# Universidad Nacional Mayor de San Marcos
# School of Computer Science
# Syllabus of Course
# Academic Period 2018-II

1. **Code and Name:** CS3602. Robotics (Elective)
2. **Credits:** 4
3. **Hours of theory and Lab:** 2 HT; 4 HL; (15 weeks)
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) **Prerrequisites:** CS2601. Artificial intelligence . ($7^{th}$ Sem)

   (c) **Type of Course:** Elective

   (d) **Modality:** Face to face

7. **Specific goals of the Course**

   - 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**)

**e)** Understand correctly the professional, ethical, legal, security and social implications of the profession. (**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**)

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**9. Competences (IEEE)**

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

**C8.** Understanding of what current technologies can and cannot accomplish. ⇒ **Outcome e**

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

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

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**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 theory sessions are held in master classes with activities including active learning and roleplay to allow students to internalize the concepts.

**Lab Sessions:**
In order to verify their competences, several activities including active learning and roleplay will be developed during lab sessions.

**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** |
| • 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]<br>• Integrate sensors, actuators, and software into a robot designed to undertake some task [Usage] | • Overview: problems and progress<br>– State-of-the-art robot systems, including their sensors and an overview of their sensor processing<br>– Robot control architectures, e.g., deliberative vs. reactive control and Braitenberg vehicles<br>– World modeling and world models<br>– Inherent uncertainty in sensing and in control<br>• Configuration space and environmental maps |
| **Readings :** [SN04], [SWD05], [Sto00] | |

| **Unit 2: Robotics (15)** | |
|---|---|
| **Competences Expected: C2,C23** | |
| **Learning Outcomes** | **Topics** |
| • Program a robot to accomplish simple tasks using deliberative, reactive, and/or hybrid control architectures [Usage]<br>• Implement fundamental motion planning algorithms within a robot configuration space [Usage] | • Interpreting uncertain sensor data<br>• Localizing and mapping |
| **Readings :** [SN04], [SWD05] | |

| **Unit 3: Robotics (20)** | |
|---|---|
| **Competences Expected: CS1** | |
| **Learning Outcomes** | **Topics** |
| • Characterize the uncertainties associated with common robot sensors and actuators; articulate strategies for mitigating these uncertainties [Usage]<br>• List the differences among robots' representations of their external environment, including their strengths and shortcomings [Usage] | • Navigation and control<br>• Motion planning |
| **Readings :** [SN04] | |

| **Unit 4: Perception and Computer Vision (10)** | |
|---|---|
| **Competences Expected: C2,CS1** | |
| **Learning Outcomes** | **Topics** |
| • Summarize the importance of image and object recognition in AI and indicate several significant applications of this technology [Usage]<br>• Implement 2d object recognition based on contour- and/or region-based shape representations [Usage] | • Computer vision<br>– Image acquisition, representation, processing and properties<br>– Shape representation, object recognition and segmentation<br>– Motion analysis<br>• Modularity in recognition |
| **Readings :** [MVR07], [RR07] | |

| **Unit 5: Robotics (10)** | |
|---|---|
| **Competences Expected: C23,CS1** | |
| **Learning Outcomes** | **Topics** |
| • Compare and contrast at least three strategies for robot navigation within known and/or unknown environments, including their strengths and shortcomings [Familiarity]<br>• Describe at least one approach for coordinating the actions and sensing of several robots to accomplish a single task [Familiarity] | • Multiple-robot coordination |
| **Readings :** [Sto00] | |