**COURSE UNIT (MODULE) DESCRIPTION**

| Course unit (module) title | Code |
|---|---|
| Introduction to Robotics | |

| Lecturer(s) | Department(s) where the course unit (module) is delivered |
|---|---|
| **Coordinator: Aistis Raudys**<br><br>**Other(s): Vytautas Valaitis** | Department of Software Engineering<br>Institute of Computer Science<br>Faculty of Mathematics and Informatics<br>Vilnius University |

| Study cycle | Type of the course unit (module) |
|---|---|
| 1st (BA) | Compulsory |

| Mode of delivery | Period when the course unit (module) is delivered | Language(s) of instruction |
|---|---|---|
| Face-to-face | 5, 7. semester | English |

| Requirements for students | |
|---|---|
| **Prerequisites:** basic programming skills | **Additional requirements (if any): none** |

| Course (module) volume in credits | Total student's workload | Contact hours | Self-study hours |
|---|---|---|---|
| 5 | 137 | 62 | 75 |

**Purpose of the course unit (module): programme competences to be developed**

Purpose of the module: Robotics is an interdisciplinary field involving mechatronics, electronics, programming and data science. The aim of the module is to convey knowledge of modern robotics to students, to discuss interdisciplinary applications of robotics. Students will be able to explain hardware features and to integrate it with software. It also aims to develop students' ability to evaluate the reliability of scientific results, to understand the significance of scientific information in decision-making.

**Generic competences:**

- Analyze and systematize information (BK1).
- Put knowledge into practice (BK2).
- Organize and plan work individually and in groups (BC3).

**Specific competences:**

- Electronics Fundamentals (DK5).
- Programming Basics for Microcontrollers (DK6).
- Fundamentals of Sensor Systems (DK7).
- Fundamentals of Electromechanics (DK9).
- Principles of Data Processing and Artificial Intelligence (DK10).

| Learning outcomes of the course unit (module) | Teaching and learning methods | Assessment methods |
|---|---|---|
| Understand the principles of robotics: how sensors, moving parts, and other devices interact with them. | Problem-based teaching, case study, independent reading of literature | Written exam |
| Understand the principles of how microcontrollers and devices based on them work. | Problem-based teaching, discussions, independent reading of literature | Written exam, homework |

| | | |
|---|---|---|
| Understand how sensors work and get to know the most common ones. | Problem-based teaching, laboratory works, independent reading of literature | Written exam, homework, project work. |
| Understand and know how to control moving devices, various types of motors and solenoids. | Problem-based teaching, laboratory works, independent reading of literature | Written exam, homework, project work. |

| Content: breakdown of the topics | Contact hours | | | | | | | Self-study work: time and assignments | |
|---|---|---|---|---|---|---|---|---|---|
| | Lectures | Tutorials | Seminars | Exercises | Laboratory work | Internship/work placement | **Contact hours** | **Self-study hours** | **Assignments** |
| 1. Microcontrollers and microcomputers, their specifics and differences | 2 | | | | 2 | | 4 | 5 | Write code for easy task |
| 2. Linear power circuits, their elements and processes taking place in them. | 2 | | | | 2 | | 4 | 5 | Creating a simple circuit |
| 3. Non-linear electrical circuits, their elements, as follows methods of circuit analysis, application | 2 | | | | 2 | | 4 | 5 | Create nonlinear circuit |
| 4. Sensors, perception of the surrounding world | 2 | | | | 2 | | 4 | 5 | Use two or more sensors |
| 5. Digital-to-analogue conversion: PWM, ADC, DAC | 2 | | | | 2 | | 4 | 5 | Programmed PWM |
| 6. Programming of microcontrollers | 2 | | | | 2 | | 4 | 5 | Program a complex task |
| 7. Data communication, signals, media, transmission equipment, protocols are used in robotics. | 2 | | | | 2 | | 4 | 5 | Transmit data in at least 2 ways |
| 8. Electric motors, steppers, moving parts | 2 | | | | 2 | | 4 | 5 | To create a moving device |
| 9. Motor and step controllers, servo motors | 2 | | | | 2 | | 4 | 5 | Use the widget |
| 10. Gyro, accelerometers, compasses | 2 | | | | 2 | | 4 | 5 | Use a gyroscope |
| 11. Cameras, LED lights | 2 | | | | 2 | | 4 | 5 | Use the camera |
| 12. Screens, data output | 2 | | | | 2 | | 4 | 5 | Output data in textual and graphical form |
| 13. Linear and pulsed power supplies | 2 | | | | 2 | | 4 | 5 | Create a simple power supply source |
| 14. Virtual robotics environments | 2 | | | | 2 | | 4 | 5 | Create a virtual gadget |
| 15. Artificial Intelligence Methods in Robotics | 2 | | | | 2 | | 4 | 5 | Try the AI API |
| 16. Exam | | | | | | | 2 | | |
| **Total** | 30 | 0 | 0 | 0 | 30 | 0 | 62 | 75 | |

| Assessment strategy | Weight,% | Deadline | Assessment criteria |
|---|---|---|---|
| Homework: microcontrollers | 15% | Week 3 | Judged by: completeness and quality of work. |
| Homework: Sensors | 15% | Week 6 | Judged by: completeness and quality of work. |
| Homework: Motors and Displays | 15% | Week 9 | Judged by: completeness and quality of work. |
| Project | 15% | Week 14 | Combine all aspects of project work into one work. Judged by: completeness and quality of work. |
| Exam (written) | 40% | At the end of the semester | Answers to 4 questions from lecture material. Evaluation according completeness and examples. |

| Author | Year of publication | Title | Issue of a periodical or volume of a publication | Publishing place and house or web link |
|---|---|---|---|---|
| **Compulsary reading** | | | | |
| Aistis Raudys<br>Vytautas Valaitis | 2019 | Lecture slides | - | http://wiki.raudys.com/doku.php?id=robotika2018:paskaitos |
| **Optional reading** | | | | |
| Horowitz and Hill | 2015 | The Art of Electronics 3rd Edition | ISBN-13: 978-0521809269 | Cambridge University Press |
| Brian Huang and Derek Runberg | 2017 | The Arduino Inventor's Guide | ISBN-13: 978-1593276522 | No Starch Press |
| Michael Margolis | 2011 | Arduino Cookbook | ISBN-13: 978-1449313876 | O'Reilly Media |
| Various Authors | | Instructables.com, hackaday.io | | |