SYLLABUS

1. Information regarding the programme

1.1 Higher education institution	Babes-Bolyai University of Cluj-Napoca
1.2 Faculty	Faculty of Mathematics and Computer Science
1.3 Department	Department of Computer Science
1.4 Field of study	Computer Science
1.5 Study cycle	Master's degree
1.6 Study programme / Qualification	Sisteme informatice avansate

2. Information regarding the discipline

2.1 Name of the discipline (en) (ro)			Introduction to Automated Driving Introducere in conducerea automata				
2.2 Course coordinator			Dr. Mathe Stefan				
2.3 Seminar coordinator			Dr. Mathe Stefan				
2.4. Year of study	**1**	2.5 Semester	**2**	2.6. Type of evaluation	**E**	2.7 Type of discipline	**Optional**
2.8 Code of the discipline		**MME8160**					

3. Total estimated time (hours/semester of didactic activities)

3.1 Hours per week	3	Of which: 3.2 course	2	3.3 seminar/laboratory	1
3.4 Total hours in the curriculum	42	Of which: 3.5 course	28	3.6 seminar/laboratory	14
Time allotment:					hours
Learning using manual, course support, bibliography, course notes					40
Additional documentation (in libraries, on electronic platforms, field documentation)					40
Preparation for seminars/labs, homework, papers, portfolios and essays					40
Tutorship					13
Evaluations					3
Other activities:					0

3.7 Total individual study hours	133
3.8 Total hours per semester	175
3.9 Number of ECTS credits	7

4. Prerequisites (if necessary)

4.1. curriculum	• Computer programming, calculus, linear algebra, data structures and algorithms, artificial intelligence
4.2. competencies	• mathematics, programming, analytical skills

5. Conditions (if necessary)

5.1. for the course	• N/A
5.2. for the seminar /lab activities	• The presence is mandatory

6. Specific competencies acquired

Professional competencies	C1: Operating with basic concepts of mathematics, physics, measurement science, mechanical engineering, chemical engineering, electrical engineering in systems engineering C2: Operating with basic concepts of computer science, information technology and communication C3: Operating with fundamentals of control engineering, process modelling, simulation, identification and analysis methods, and computer aided design. C4: Design, implementation, testing, operation and maintenance of systems with generic and dedicated equipment, including computer networks for control engineering and applied informatics. C5: Development and implementation of automatic control structures and algorithms based on project management principles, software environments and technologies based on microcontrollers, signal processors, programmable logic controllers and embedded systems.
Transversal competencies	CT1: Applying the organized and efficient work rules, and a responsible attitude towards the didactic-scientific field, for the creative valorization of their own potential, by respecting the principles and norms of professional ethics. CT3: Using effective methods and techniques of efficient learning, get informed, research and development of the capabilities to use the knowledge, adapting to the requirements of a dynamic society in the communication era.

7. Objectives of the discipline (outcome of the acquired competencies)

7.1 General objective of the discipline	• Build system, software and algorithms development skills in the area of autonomous driving
7.2 Specific objective of the discipline	• Understanding the technology and strategies used for autonomous driving • Understanding of algorithms for perception and sensors data fusion • Get an overview on connectivity in vehicles

8. Content

8.1 Course	Teaching methods	Remarks
1. Introduction in automated driving **(1 course)** **2.** Ultrasonic and electromagnetic sensors **(2 courses)** a) Ultrasonic - Physical principles of operation of ultrasonic sensors - Applications where the sensor is best to be used (technologies for driver assistance systems based on ultrasonic sensors) b) LiDAR - Principles of operation and examples - Applications where the sensor is best to be used c) RADAR - Sensor model - Applications where the sensor is best to be	Slides presentation, explanations and demonstrations, discussions, case studies	

used		
3. Video sensor **(3 courses)** a) Image processing basics - Image transformations, image filtering, edge detection b) Computer vision basics - Image representation & acquisition - Camera model - Distortion correction c) Stereo video processing - Epipolar geometry basics - Stereo camera model - Rectification - Disparity estimation d) Optical flow		
4. Classification and object detection **(3 courses)** a) Machine Learning review - Supervised learning - Unsupervised learning - Reinforcement learning b) Deep Learning - Relation to machine learning - Deep feedforward networks (cross entropy, regularization, dropout) - Back propagation - Convolutional neural networks - Recurrent neural networks - Examples of DNN architectures		
5. Sensor data fusion for perception and localization **(1 course)** - State estimators and Kalman filter - Extended Kalman filter - Fusion of video and RADAR sensors data - GPS and odometry fusion for localziation - Localization techniques & precise mapping		
6. Connectivity **(2 courses)** - Introduction to connectivity and cloud computing - Big data analytics methods for automated driving		
7. Office hours and exam Q&A session **(1 course)**		
Bibliography IEEE Explore articles on autonomous driving (shared on the courses) Automation: From Driver Assistance Systems to Automated Driving, VDA, 2015 Automotive handbook, Robert Bosch GmbH, 2007		
8.2 Seminar / laboratory	Teaching methods	Remarks
1. Radar sensors application (ex: RARAD-based objects detection)		
2. Video sensors application 1(ex: 3D reconstruction)		

3. Video sensors application 2 (ex: occupancy-grid based free-space)		
4. Machine learning application		
5. Deep learning application (ex: objects detection)		
6. Sensor data fusion application (ex: Kalman filters)		
Bibliography - Will be shared at each laboratory		

9. Corroborating the content of the discipline with the expectations of the epistemic community, professional associations and representative employers within the field of the program

- The content of the course and applications is developed together with an automotive company

10. Evaluation

Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Share in the grade (%)
10.4 Course	Evaluation of the acquired skills, activity within lectures and seminars	Exam	100%
10.5 Seminar/lab activities	Evaluation of the practical skills, activity within laboratory classes	Will be evaluated as part of the final exam (row above)	0%
10.6 Minimum performance standards			
➢ Exam grade > 5			

Date	Signature of course coordinator	Signature of seminar coordinator
03.05.2018	Dr. Mathe Stefan	Dr. Mathe Stefan

Date of approval ..... Signature of the head of department

Prof. Dr. Andreica Anca