ANNEX 2 – COURSE DESCRIPTION

Course Title	Driver Assistance Systems (DAS) and Intelligent Vehicle Control				
Course Code	AU411				
Course Type	Compulsory				
Level	BSc (Level 1)				
Year / Semester	4th (Fall)				
Teacher's Name	Evagoras Xydas				
ECTS	6	Lectures / week	3	Laboratories/week	-
Course Purpose	The aim of the course is to familiarize students with the principles underlying the design, legal regulation implementation and operation of Driver Assistance Systems (DAS) such as cruise control, assist-breaking, lane-assist, autonomous drive, etc. which enhance vehicle stability and control, as well as the design principles and techniques pertinent to specific vehicle control applications such as anti-lock braking, lane departure warning, auto emergency braking, adaptive cruise control, modern steering systems, etc. The course familiarizes students with the fundamental concepts associated with the development of the considered intelligent vehicle systems, as for example the human capabilities and driver characteristics, the vehicle dynamics, the sensing and actuation system characteristics, etc.				
Learning Outcomes	By the end of the course, students must be able to: 1. Justify and the necessity for DAS with reference to human driver capabilities. 2. Understand the nomenclature and classification of DAS as well as know the main regulations affecting DAS. 3. List the various sensors and actuators relating to DAS and their installation locations, describe the basic principles of their operation. 4. Identify and describe the DAS for stabilization, road behaviour and navigation. 5. Implement machine vision methods for feature extraction from road images. 6. Program simple vehicles (such as Arduino-based) for performing various DAS functions.				
Prerequisites	AU303, AU307	Corequisites	None		
Course Content	**The human driver:** capabilities of humans with reference to vehicle guidance, basic driver behaviour models, necessity for DAS based on human skills and performance, framework conditions and requirements for the development of DAS. **Categorization of DAS:** nomenclature and classification of DAS with				

	reference to operation, degree of continuous automation, etc. main legal requirements relating to different levels of control, relevant safety classifications such as the European New Car Assessment Programme (Euro NCAP), etc. **Sensors for DAS:** Vehicle dynamic sensors, Ultrasonic sensors, Automotive RADAR and LIDAR, Automotive Camera and principles of Machine Vision, pedestrian detection, Data fusion. **DAS Actuation and human-machine interface:** Hydraulic brake systems, electromechanical brake systems, steering actuation, human-machine interface system. **DAS functions:** Brake-based assistance, Vehicle dynamics control with breaking and steering assistance, adaptive cruise control, collision protection, lane change assistance, lateral guidance assistance, autonomous driving, motion planning. **Hands-on:** the students identify the different elements of DAS on an actual SMART model at the Automotive Engineering Laboratory. **Design project:** the students work in groups to modify (adding sensors such as accelerometers) and program the Smart Robot Car kit (Keyestudio) to perform different DAS functions such as collision protection, pedestrian-detection, line-change assist, vehicle dynamics control, etc. **Computer lab:** the students carry out a computer lab assignment where they are asked to use MATLAB image processing tool-box to implement machine vision functions such as pedestrian detection, lane detection etc.
Teaching Methodology	Students are taught the course through lectures (3 hours per week) in classrooms or lectures theatres, by means of traditional tools or using computer demonstration as well as practical exercises involving the computer lab or laboratory equipment. Auditory exercises, where examples regarding matter represented at the lectures, are solved and further, questions related to particular open-ended topic issues are compiled by the students and answered, during the lecture or assigned as homework. Topic notes are compiled by students, during the lecture which serve to cover the main issues under consideration and can also be downloaded from the e-learning platform or the lecturer's webpage. Students are also advised to use the subject's textbook or reference books for further reading and practice in solving related exercises. Tutorial problems are also submitted as homework and these are solved during lectures or privately during lecturer's office hours. Furthermore, design projects may be assigned to the students, where literature search is encouraged to identify a specific problem related to some issue, gather relevant scientific information about how others have addressed the problem, implement to implement the design and report the results in written or orally. Where appropriate, taught material as well as examples and design problems are drawn from the recent research activities of the lecturer or other faculty members.
Bibliography	**(a) <u>Textbooks:</u>**

	• Hermann Winner, Stephan Hakuli, Felix Lotz and Christina Singer, **Handbook of Driver Assistance Systems: Basic Information, Components and Systems for Active Safety and Comfort**, Springer reference, 2016 • **On-Road Intelligent Vehicles Motion Planning for Intelligent Transportation Systems** • R. Rajamani, **Vehicle Dynamics & Control,** Springer, 2nd Edition, 2012. **(b) References:** • H. Yu et al, **Safe, Autonomous and Intelligent Vehicles,** Springer, 2019
Assessment	The Students are assessed via continuous assessment throughout the duration of the Semester, which forms the Coursework grade and the final written exam. The coursework and the final exam grades are weighted 40% and 60%, respectively, and compose the final grade of the course. Various approaches are used for the continuous assessment of the students, such as mid-term written exam, oral exam, quizzes, design assignments, design projects and laboratory experiments. The assessment weight, date and time of each type of continuous assessment is being set at the beginning of the semester via the course outline. An indicative weighted continuous assessment of the course is shown below: • Laboratory Assignment 10% • Mid-Term written exams 15% • Design Project 10% • Quizzes 5% • Final exam 60% Students are prepared for final exam, by revision on the matter taught, problem solving and concept testing and are also trained to be able to deal with time constrains and revision timetable. The criteria considered for the assessment of each type of the continuous assessment and the final exam of the course are: (i) the comprehension of the fundamental concepts and theory of each topic, (ii) the application of the theory in solving related problems and (iii) the ability to apply the above knowledge in more complex design problems. The above criteria are weighted 30%, 40% and 30%, respectively. The final assessment of the students is formative and summative and is assured to comply with the subject's expected learning outcomes and the quality of the course
Language	**English**