UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Ingegneria
ACADEMIC YEAR	2020/2021
MASTER'S DEGREE (MSC)	ELECTRONICS ENGINEERING
SUBJECT	AUTOMOTIVE CONTROL SYSTEMS
TYPE OF EDUCATIONAL ACTIVITY	C
AMBIT	20925-Attività formative affini o integrative
CODE	20508
SCIENTIFIC SECTOR(S)	ING-INF/04
HEAD PROFESSOR(S)	SFERLAZZA ANTONINO Ricercatore a tempo determinato Univ. di PALERMO
OTHER PROFESSOR(S)	
CREDITS	6
INDIVIDUAL STUDY (Hrs)	102
COURSE ACTIVITY (Hrs)	48
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	
YEAR	2
TERM (SEMESTER)	2° semester
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	**SFERLAZZA ANTONINO** Monday 15:00 17:00 Ufficio del Docente o su M. Teams (4r406w2) Thursday 11:00 13:00 Ufficio del Docente o su M. Teams (4r406w2)

DOCENTE: Prof. ANTONINO SFERLAZZA

PREREQUISITES	Fundamentals of automatic control, Fundamentals of electrical and electronic systems
LEARNING OUTCOMES	• Knowledge and understanding: At the end of the course, the student will have acquired new methodologies for controlling the different parts of a vehicle. In particular, he will acquire the ability to: - Know the fundamental parts of a vehicle and their operating principles (Brakes: ABS - ASR - EBD, Stability: ESP, Engine, Drive, Clutch and Transmission - MT, Steer-by-wire, Drive-by-wire, Active and Passive Suspensions, etc.); - Modelling the various subsystems of a vehicle; - Assess the interactions between the various subsystems; - Understand the goals of the control systems for the various subsystems - Design of different controllers concerning the different parts of the vehicle; - Evaluate the performance of the various control systems; - Design controllers for electric and hybrid vehicles; • Applying knowledge and understanding: The student will be able to apply the knowledge acquired during the course, and in particular he will be able to: Model and simulate the various subsystems of a vehicle, (Brakes: ABS - ASR - EBD, Stability: ESP, Engine, Drive, Clutch and gearbox - AMT, Steer-by-wire, Drive-by-wire, Suspensions, etc.); Design of the various control systems to ensure: assigned specifications, stability and reliability of the system; Evaluate performance and establish the specifications of a given control system; Implement experimentally the various control systems; • Making judgements The Students will be able to determine the essential properties of the system under study, and choose the correct approach for solving the control problem, after defining the design requirements. Moreover, they will be able to validate the designed controller by means of simulation. The Students will acquire ability in making judgements that will allow to apply also the theoretical and practical knowledge to general control problems in the automotive field. The development of the essay will allow to the Students to apply the acquired knowledge to real cases, effecting bibliographic searches and choosing autonomously the scientific materials to be used. The discussion of the essay will allow to verify the reaching of this objective. • Communication skills The Students will acquire communication skills, which allow them to communicate and/or discuss with experts in various sectors, the properties and the design of an automotive control system, and the realization aspects of a prototype of the whole control system. Moreover, the Students will be also able to interact with other experts for understanding and satisfying the demand of the users, thanks to the multidisciplinary characteristics of the degree course. In order to pursue this objective, tutorials will be executed by the Students under the supervision of the teacher, with the aim of motivating the Students to discuss between them and with the teacher about the topic object of the current tutorial. The verification of the acquired skill will take place thanks to the tutorials, the essay, and the oral exam. • Learning skills The degree course is aimed also to motivate the Students towards a systematic approach for the study of dynamical systems used in automotive. The Students will acquire learning skill, and generalization skill, which will allow he to autonomously address an solve different problems from those considered in the course itself. In order to pursue this objective, the lessons will be held so as to transfer to the Students a systematic methodology of study. The validation of the objective will take place during the discussion of the essay and the oral exam.
ASSESSMENT METHODS	The learning assessment will be done by carrying out two tests. The first test concerns the design of a control system (among those presented during the course) that will be assigned to the students, who will develop it using the Matlab/Simulink software. Minimum mark for passing the test is 18/30. Before taking the second test the Student have to pass the written exam. The second test is an oral exam, and it consists of some questions on course topics. For each question, the Student will have to address the following aspects: significance and importance of the topic, for example giving formal definitions and putting in evidence the related application fields; choice of the most suitable methods of study. Finally, the Student will have to answer the questions with correct use of language, clearness and fluency in presentation. At the end of the oral examination, the examination board assigns the final mark, or alternatively, informs the student that the exam is failed. In case of passed exam, the final mark is assigned taking into account the following criteria: a) correctness of problem formulation, problem solving and achieved results in the first test (40% of the final mark); b) knowledge of the topics

	discussed during the oral exam, autonomy in making judgements and disciplinary connections within the course topics (50% of the final mark); c) correct use of language, clearness and fluency (10% of the final mark).
EDUCATIONAL OBJECTIVES	The course is aimed at giving to the Students suitable knowledge in order to solve problems of analysis and design of control systems commonly used in the automotive field.
TEACHING METHODS	Lectures, exercises using PC and Matlab/Simulink software.
SUGGESTED BIBLIOGRAPHY	• Rajamani, Rajesh. Vehicle dynamics and control. Springer, 2011. • Kiencke, Uwe, and Lars Nielsen. Automotive control systems: for engine, driveline, and vehicle. Springer, 2005. • Ulsoy, A. Galip, Huei Peng, and Melih Çakmakci. Automotive control systems. Cambridge University Press, 2012.

SYLLABUS

Hrs	Frontal teaching
2	Overview of the fundamental parts of a vehicle.
4	Control of the longitudinal dynamics ABS
4	Control of the yaw dynamics and steering ESP
6	Cruise and headway control
4	Stability control of the vehicle
4	Design e analysis of active and passive suspensions
2	Steer-by-wire e Drive-by-wire systems
2	Air fuel ration control
2	Idle speed control
2	Knock control
4	Driveline Control
8	Dynamics and control of hybrid and electrical vehicles

Hrs	Practice
4	PRACTICE
4	PRACTICE
4	PRACTICE
4	PRACTICE