UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Ingegneria
ACADEMIC YEAR	2019/2020
MASTER'S DEGREE (MSC)	ELECTRICAL ENGINEERING
SUBJECT	ELECTRIC AUTOMOTIVE
TYPE OF EDUCATIONAL ACTIVITY	B
AMBIT	50363-Ingegneria elettrica
CODE	19943
SCIENTIFIC SECTOR(S)	ING-IND/32
HEAD PROFESSOR(S)	MICELI ROSARIO Professore Ordinario Univ. di PALERMO
OTHER PROFESSOR(S)	
CREDITS	6
INDIVIDUAL STUDY (Hrs)	96
COURSE ACTIVITY (Hrs)	54
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	
YEAR	2
TERM (SEMESTER)	2° semester
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	**MICELI ROSARIO** Monday 12:00 13:00 ufficio personale Tuesday 15:00 18:00 studio terzo piano Friday 15:00 18:00 studio terzo piano

DOCENTE: Prof. ROSARIO MICELI

PREREQUISITES	Basic skills of physics, electrotechnics, electrical machines, power electronics and electrical drives are needed.
LEARNING OUTCOMES	- Knowledge and understanding skills At the end of the class the student will have acquired the knowledge of the working principles, mathematical models, control and design issues of electrical automotive. Particularly he will be able to choice and to design electric components, basing on specific requirements, in the field of electric automotive systems, board plants and electrical drives for light traction. The student will be aware in advanced topics in the field of electric automotive. To reach these targets frontal lessons, cases study discussion and guided exercises are expected. These targets verification in the oral test has been expected. - Ability in applying knowledge and understanding The student will be able to use the mathematical, physical and engineering instruments for the investigation, the design and the realization of systems, or parts of them, within light traction. He will be able to pose or hold reasonings dealing with the study, the application, the design and the setting up of electrical drives and electrical automotive systems. To reach these targets frontal lessons, cases study discussion, guided exercises, autonomous exercises, specialistic software and commercial catalogs are expected. These targets verification in the oral test has been expected. - Autonomy of judgement The student will be able to know and interpret the main electromechanical data and parameters of electrical machines; he will be able to collect the data in order to carry out the correct sizing, to interpret their operation and to evaluate their correct operation during service. He will be able even to acquire a sufficient general knowledge of many aspects dealing with the electrical automotive systems. To reach these targets frontal lessons, cases study discussion, guided exercises, autonomous exercises, specialistic software and a design implementation are expected. These targets verification in the oral test has been expected with the presentation of a own design. - Communication skills The student will acquire skills to communicate information and ideas and to express issues related to the course topics. In addition, he will be not only able to hold discussions on topics concerning the electrical machines design, but also to highlight problems on the choice and on the adequate use of electrical machines, electrical drives, electric storage systems in automotive systems, proposing possible solutions. To reach these targets frontal lessons, cases study discussion are expected. These targets verification in the oral test has been expected. - Learning skills The student will gain learning skills on further comprehension of electrical drives, power electronics, electrical traction systems, electric energy storage systems and their operating principles. He will acquire the ability to synthesize information and to judge the interactions between different topics and between the fundamental branches of knowledge regarding electrical engineering. These abilities will allow the student to continue the study with higher autonomy and discernment. To reach these targets frontal lessons and numerical applications are expected. These targets verification in the oral test has been expected.
ASSESSMENT METHODS	Oral test with the presentation and discussion of the numeric exercises carried out during the course. The exam consist in an oral mandatory test. In the learning evaluation oral test the student will have to argument on 3 questions, at least, concerning the issues of the module and the report on the laboratory experiences gone during the course. The assessment of the test is expressed in thirtieth. - Learning evaluation The pass mark (18/30) will be reached only if the student demonstrates adequate knowledge and comprehension of at least the general outlines of the topics discussed during the course. Moreover, he must own adequate application skills, allowing the resolution of specific case studies. Particular attention will be given to his clarity of exposition and argumentation, so that his knowledge can be transmitted to the examiner. Otherwise, the test will be declared inadequate. In dependence of both the argumentation/exposition skills of the student with the examiner (more than sufficient, fair, good, more than good, excellent) and the level of knowledge/application skills of the topic shown by the student (more than sufficient, fair, good, more than good, excellent), the rating can be increased up to 30/30 "cum laude".
EDUCATIONAL OBJECTIVES	Goal of this course is to give the general knowledges to enable students to evaluate and to solve problems connected to the

	exploitation of electrical drives in transportation systems. The achievement of such goal requires the development of the following student's capabilities: - knowledge of the application context and the design constraints of electrical drives for each transportation system; - knowledge of functional design principles and technical specifications of electrical drives with particular attention on the interaction transportation vehicle-supply; - knowledge of different technological options according to required performances; - knowledge of the dynamic behaviour of electrical drives and of the estimation of the limiting conditions of their exploitation within the application context.
TEACHING METHODS	The course includes the following teaching activities: lectures, class exercises, laboratory exercises. The above activities are organized such a way to facilitate the achievement of learning objectives and learning outcomes, reported in the appropriate frameworks of this form. In particular, during the laboratory exercises each student is guided: - to analyze, through mathematical models, computer simulations and experimental verification, the behavior of the main electrical power components, both at steady-state and during transients; - to acquire the ability to apply methodologies allowing analyze and solve typical problems of design, development and fine-tuning of the systems, even operating autonomous choices.
SUGGESTED BIBLIOGRAPHY	Educational material used during the course will be placed at student's disposal by means of the website. Il materiale didattico impiegato durante le lezioni ed esercitazioni sara' reso disponibile agli studenti. For detailed study: Per approfondimenti: - L. Guzzella, A. Sciarretta, 'Vehicle Propulsion Systems - Introduction to Modeling and Optimization', Springer-Verlag, Berlin Heidelberg, 2005; - I. Husain, 'Electric and hybrid vehicles: design fundamentals', CRC Press, 2010.

SYLLABUS

Hrs	Frontal teaching
4	1. Introduction and brief hystory on the use of electric energy within the road tranportation systems; 2. Evolution tendencies, "more electric transports";
4	3. Recalls on the principal electrical rotating machines for road transportation;
4	4. Control of torque and speed in electrical machines;
4	5. Components and electronic power converters;
4	6. Control systems and strategies for electrical drives devoted to road traction (general characteristics);
4	7. Electric supply and storage systems;
4	8. Mechanical coupling systems. Gears and gearboxes. Electric differential gear.
4	9. Electric board systems;
4	10. Purely electrical traction vehicles;
4	11. Hybrid traction vehicles;
4	12. Braking systems: dissipative braking and regenerative braking.

Hrs	Practice
2	10. Examples of purely electrical traction vehicles present on the market and analysis of their performances;
2	11. Examples of hybrid traction vehicles present on the market and analysis of their performances;
4	Automotive power train design
2	Automotive battery pack design