



University of Engineering and Technology
School of Computer Science
Syllabus of Course – Academic Period 2017-I

1. **Code and Name:** CS362. Robotics

2. **Credits:** 4

3. **Hours of theory and Lab:** 2 HT; 4 HP;

4. **Professor(s)**

Meetings after coordination with the professor

5. **Bibliography**

- [MVR07] Sonka. M, Hlavac. V, and Boile. R. *Image Processing, Analysis and Machine Vision*. Cengage-Engineering, 2007.
- [RR07] Gonzales. R C and Woods. R E. *Digital Image Processing*. Prentice Hall, 2007. ISBN: 013168728X,978013168728B.
- [SN04] R. Siegwart and I. Nourbakhsh. *Introduction to Autonomous Mobile Robots*. The MIT Press., 2004. ISBN: 0-262-19502-X.
- [Sto00] Peter Stone. *Layered Learning in Multiagent Systems*. Intelligent Robots and Autonomous Agents. The MIT Press, 2000. ISBN: 9780262194389.
- [SWD05] Thrun. S, Burgard. W, and Fox. D. *Probabilistic Robotics*. Intelligent Robots and Autonomous Agents. The MIT Press, 2005.

6. **Information about the course**

- (a) **Brief description about the course** That the student knows and understands the concepts and fundamental principles of control, road planning and the definition of strategies in robotics as well as concepts of robotic perception in a way that understands the potential of robotic systems
- (b) **Prerequisites:** CS261. Inteligencia Artificial. (7^{mo} Sem)
- (c) **Type of Course:** Elective

7. **Competences**

- Synthesize the potential and limitations of the state-of-the-art of today's robotic systems.
- Implement Simple Motion Planning Algorithms.
- Explain the uncertainties associated with sensors and how to treat them.
- Designing a Simple Control Architecture.
- Describes several navigation strategies
- Describe the importance of recognizing images and objects in intelligent systems
- Outline the main techniques of object recognition
- Describe the different characteristics of the technologies used in perception

8. **Contribution to Outcomes**

- a) An ability to apply knowledge of mathematics, science. (**Usage**)
- b) An ability to design and conduct experiments, as well as to analyze and interpret data. (**Usage**)
- h) A recognition of the need for, and an ability to engage in life-long learning. (**Familiarity**)

i) An ability to use the techniques, skills, and modern computing tools necessary for computing practice. (**Usage**)

9. Competences (IEEE)

C2. Ability to have a critical and creative perspective in identifying and solving problems using computational thinking.
⇒ **Outcome a**

C23. Ability to undertake, complete, and present a capstone project.⇒ **Outcome b,h**

CS1. Model and design computer-based systems in a way that demonstrates comprehension of the tradeoff involved in design choices.⇒ **Outcome b**

CS12. Operate computing equipment and software systems effectively.⇒ **Outcome i**

10. List of topics

1. Robotics
2. Robotics
3. Robotics
4. Perception and Computer Vision
5. Robotics

11. Methodology and Evaluation

Methodology:

Theory Sessions:

The development of the theoretical sessions is focused on the student, through his active participation, solving problems related to the course with the individual contributions and discussing real cases of the industry. The students will develop throughout the course a project of application of the tools received in a company.

Lab Sessions:

Practical sessions are held in the laboratory. Laboratory practices are performed in teams to strengthen their communication. At the beginning of each laboratory the development of the practice is explained and at the end the main conclusions of the activity in group form are highlighted.

Oral Presentations :

Individual and team participation is encouraged to present their ideas, motivating them with additional points in the different stages of the course evaluation.

Reading:

Throughout the course different readings are provided, which are evaluated. The average of the notes in the readings is considered as the mark of a qualified practice. The use of the UTEC Online virtual campus allows each student to access the course information, and interact outside the classroom with the teacher and with the other students.

Evaluation System:

12. Content

Unit 1: Robotics (5)	
Competences Expected: CS12	
Learning Outcomes	Topics
<ul style="list-style-type: none"> • List capabilities and limitations of today’s state-of-the-art robot systems, including their sensors and the crucial sensor processing that informs those systems [Familiarity] • Integrate sensors, actuators, and software into a robot designed to undertake some task [Usage] 	<ul style="list-style-type: none"> • Overview: problems and progress <ul style="list-style-type: none"> – State-of-the-art robot systems, including their sensors and an overview of their sensor processing – Robot control architectures, e.g., deliberative vs. reactive control and Braitenberg vehicles – World modeling and world models – Inherent uncertainty in sensing and in control • Configuration space and environmental maps
Readings : [SN04], [SWD05], [Sto00]	

Unit 2: Robotics (15)	
Competences Expected: C2,C23	
Learning Outcomes	Topics
<ul style="list-style-type: none"> • Program a robot to accomplish simple tasks using deliberative, reactive, and/or hybrid control architectures [Usage] • Implement fundamental motion planning algorithms within a robot configuration space [Usage] 	<ul style="list-style-type: none"> • Interpreting uncertain sensor data • Localizing and mapping
Readings : [SN04], [SWD05]	

Unit 3: Robotics (20)	
Competences Expected: CS1	
Learning Outcomes	Topics
<ul style="list-style-type: none"> • Characterize the uncertainties associated with common robot sensors and actuators; articulate strategies for mitigating these uncertainties [Usage] • List the differences among robots’ representations of their external environment, including their strengths and shortcomings [Usage] 	<ul style="list-style-type: none"> • Navigation and control • Motion planning
Readings : [SN04]	

Unit 4: Perception and Computer Vision (10)	
Competences Expected: C2,CS1	
Learning Outcomes	Topics
<ul style="list-style-type: none"> • Summarize the importance of image and object recognition in AI and indicate several significant applications of this technology [Usage] • Implement 2d object recognition based on contour- and/or region-based shape representations [Usage] 	<ul style="list-style-type: none"> • Computer vision <ul style="list-style-type: none"> – Image acquisition, representation, processing and properties – Shape representation, object recognition and segmentation – Motion analysis • Modularity in recognition
Readings : [MVR07], [RR07]	

Unit 5: Robotics (10)	
Competences Expected: C23,CS1	
Learning Outcomes	Topics
<ul style="list-style-type: none"> • Compare and contrast at least three strategies for robot navigation within known and/or unknown environments, including their strengths and shortcomings [Familiarity] • Describe at least one approach for coordinating the actions and sensing of several robots to accomplish a single task [Familiarity] 	<ul style="list-style-type: none"> • Multiple-robot coordination
Readings : [Sto00]	