

## 220135 - Fundamentals of Robotics

Coordinating unit:	205 - ESEIAAT - Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit:	707 - ESAII - Department of Automatic Control
Academic year:	2019
Degree:	BACHELOR'S DEGREE IN INDUSTRIAL DESIGN AND PRODUCT DEVELOPMENT ENGINEERING (Syllabus 2010). (Teaching unit Optional) BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional) BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional) BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional) BACHELOR'S DEGREE IN AUDIOVISUAL SYSTEMS ENGINEERING (Syllabus 2009). (Teaching unit Optional) BACHELOR'S DEGREE IN TEXTILE TECHNOLOGY AND DESIGN ENGINEERING (Syllabus 2009). (Teaching unit Optional) BACHELOR'S DEGREE IN INDUSTRIAL TECHNOLOGY ENGINEERING (Syllabus 2010). (Teaching unit Optional) BACHELOR'S DEGREE IN AEROSPACE TECHNOLOGY ENGINEERING (Syllabus 2010). (Teaching unit Optional) BACHELOR'S DEGREE IN AEROSPACE VEHICLE ENGINEERING (Syllabus 2010). (Teaching unit Optional)
ECTS credits:	3
Teaching languages:	English

### Teaching staff

Coordinator:	Jaume Figueras
Others:	Laureano Tinoco Carlos Tapiello

### Teaching methodology

The course is divided into parts:  
Theory classes  
Laboratory sessions  
Self-study (including proposed exercises and activities).

In the theory classes, teachers will introduce the theoretical basis of the concepts, methods and results and illustrate them with examples appropriate to facilitate their understanding.  
In the lab sessions, teachers guide students in applying theoretical concepts to solve problems, always using critical reasoning. Students will be able to robotize a proposed industrial task, working in pairs in the lab, in order to promote contact and use the basic tools needed to solve problems.  
Students, independently, need to work on the materials provided by teachers in order to fix and assimilate the concepts. The teachers provide the syllabus and monitoring of activities by ATENEA.

### Learning objectives of the subject

The course wants to introduce students to theoretical and practical aspects of the industrial robotics, with special emphasis on the manipulating robots.  
Students should after this course know different applications of robotic systems as well as to be able to describe mechanical robotic structures and systems. They should also be familiar with the involved mathematics and with the simple robot control systems.

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The main objective of the course is to provide students with the skills and the needed knowledge to use industrial robots in their future professional performance.

### Study load

Total learning time: 75h	Hours large group:	30h	40.00%
	Hours medium group:	0h	0.00%
	Hours small group:	0h	0.00%
	Guided activities:	0h	0.00%
	Self study:	45h	60.00%

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### Content

<p>Module 1: Introduction</p>	<p>Learning time: 7h 30m Theory classes: 3h Self study : 4h 30m</p>
<p>Description:</p> <ol style="list-style-type: none"> <li>1. Brief history</li> <li>2. Classification of robots</li> <li>3. Elements of robots, joints, links, actuators, and sensors</li> </ol>	
<p>Module 2: Some involved mathematics</p>	<p>Learning time: 15h Theory classes: 6h Self study : 9h</p>
<p>Description:</p> <ol style="list-style-type: none"> <li>4. Position and orientation of a rigid body</li> <li>5. Homogeneous transformations</li> <li>6. Introduction to D-H parameters and its physical significance, orientation of Gripper</li> <li>7. Direct and inverse kinematics serial robots</li> <li>8. Examples of kinematics of common serial manipulators.</li> </ol>	
<p>Module 3: Principles of Robot Control</p>	<p>Learning time: 12h 30m Theory classes: 5h Self study : 7h 30m</p>
<p>Description:</p> <ol style="list-style-type: none"> <li>9. Planning of trajectory.</li> <li>10. Calculation of a link velocity and acceleration.</li> <li>11. Calculation of reactions forces.</li> <li>12. Trajectory-following control.</li> </ol>	

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<p>Module 4: Robot Programming</p>	<p>Learning time: 35h Theory classes: 14h Self study : 21h</p>
<p>Description: 13. Robot programming methods 14. Robot programming languages 15. Requirements of a programming robots system The robot as a multitasking system: - Flow Control - Task Control</p> <p>Related activities: To program a robot in order to robotize a proposed industrial task included in an automated production system.</p>	
<p>Module 5: System integration and robotic applications</p>	<p>Learning time: 5h Theory classes: 2h Self study : 3h</p>
<p>Description: 16. Robot system integration. 17. Robotic applications.</p>	

### Qualification system

Final Exam (written and individual): 45%

Lab work (in groups): 30%

Deliverable exercises: 25%

All those students who can not attend the partial exam, or if you want to improve your result, you will have the option to recover it through an additional written test that will be made the same day fixed for the final examination. The qualification of this test Conversion will be between 0 and 10, and replace the partial exam as long as it is superior.

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### Bibliography

#### Basic:

Corke, Peter I. Robotics, vision and control : fundamental algorithms in Matlab. 1st ed. New York: Springer, 2011. ISBN 9783642201431.

Craig, John J. Introduction to robotics : mechanics and control. 3rd ed. Upper Saddle Hall: Pearson Educacion Internacional, cop. 2005. ISBN 0201543613.

RAPID Reference Manual. System Data Types and Routines On-line [on line]. Västerås: ABB Robotics Products AB, [2013?] Available on: <[http://rab.ict.pwr.wroc.pl/irb1400/datasys\\_rev1.pdf](http://rab.ict.pwr.wroc.pl/irb1400/datasys_rev1.pdf)>.

#### Complementary:

Fu, K. S; González, Rafael C; Lee, C.S.G. Robótica : Control, detección, visión e inteligencia. Madrid: McGraw-Hill, 1988. ISBN 8476152140.

Saha, S. K. Introducción a la robótica. México: McGraw-Hill, 2010. ISBN 9786071503138.