelligence Bio-inspired robotics
Elements of a robotic system	Real environments Embodiment Sensors Actuators Autonomous robot control: - knowledge vs. behavior - reactive vs. deliberative
Knowledge-based robotics	Knowledge representation Modeling of the environment. Maps. Scheduling
Behavior-based robotics	Antecedents Reactive behaviours Implementation of behaviours.
Hybrid approximations	Deliberative and reactive Main hybrid architectures
Learning in autonomous robotics	Learning in classifier systems reinforcement learning: Q-learning Combination of reinforcement and connectionist learning
Evolutionary robotics	Evolutionary algorithms Main problems to solve Simulation vs. reality Hybrid approximations: evolution and learning
Multirobot systems	Coordination Composition of the team How to obtain the coordinated control

Planning			
Methodologies / tests	**Ordinary class hours**	**Student?s personal work hours**	**Total hours**

Laboratory practice	21	21	42
Mixed objective/subjective test	3	18	21
Supervised projects	0	40	40
Guest lecture / keynote speech	21	21	42
Personalized attention	5	0	5
(*)The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
Methodologies	**Description**
Laboratory practice	Lab. sessions in which the design, implementation and validation of the control system of an autonomous robot in a real or simulated robot, under the supervision of a teacher.
Mixed objective/subjective test	Realization of objective tests about the theoretical contents of the subject
Supervised projects	Programming exercises that must be developed using a robotic simulator. These exercises will be carried out in an autonomous way and their progress will be supervised by the teachers
Guest lecture / keynote speech	Oral exposition by the teachers of the theory of the subject.

Personalized attention	
Methodologies	**Description**
Laboratory practice Supervised projects	During the lab practices and tutorials, the student can consult the teacher all the doubts that appear about the realization of the formulated practical problem or about the use of the simulator or the real robot. Supervised projects: It is recommendable the use of a personal assistance in these activities to resolve conceptual doubts or procedures than can appear during the resolution of the practical problems. Also, the personal assistance will be focused on in the explanation, by the student, of the proposed solution.

Assessment		
Methodologies	**Description**	**Qualification**
Laboratory practice	The weekly work of the student will be assessed, in the practical classes, by means of the evaluation of the progress of the weekly proposed exercixes	30
Mixed objective/subjective test	Objective test that will consist of an individual exam (written exam) about the theoretical contents of the subject. One or several tests could be performed depending on the course development.	50
Supervised projects	Different projects will be proposed along the course that must be carried out in an autonomous way by the student and that will be presented and explained to the teachers afterwards.	20

Assessment comments
The continuous supervision of the student's progress will have a 10% weight in the global qualification, distributed between the Laboratory Practice and the Supervised Projects

Sources of information	
Basic	- Bekey, A. (2005). Autonomous Robots. MIT Press - Arkin, R.C. (1998). Behavior Based Robotics. MIT Press - Santos, J., Duro, R.J. (2005). Evolución Artificial y Robótica Autónoma. RA-MA - Mataric, Maja J. (2007). The Robotics Primer. MIT Press

Complementary	- Santos, J. (2007). Vida Artificial. Realizaciones Computacionales. ServicioPublicaciones UDC - Floreano, D. and Mattiussi, C. (2008). Bio-Inspired Artificial Intelligence. Tema 7. MIT Press - Salido, J. (2009). Cibernética aplicada. Robots educativos. Ra-Ma - Nolfi, S., Floreano, D. (2000). Evolutionary Robotics. MIT Press - Thurn, S., Burgard, W., Fox, D. (2005). Probabilistic Robotics. MIT Press - Sutton, R.S., Burton A.G. (1998). Reinforcement Learning. MIT Press - Pfeifer, R. and Scheier, C. (1999). Understanding Intelligence. MIT Press

Recommendations
Subjects that it is recommended to have taken before
Subjects that are recommended to be taken simultaneously
Subjects that continue the syllabus
Sistemas Intelixentes/614G01020 Representación do Coñecemento e Razoamento Automático/614G01036 Desenvolvemento de Sistemas Intelixentes/614G01037 Aprendizaxe Automático/614G01038
Other comments

(*)The teaching guide is the document in which the URV publishes the information about all its courses. It is a public document and cannot be modified. Only in exceptional cases can it be revised by the competent agent or duly revised so that it is in line with current legislation.