Course guide
240637 - 240637 - Robotics in Engineering

Unit in charge: Barcelona School of Industrial Engineering
Teaching unit: 707 - ESAII - Department of Automatic Control.

Degree: BACHELOR’S DEGREE IN INDUSTRIAL TECHNOLOGY ENGINEERING (Syllabus 2010). (Optional subject).

Academic year: 2022  ECTS Credits: 4.5  Languages: Catalan

LECTURER

Coordinating lecturer: Yolanda Bolea Monte
Others: Yolanda Bolea Monte
Antoni Grau Saldes

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>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self study</td>
<td>67.5</td>
<td>60.00</td>
</tr>
<tr>
<td>Hours medium group</td>
<td>45.0</td>
<td>40.00</td>
</tr>
</tbody>
</table>

Total learning time: 112.5 h

CONTENTS

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

Full-or-part-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

Full-or-part-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

Full-or-part-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)

**Full-or-part-time:** 6h
Theory classes: 6h

## 5. Sensing and perception

**Description:**
- Force and tactile sensors
- Inertial sensors, GPS and odometry
- Range sensors
- 2D and 3D vision
- Multisensor data fusion

**Full-or-part-time:** 3h
Theory classes: 3h

## 6. Manipulation

**Description:**
- Motion for manipulation tasks
- Contact modelling / Grasping
- Cooperative manipulation
- Haptic devices / telerobotics

**Full-or-part-time:** 3h
Theory classes: 3h

## 7. Social and ethical implications of robotics

**Description:**
- Ethical issues in science and technology
- Roboethics taxonomy

**Full-or-part-time:** 1h 30m
Theory classes: 1h 30m

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**GRADING SYSTEM**

For the spring term of the academic year 2019-2020, and as a consequence of the sanitary crisis due to the Covid19, the qualification method will be:

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

Basic: