

## 230105 - SAM - Sensors, Actuators and Microcontrollers in Mobile Robots

Coordinating unit: 230 - ETSETB - Barcelona School of Telecommunications Engineering  
 Teaching unit: 710 - EEL - Department of Electronic Engineering  
 Academic year: 2019  
 Degree: BACHELOR'S DEGREE IN TELECOMMUNICATIONS SCIENCE AND TECHNOLOGY (Syllabus 2010). (Teaching unit Optional)  
 BACHELOR'S DEGREE IN ELECTRONIC SYSTEMS ENGINEERING (Syllabus 2009). (Teaching unit Optional)  
 BACHELOR'S DEGREE IN TELECOMMUNICATIONS TECHNOLOGIES AND SERVICES ENGINEERING (Syllabus 2015). (Teaching unit Optional)  
 ECTS credits: 6 Teaching languages: Catalan, Spanish, English

### Teaching staff

Coordinator: Sergio Bermejo Sánchez

Others:

### Prior skills

Analogue and digital electronics concepts. Microprocessors.

### Learning objectives of the subject

The subject gives an introduction to the mobile autonomous robotics wherein microcontrollers are a part of the strategies of control of the electronic system. The basic concepts of different types of sensors and actuadores of habitual use in robotics as well as the basic strategies of control are analysed including his achievement, with special emphasis on the adaptive and action;reaction strategies of control. In the laboratory, a prototype of an autonomous robot will be mounted.

### Study load

Total learning time: 150h	Hours large group:	26h	17.33%
	Hours small group:	26h	17.33%
	Self study:	98h	65.33%

## 230105 - SAM - Sensors, Actuators and Microcontrollers in Mobile Robots

### Content

#### 1. Introduction to mobile autonomous robotics (2 hours)

Degree competences to which the content contributes:

##### 1.1. Basic concepts

Degree competences to which the content contributes:

##### 1.2. Design considerations

Degree competences to which the content contributes:

##### 1.3. Parts of a robot

Degree competences to which the content contributes:

##### 1.4. Robot control

Degree competences to which the content contributes:

#### 2. Sensors (6 hours)

Degree competences to which the content contributes:

##### 2.1. Concepts. Introduction

Degree competences to which the content contributes:

##### 2.2. Types of sensors: Pressure/contact. Resistive position. Infrared. Light. Ultrasound. Magnetic

Degree competences to which the content contributes:

##### 2.3. Signal conditioning. Basic circuits

Degree competences to which the content contributes:

## 230105 - SAM - Sensors, Actuators and Microcontrollers in Mobile Robots

### 2.4. Use of A/D and D/A converters

Degree competences to which the content contributes:

### 3. Actuators (4 hours)

Degree competences to which the content contributes:

#### 3.1. DC Motors

Degree competences to which the content contributes:

#### 3.2. Gears

Degree competences to which the content contributes:

#### 3.3. Pulse Width Modulation (PWM)

Degree competences to which the content contributes:

#### 3.4. Stepper motors

Degree competences to which the content contributes:

#### 3.5. Servomotors

Degree competences to which the content contributes:

### 4. Microcontrolador architecture (8 hours)

Degree competences to which the content contributes:

#### 4.1. Introduction

Degree competences to which the content contributes:

## 230105 - SAM - Sensors, Actuators and Microcontrollers in Mobile Robots

### 4.2. Blocks diagram

Degree competences to which the content contributes:

### 4.3. Memory

Degree competences to which the content contributes:

### 4.4. Input/output ports

Degree competences to which the content contributes:

### 4.5. Timers/counters

Degree competences to which the content contributes:

### 4.6. A/D conversion

Degree competences to which the content contributes:

### 4.7. Interrupts

Degree competences to which the content contributes:

### 4.8. Instruction set and addressing modes

Degree competences to which the content contributes:

### 5. Communications between systems (2 hours)

Degree competences to which the content contributes:

#### 5.1. Serial line

Degree competences to which the content contributes:

## 230105 - SAM - Sensors, Actuators and Microcontrollers in Mobile Robots

### 5.2. Infrared and wireless connections

Degree competences to which the content contributes:

### 6. Control systems. Algorithms (4 hours)

Degree competences to which the content contributes:

#### 6.1. Control basis and principles

Degree competences to which the content contributes:

#### 6.2. Control systems and their stability

Degree competences to which the content contributes:

#### 6.3. PID controllers

Degree competences to which the content contributes:

#### 6.4. Introduction to adaptive control

Degree competences to which the content contributes:

#### 6.5. Active learning based algorithms

Degree competences to which the content contributes:

#### 6.6. Inductive learning in automatas

Degree competences to which the content contributes:

#### 6.7. Reinforcement learning algorithms

Degree competences to which the content contributes:

## 230105 - SAM - Sensors, Actuators and Microcontrollers in Mobile Robots

### 7. Autonomous navigation (4 hours)

Degree competences to which the content contributes:

#### 7.1. Basic requirements

Degree competences to which the content contributes:

#### 7.2. Environment maps construction

Degree competences to which the content contributes:

#### 7.3. Environment maps abstraction

Degree competences to which the content contributes:

#### 7.4. Several architectures examples (neural nets, fuzzy logic, biological based...)

Degree competences to which the content contributes:

### Qualification system

The evaluation of the subject is obtained as a 100 % of a robotics project realised within the laboratory divided into diverse phases in a work continued along the course and his later presentation in public.

## 230105 - SAM - Sensors, Actuators and Microcontrollers in Mobile Robots

### Bibliography

#### Basic:

McComb, G.. Robot builder's bonanza. 4th ed. New York [etc.]: McGraw-Hill, 2011. ISBN 9780071750363.

Braünl, T. Embedded robotics: mobile robot design and applications with embedded systems. 3rd ed. Berlin ; Heidelberg: Springer, 2008. ISBN 9783540705338.

Martin, F.G. Robotic explorations: a hands-on introduction to engineering. Upper Saddle River, N.J.: Prentice-Hall, 2001. ISBN 0130895687.

#### Complementary:

Stewart, J.W.; Miao, K.X. The 8051 microcontroller: hardware, software and interfacing. 2nd ed. Upper Saddle River: Prentice Hall, 1999. ISBN 013531948X.

Predko, M. Programming and customizing PICmicro microcontrollers. 2nd ed. New York [etc.]: McGraw-Hill, 2002. ISBN 0071361723.

Everett, H.R. Sensors for mobile robots: theory and application. Wellesley, Mass.: AK Peters, 1995. ISBN 1568810482.

Arkin, R.C. Behavior-based robotics. London: MIT Press, 1998. ISBN 0262011654.

#### Others resources: