

## SYLLABUS OF A MODULE

Polish name of a module	<b>Systemy autonomiczne</b>
English name of a module	Autonomous Systems
ISCED classification - Code	0619
ISCED classification - Field of study	<i>Information and Communication Technologies (ICTs), not elsewhere classified</i>
Languages of instruction	<i>English</i>
Level of qualification:	2
Number of ECTS credit points	4
Examination:	A
Available in semester:	A

### Number of hours per semester:

Lecture	Tutorial	Laboratory	Seminar	Project	Others
15	0	45	0	0	0

### **MODULE DESCRIPTION**

#### **Module objectives**

- O1. To familiarize students with autonomous, agent and multi-agent systems with their equipment.
- O2. Acquisition by students of practical skills in the processing of data collected from sensors
- O3. Acquisition by students of practical skills in the field of analysis, construction and creation of autonomous systems

### **PRELIMINARY REQUIREMENTS FOR KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. Knowledge of the basics of programming.

2. Basic knowledge of the neural networks.
3. Basic knowledge of electronics / embedded systems.
4. Ability to use various sources of information, including manuals and technical documentation
5. Skills of correct interpretation and presentation of one's own actions

## LEARNING OUTCOMES

LO 1 - The student knows the methods of intelligent control of robots and autonomous systems.

LO 2 - Can design and model intelligent IT systems, taking into account the principles of collective creation of cooperating system elements.

LO 3 - The student has insufficient competences to work independently and in a team, as well as to conduct scientific research and draw conclusions from the conducted experiments.

## MODULE CONTENT

Type of classes – Lectures	Number of hours
W1 - Types of sensors: cameras, thermal imaging cameras, DVS (event camera), LIDAR, LIDAR 3D, IMU cameras	1
W2 - Processing of raw data from sensors, types of data conditioning filters.	1
W3 - Data transfer interfaces between microprocessors, automotive data buses (especially CAN (FD))	1
W4 - ROS (Robot Operating System) Basics	1
W5 - Mobile robots	1
W6 - Types of ML algorithms, deep and convolutional neural networks, impulse neural networks (depending on the course of study, you can omit the concepts that were already there)	1
W7 - Python ML frameworks (adapted to laboratories)	1

W8 - Interpretation and understanding of images	<b>1</b>
W9 - Intelligent autonomous systems	<b>1</b>
W10 - Programming of autonomous systems	<b>1</b>
W11 - The concept of Edge AI. Edge AI platforms, e.g. CPU (RPI), GPGPU (CUDA, NVidia Jetson), ANN coprocessors (Google Coral), neuromorphic circuits	<b>1</b>
W12 - Platforms and agent tools, examples of use	<b>1</b>
W13 - Architectures of agent and multi-agent systems	<b>1</b>
W14 - Typical control structures and multi-agent systems	<b>1</b>
W15 - Completion of lectures	<b>1</b>
<b>Type of classes– Laboratories</b>	<b>Number of hours</b>
L1 - Examination of various types of data returned by sensors	<b>3</b>
L2, L3 - Raw data processing (IMU, temperature, humidity, lidar)	<b>6</b>
L4 - Data transfer between microprocessors using the selected bus / interface	<b>3</b>
L5 - Introduction to ROS software	<b>3</b>
L6 - Testing sensors using ROS software	<b>3</b>
L7 - Introduction to Python programming	<b>3</b>
L8, L9 - Use of Python frameworks for selected ML issues, deep and convolutional neural networks, impulse neural networks	<b>6</b>
L10 - Use of Python frameworks for image interpretation	<b>4</b>
L11, L12, L13 - Development of a simple autonomous platform	<b>6</b>
L14 - The use of agendas or multi-agent systems in the platform	<b>3</b>
L15 - Testing the autonomous platform and passing	<b>3</b>

## TEACHING TOOLS

1. lecture with the use of multimedia presentations
2. preparation of reports on the implementation of the course of exercises

3. instructions for carrying out laboratory exercises
4. laboratory equipped with PC computers, microcontrollers, sensors

### WAYS OF ASSESSMENT ( F – FORMATIVE, S – SUMMATIVE

<b>F1.</b> – assessment of preparation for laboratory exercises
<b>F2.</b> – assessment of the ability to apply acquired knowledge during laboratory exercises and projects
<b>F3.</b> – assessment of reports
<b>F4.</b> – assessment of activity during classes
<b>S1.</b> – assessment of the ability to solve the posed problems and the method of presentation of the obtained results - credit for the grade
<b>S2.</b> – assessment of mastery of the lecture material - passing the lecture (or exam)

\*) warunkiem uzyskania zaliczenia jest otrzymanie pozytywnych ocen ze wszystkich ćwiczeń laboratoryjnych oraz realizacji zadania sprawdzającego

### STUDENT'S WORKLOAD

L.p.	Forms of activity	Average number of hours required for realization of activity
<b>1.</b>	<b>Contact hours with teacher</b>	
1.1	Lectures	15
1.2	Tutorials	0
1.3	Laboratory	45
1.4	Seminar	0
1.5	Project	0
Total number of contact hours with teacher:		60
<b>2.</b>	<b>Student's individual work</b>	
2.1	Preparation for tutorials and tests	0
2.2	Prpreparation for laboratory exercises, writing reports on laboratories	15
2.3	Preparation of project	0

2.4	Preparation for final lecture assessment	10
2.5	Preparation for examination	0
2.6	Individual study of literature	15
Total number of hours of student's individual work:		40
Overall student's workload:		100
<b>Overall number of ECTS credits for the module</b>		4
Number of ECTS points that student receives in classes requiring teacher's supervision:		2,4
Number of <b>ECTS</b> credits acquired during practical classes including laboratory exercises and projects :		1,8

### **BASIC AND SUPPLEMENTARY RESOURCE MATERIALS**

1. Zimmermann W., Schmidgall R.: „Magistrale danych w pojazdach. Protokoły i standardy”, WKŁ, W-wa, 2008
2. Pałka P.: „Wieloagentowe systemy decyzyjne”, Oficyna Wydawnicza Politechniki Warszawskiej, W-wa, 2019
3. Raschka S., Mirjalili V.: „Python. Uczenie maszynowe. Wydanie II”, Helion, Gliwice, 2019
4. Zieliński T. P.: „Cyfrowe przetwarzanie sygnałów. Od teorii do zastosowań”, WKŁ, W-wa, 2014
5. Hughes C., Hughes T.:” <a href="#">Robot Programming: A Guide to Controlling Autonomous Robots</a> ”, Que Publishing; 1 edition (May 22, 2016)

### **MODULE COORDINATOR ( NAME, SURNAME, INSTITUTE, E-MAIL ADDRESS)**

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