240637 - Robotics in Engineering

Degree competences to which the subject contributes

Specific:
4. Spatial vision capacity and knowledge on graphic representation techniques, both with traditional methods of metrical geometry and descriptive geometry, and by means of computer aided design applications.
3. Basic knowledge on the use and programming of computers, operative systems, data bases and computer software with an engineering application.
2. Knowledge on automatic regulation and control techniques and their application in industrial automation.
1. Capacity to solve mathematical problems that can appear in engineering. Aptitude to apply knowledge about: linear algebra; geometry; differential geometry; differential and integral calculus; differential equations and derived partial equations; numerical methods; numerical algorithm; statistics and optimisation.

Transversal:
6. TEAMWORK. Being able to work as a team player, either as a member or as a leader. Contributing to projects pragmatically and responsibly, by reaching commitments in accordance to the resources that are available.
7. EFFECTIVE USE OF INFORMATION RESOURCES. Managing the acquisition, structure, analysis and display of information from the own field of specialization. Taking a critical stance with regard to the results obtained.
5. SELF-DIRECTED LEARNING. Detecting gaps in one's knowledge and overcoming them through critical self-appraisal. Choosing the best path for broadening one's knowledge.
8. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.

Teaching methodology
Lectures, practical classes in computer classroom.

Learning objectives of the subject
Students attending this course must be able to:
a) Describe the types of robots and the current applications of robotics
b) Explain de needs and alternatives in planning and programming of robotic systems
c) Describe the sensors used in robotics and the robotic manipulation issues.
d) Use the Matlab Robotics Toolbox for planning paths and for defining trajectories of simple mobile robots
## Study load

<table>
<thead>
<tr>
<th></th>
<th>Hours large group:</th>
<th>Hours medium group:</th>
<th>Hours small group:</th>
<th>Guided activities:</th>
<th>Self study:</th>
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<tbody>
<tr>
<td><strong>Total learning time:</strong></td>
<td>112h 30m</td>
<td>0h</td>
<td>45h</td>
<td>0h</td>
<td>67h 30m</td>
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## Content

### 1. Type of robots

**Description:**
- Manipulators
- Mobile robots (wheeled robots / freeflying robots)
- Mobile manipulators
- Legged robots / mechanical hands / humanoids / exoskeleton for human performance augmentation
- Biologically inspired robots / micro-robots and nano-robots
- Multiple robotic systems / networked robots

**Learning time:** 3h  
Theory classes: 3h

### 2. Application fields

**Description:**
- Industrial robotics
- Underwater robotics / Aerial robotics / Space robotics
- Robotics in agriculture and forestry / Robotics in construction / Mining Robotics
- Robotics in hazardous environments / Search and rescue robotics
- Medical and surgery robotics / Rehabilitation robotics
- Domestic robotics / Robots for education / Social robotics

**Learning time:** 3h  
Theory classes: 3h

### 3. Robotics foundations

**Description:**
- Kinematics and dynamics
- Actuation / Sensing and estimation
- Motion control / Force control
- Robotic systems architectures / Robot programming

**Learning time:** 3h  
Theory classes: 3h

### 4. Planning and programming

**Description:**
- World modelling / SLAM
- Motion planning / Obstacle avoidance
- Task planning
- Learning / Programming by demonstration / Evolutionary robotics / Behavior-based systems
- Robotic Operating System (ROS)

**Learning time:** 6h  
Theory classes: 6h
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## 5. Sensing and perception

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<td>Theory classes: 3h</td>
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### Description:
- Force and tactile sensors
- Inertial sensors, GPS and odometry
- Range sensors
- 2D and 3D vision
- Multisensor data fusion

## 6. Manipulation

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<td>Theory classes: 3h</td>
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### Description:
- Motion for manipulation tasks
- Contact modelling / Grasping
- Cooperative manipulation
- Haptic devices / telerobotics

## 7. Social and ethical implications of robotics

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<td>Theory classes: 1h 30m</td>
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### Description:
- Ethical issues in science and technology
- Roboethics taxonomy

## Qualification system

Final assessment = 0.5* Final Exam + 0.25*Practicals reports + 0.25*Final work

## Bibliography

### Basic:
