<table>
<tr><td>NAME OF THE COURSE</td><td colspan="5">Physics of Sensors</td></tr>
<tr><td>Code</td><td>PMP20G</td><td>Year of study</td><td colspan="3">GU-1
GU-2</td></tr>
<tr><td>Course teacher</td><td>Ivica Aviani, PhD, Professor</td><td>Credits (ECTS)</td><td colspan="3">5,0</td></tr>
<tr><td rowspan="2">Associate teachers</td><td rowspan="2"></td><td rowspan="2">Type of instruction (number of hours)</td><td>L</td><td>S</td><td>E</td><td>F</td></tr>
<tr><td>30</td><td>15</td><td>15</td><td></td></tr>
<tr><td>Status of the course</td><td>Elective</td><td>Percentage of application of e-learning</td><td colspan="3">30%</td></tr>
<tr><td colspan="6">COURSE DESCRIPTION</td></tr>
<tr><td>Course objectives</td><td colspan="5"></td></tr>
<tr><td>Course enrolment requirements and entry competences required for the course</td><td colspan="5"></td></tr>
<tr><td>Learning outcomes expected at the level of the course (4 to 10 learning outcomes)</td><td colspan="5">1. Understand the basic characteristics of sensors.
2. Describe mathematical models of sensors.
3. Explain the physical principles on which the operation of the sensor is based.
4. Describe the materials and methods used to make sensors.
5. Describe the types of sensors and their applications.
6. Understand the basics of programming Arduino / Raspberry Pi microcontroller.
7. Make a sensor device based on Arduino / Raspberry Pi technology.</td></tr>
<tr><td>Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="5">Lectures:
(6h) Introduction and sensor characteristics
- Sensors, signals, systems, sensor classification, mathematical models, basics of sensor electronics, sensor characteristics: accuracy, precision, sensitivity, selectivity, minimum detection, linearity, hysteresis
(8h) Physical principles of sensors
- Hall effect, Seebeck effect, Peltier effect, Doppler effect, Kerr effect, photoelectric effect, piezoelectric effect, pyroelectric effect, photoluminescent effect, dielectric effect and other physical principles
(4h) Sensor fabrication materials and methods
- Materials, nanomaterials, surface methods, MEMS methods
(6h) Sensor types
- Pressure sensors, temperature sensors, flow sensors, humidity sensors, speed sensors, force sensors, acceleration sensors, ultrasonic detectors, light detectors, ionizing radiation detectors
(6h) Development of a sensor device with Arduino / Raspberry Pi technology
- Programming, automation and electronics of Arduino / Raspberry Pi microcontrollers, sensor protocols, commercially available sensors
Practical exercises
(15h) During the semester, students work on a project based on the development of a sensor device with Arduino / Raspberry Pi technology.
Seminar
(15h) At the end of the project, students give a seminar presentation related to the project.</td></tr>
<tr><td>Format of instruction</td><td colspan="2">☒ lectures
☒ seminars and workshops
☒ exercises
☐ on line in entirety
☐ partial e-learning
☐ field work</td><td colspan="3">☐ independent assignments
☐ multimedia
☐ laboratory
☐ work with mentor
☐ homework assignments</td></tr>
<tr><td>Student responsibilities</td><td colspan="5">Attendance and commitment of students in lectures and practical exercises. Held seminar presentation.</td></tr>
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<tr><td>Screening student work (name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)</td><td>
<table>
<tr><th>Name</th><th>Ects</th><th>Name</th><th>Ects</th><th>Name</th><th>Ects</th></tr>
<tr><td>Class attendance</td><td>1.0</td><td>Research</td><td></td><td>Experimental work</td><td></td></tr>
<tr><td>Oral exam</td><td>2.0</td><td>Report</td><td></td><td>Homework assignments</td><td></td></tr>
<tr><td>Seminar essay</td><td>0.5</td><td>Essay</td><td></td><td></td><td></td></tr>
<tr><td>Tests</td><td></td><td>Practical training</td><td>1.5</td><td></td><td></td></tr>
<tr><td>Written exam</td><td></td><td>Project</td><td></td><td></td><td></td></tr>
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<tr><td>Grading and evaluating student work in class and at the final exam</td><td>The final grade of the course consists of three parts:
1. evaluation of the practical work (35%),
2. evaluation of the seminar presentation (15%),
3. Assessments of theoretical knowledge (50%).
The evaluation of the practical work is obtained at the end of the project after the presentation of the seminar presentation. During the semester, theoretical knowledge is tested through a colloquium or through an oral exam at the end of the semester.</td></tr>
<tr><td>Required literature (available in the library and via other media)</td><td>
<table>
<tr><th>Title</th><th>Number of copies in the library</th><th>Availability via other media</th></tr>
<tr><td>[1] J.Fraden, Handbook of Modern Sensors: Physics, Designs, and Applications" 5th edition, Springer, 2016.</td><td>0</td><td>Yes</td></tr>
<tr><td>[2] T. Karvinen, K.Karvinen, V. Valtokari, Make: Sensors: A Hands-On Primer for Monitoring the Real World with Arduino and Raspberry Pi , Maker Media, 2014.</td><td>0</td><td>Yes</td></tr>
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<tr><td>Optional literature (at the time of submission of study programme proposal)</td><td>[1] Kourosh Kalantar-zadeh, Sensors: An Introductory Course, Springer, 2013.
[2] K.Karvinen, T. Karvinen, Make: Getting Started with Sensors, Maker Media, 2014.</td></tr>
<tr><td>Quality assurance methods that ensure the acquisition of exit competences</td><td>Exam results statistics and student evaluation through an anonymous survey at the end of the course. The survey is conducted according to the regulations of the University of Split.</td></tr>
<tr><td>Other (as the proposer wishes to add)</td><td></td></tr>
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