UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Ingegneria		
ACADEMIC YEAR	2017/2018		
MASTER'S DEGREE (MSC)	ELECTRICAL ENGINEERING		
INTEGRATED COURSE	ELECTRIC DRIVE AND ELECTRIC AUTOMOTIVE - INTEGRATED COURSE		
CODE	18059		
MODULES	Yes		
NUMBER OF MODULES	2		
SCIENTIFIC SECTOR(S)	ING-IND/32		
HEAD PROFESSOR(S)	MICELI ROSARIO	Professore Ordinario	Univ. di PALERMO
OTHER PROFESSOR(S)	DI TOMMASO ANTONINO OSCAR	Professore Associato	Univ. di PALERMO
	MICELI ROSARIO	Professore Ordinario	Univ. di PALERMO
CREDITS	12		
PROPAEDEUTICAL SUBJECTS			
MUTUALIZATION			
YEAR	2		
TERM (SEMESTER)	Annual		
ATTENDANCE	Not mandatory		
EVALUATION	Out of 30		

TEACHER OFFICE HOURS

DI TOMMASO ANTONINO OSCAR

Monday	15:00	16:00	Laboratorio "EDALab" (all'interno della sala macchine) - Edificio nr. 9, ex DEIM. E' gradito un contatto (telefono o e-mail) almeno un giorno prima.
Tuesday	15:00	16:00	Laboratorio "EDALab" (all'interno della sala macchine) - Edificio nr. 9, ex DEIM. E' gradito un contatto (telefono o e-mail) almeno un giorno prima.
Wednesday	15:00	16:00	Laboratorio "EDALab" (all'interno della sala macchine) - Edificio nr. 9, ex DEIM. E' gradito un contatto (telefono o e-mail) almeno un giorno prima.
Thursday	15:00	16:00	Laboratorio "EDALab" (all'interno della sala macchine) - Edificio nr. 9, ex DEIM. E' gradito un contatto (telefono o e-mail) almeno un giorno prima.
Friday	15:00	16:00	Laboratorio "EDALab" (all'interno della sala macchine) - Edificio nr. 9, ex DEIM. E' gradito un contatto (telefono o e-mail) almeno un giorno prima.

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 traction and automotive. Particularly he will be able to choice and to design electric components, basing on specific requirements, in the field of electric traction systems, board plants and electrical drives for both heavy and light traction. The student will be aware in advanced topics in the field of electric traction and automotive. - 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 heavy and 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 traction systems. - 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 traction systems and automotive. - 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 traction systems and automotive, proposing possible solutions. - 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.
ASSESSMENT METHODS	Oral test with the presentation and discussion of the numeric exercises carried out during the course. The exam consist in a “first oral mandatory test” for the “Electric Drives” module and in a “second oral mandatory test” for the “Electric Automotive” module. The assessment of the whole exam is expressed in thirtieth and is obtained as the weighted averaging of the single module assessments with respect to the credits of the two modules. In the first learning evaluation oral test for the “Electric Drives” module, which will be placed in the calls after the conclusion of the lectures period in the semester, the student will have to argument on 3 questions, at least, concerning the issues of the module. The assessment of test is expressed in thirties. In the second learning evaluation oral test for the “Electric Automotive” module, which will be placed in the calls after the conclusion of the lectures period in the semester, 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".
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.

MODULE
ELECTRIC DRIVE

Prof. ANTONINO OSCAR DI TOMMASO

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;
- G. Vicuna, 'Organizzazione e tecnica ferroviaria', CIFI Ed, 1986.

AMBIT	50363-Ingegneria elettrica
INDIVIDUAL STUDY (Hrs)	96
COURSE ACTIVITY (Hrs)	54

EDUCATIONAL OBJECTIVES OF THE MODULE

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 focusing on the interaction between the transportation vehicle and the 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.

SYLLABUS

Hrs	Frontal teaching
6	1. Introduction and brief hystory on the use of electric energy within the railroad (railway), subway (underground) and tram tranportation systems; 2. Evolution tendencies, "more electric transports";
4	3. Elements of locomotion mechanics: traction and resistance forces, adherence; 4. Recalls on the principal elecrical rotating machines for railroad, subway and tram applications; Control of torque and speed of elecrical rotating machines;
4	5. Mechanical coupling elemets: gears, gearbox, shaft couplings; Mechanical brakes. Energetic and termic aspects; The contact wheel-rail;
4	6. Integration on board (board electrical plats, control and telecommunication systems);
4	7. Electric traction networks and supply substations;
1	8. Direct current traction systems with rheostatic control;
4	9. Direct current traction systems with electronic control;
4	10. Alternating current traction systems;
4	11. Multi voltage electric locomotives;
1	12. Diesel-electric locomotives;
3	13. High speed trains;
2	14. Magnetic levitation (MAGLEV) trains;
4	15. Railroad (railway), subway (underground) and tram signalling plants;
4	16. SCMT (Sitema di Controllo Marcia Treno=Train Traffic Control System).

Hrs	Practice
2	5. Mechanical coupling elemets: gears, gearbox, shaft couplings; Mechanical brakes. Energetic and termic aspects; The contact wheel-rail;
2	9. Direct current traction systems with electronic control: calculation on power electronic equipments;
1	10. Alternating current traction systems;

MODULE
ELECTRIC AUTOMOTIVE

Prof. ROSARIO MICELI

SUGGESTED BIBLIOGRAPHY

Educational material used during the course will be placed at student's disposal by means of the website "portale studenti".
Il materiale didattico impiegato durante le lezioni ed esercitazioni sara' reso disponibile on-line agli studenti tramite il "portale studenti".
For detailed study the following text is recomended:
Per approfondimenti si raccomanda il testo (in lingua inglese):

- 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;
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- knowledge of the dynamic behaviour of electrical drives and of the estimation of the limiting conditions of their exploitation within the application context.

SYLLABUS

Hrs	Frontal teaching
6	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);
6	7. Electric supply and storage systems;
6	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;