| I066 | **Intelligent Robotic Systems** | L | P | S | ECTS |
|---|---|---|---|---|---|
| | | 3 | 2 | 1 | 8 |

**Course objectives**. To define and to describe locomotion and kinematics of different robot configurations. To describe various sensor modalities used for robotics perception. To set and to apply computer vision in the context of mobile robotics. To concern about state-of-the-art problems in robotics: localization and navigation. To implement all the introduced topics on a real robot system.

**Prerequisites**. Undergraduate study in mathematics/mathematics and computer science

**Course content**.

1. Introduction. Localization. Legged mobile robots. Wheeled mobile robots. Aerial mobile robots.
2. Kinematics. Kinematic models and constraints. Maneuverability. Actuators. Control of robot systems by using PID controller.
3. Perception of mobile robots. Sensors used in mobile robotics. Computer vision in the context of mobile robotics.
4. Localization. Bayes' rule and estimation theory for robotic systems. Environment mapping. Probabilistic localization in environment map by using Kalman filter and particle filter. Simultaneous localization and mapping
5. Path planning with graph algorithms. Path planning using potential field. Obstacle avoidance. Robot navigation.

**LEARNING OUTCOMES**

| No. | LEARNING OUTCOMES |
|---|---|
| 1. | To enumerate various mobile robot configurations, its principle of work, cons and pros in the context of environment. |
| 2. | To mathematically derive kinematics of mobile robot configurations relative to constraints and apply it in a real system. To implement PID controller, apply it on a system. |
| 3. | To define different sensor modalities and corresponding physical quantities and apply them on a real robot systems. |
| 4. | To put computer vision into robotics context. To enumerate elementary computer vision techniques. |
| 5. | To define mobile robot localization. To apply Kalman' filter and particle filter as an approximator of a mobile robot state and dynamical system in general. |
| 6. | To enumerate path planning and obstacle avoidance algorithms and apply them in real situation. |

**RELATING THE LEARNING OUTCOMES, ORGANIZATION OF THE EDUCATIONAL PROCESS AND ASSESSMENT OF THE LEARNING OUTCOMES**

| TEACHING ACTIVITY | ECTS | LEARNING OUTCOME ** | STUDENT ACTIVITY* | EVALUATION METHOD | POINTS | |
|---|---|---|---|---|---|---|
| | | | | | min | max |
| Attending lectures and exercises | 1 | 1-6 | Lecture attendance, discussion, team work and independent work on given tasks | Attendance lists, tracking activities | 0 | 10 |
| Homework | 3 | 1-6 | Preparing for written exam | Evaluation | 20 | 40 |
| Midterm exam | 2 | 1-6 | Preparing for written exam | Evaluation | 15 | 25 |
| Final exam | 2 | 1-6 | Revision | Oral exam | 15 | 25 |

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|---|---|---|---|---|---|---|
| TOTAL | 8 | | | | 50 | 100 |

**Teaching methods and student assessment**. Lectures and exercises are obligatory. The exam consists of a written and an oral part. Upon completion of the course, students can take the exam. Successful midterm exam scores replace the written exam. Exercises are partially auditory and partially laboratory. In order to gain outcome, students can write homework and/or a seminar paper.

**Can the course be taught in English**: Yes

**Basic literature:**

1. R. Nourbakhsh, R. Siegwart, D. Scaramuzza, Introduction to Autonomous Mobile Robots, 2nd edition, The MIT Press, 2011

**Recommended literature:**

1. S. Thrun, W. Burgard, D. Fox, Probabilistic robotics, The MIT Press, 2006.
2. D. A. Forsyth, J. Ponce, Computer Vision: A Modern Approach, 2nd edition, Pearson Education, 2012.