UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Ingegneria		
ACADEMIC YEAR	2019/2020		
BACHELOR'S DEGREE (BSC)	ELECTRICAL ENGINEERING FOR THE E-MOBILITY		
INTEGRATED COURSE	ELECTRICAL MACHINES AND DRIVES - INTEGRATED COURSE		
CODE	19222		
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)	MICELI ROSARIO CARUSO MASSIMO	Professore Ordinario Ricercatore a tempo determinato	Univ. di PALERMO Univ. di PALERMO
CREDITS	15		
PROPAEDEUTICAL SUBJECTS			
MUTUALIZATION			
YEAR	3		
TERM (SEMESTER)	Annual		
ATTENDANCE	Not mandatory		
EVALUATION	Out of 30		
TEACHER OFFICE HOURS	**CARUSO MASSIMO** Monday 9:00 11:00 Edificio 9, piano terra, SDESLab **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 mathematics, physics, electrotechnics are required.
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 machines. Particularly he will be able to choice and to design electrical machines, basing on specific requirements, in the field of electric power systems, industrial automated systems. The student will be aware in advanced topics in the field of electrical machines. To reach these targets frontal lessons, cases study discussion and guided exercises are expected. These targets verification in the oral test has been expected. Moreover, the student at the end of the proposed class will acquire the know-how of the structure and the behavior of both DC and AC electrical drives. More in detail, the student will be able to understand issues related to the control of electrical drives for both direct-current machines and alternative current machines. 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 setting up of electrical machines. He will be able to pose or hold reasonings dealing with the study, the application and the setting up of electrical machines. The student will be aware in advanced topics in the field of electrical machines. To reach these targets frontal lessons, cases study discussion, guided exercises, autonomous exercises, specialistic softwares and commercial catalogs are expected. These targets verification in the oral test has been expected. Moreover, the student will gain knowledge and understanding skills in order to adequately choose and assemble the components of DC and AC electrical drives. Furthermore, the student will be able to test and manage AC and DC drives for industrial automation and railway applications. 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. 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. Moreover, the student will be able of understanding correctly and independently the challenges raised by the users of electrical drives. He will adequately review the right operation and use of both DC and AC electrical drives and he will collect all the specifications required for the most appropriate technical-economical choice of the related drive for the customer's requirements. 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, but also to highlight problems on the choice and on the adequate use of electrical machines, proposing possible solutions. To reach these targets frontal lessons, cases study discussion are expected. These targets verification in the oral test has been expected. Moreover, the student The student will acquire communication skills on the explanation of the challenges related to the proposed class. In addition, he will be not only able to carry on discussions on topics concerning the electrical drives, but also to highlight challenges on the choice and the adequate use of the electrical drives, proposing possible solutions. Learning skills The student will gain learning skills on further comprehension of electrical machines 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. Moreover, the student will gain learning skills on further comprehension of AC and DC drives for industrial automation and railway electric traction, allowing him to continue the related studies with higher autonomy and discernment.
ASSESSMENT METHODS	Oral test with the presentation and discussion of the numeric exercises carried out during the course. - Learning evaluation The examination consists of an oral test, which will be performed after the conclusion of the semester of the present class. The student must answer at least to three oral questions based on the topics of the class. The oral test evaluation will be expressed in marks out of 30.

	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	Lectures, numeric exercises, laboratory tests and visits.

MODULE
ELECTRICAL DRIVES WITH LABORATORY

Prof. MASSIMO CARUSO

SUGGESTED BIBLIOGRAPHY

•Documentation presented during the class
•R. Manigrasso: “Azionamenti Elettrici – parte I”, Pitagora Editrice, 2007.
•R. Manigrasso: “Azionamenti Elettrici” – parte II”, Pitagora Editrice, 2007.
•G. Legnani, “Meccanica degli Azionamenti Elettrici”, Società editrice Esculapio, terza edizione, 2016
•Leonhard W.: Control of Electrical Drives, Springer Verlag, 1996
•B. K. Bose: Power Electronics and AC drives, Prentice - Hall, 1986
•A. Bellini, G. Figalli: Il Motore asincrono negli azionamenti industriali, UNITOR 1990
•H. Bühler: Electronique de reglage et de puissance, Ed. Georgi, 1979

AMBIT	50298-Ingegneria elettrica
INDIVIDUAL STUDY (Hrs)	102
COURSE ACTIVITY (Hrs)	48

EDUCATIONAL OBJECTIVES OF THE MODULE

The proposed class has an applicative nature and covers the study of electrical drives currently adopted in the fields of industrial automation and railway electric traction, focusing the attention mainly towards the challenges related to their operation. In particular, after a classification of the electrical drives in dependence of the type of electrical motor, the converter and the control system, the class will focus on: the static characteristics of the loads applied to the motor, the coupling procedures between motor and load, the equations of motion, the stability conditions, the speed regulation, the four quadrant-operation of the torque/speed plane, the open-loop and closed-loop regulation, the torque/speed and position control. Thus, both the DC and the AC electrical drives are widely discussed. The educational goals consist in bringing to the students the adequate skills on:
- the choice and assembly of all the components of a DC electrical drive, an AC drive with induction motor and an AC drive with synchronous motor
- the test and management of DC drives, AC drives with induction motor and AC drives with synchronous motor for industrial automation and electric traction.

SYLLABUS

Hrs	Frontal teaching
6	Introduction to the electric drives: definitions, application fields, block diagrams and overview of the main components.
6	Working principle of DC electric drives supplied by AC/DC converters. Examples of control schemes.
6	Working principle of DC electric drives supplied by DC/DC converters. Examples of control schemes.
16	Working principle of AC electric drives supplied by DC/AC converters (VSI, CSI CRVSI). Examples of scalar control schemes.

Hrs	Practice
20	Numerical exercises on the AC and DC electrical drives. Simulations using the matlab/simulink environment for the implementation of DC and AC electrical drives.

MODULE
ELECTRICAL MACHINES

Prof. ROSARIO MICELI

SUGGESTED BIBLIOGRAPHY

M. Kostenko, Piotrovsky, Electrical Machines (Vol. I e II), MIR Publishers, Moscow.
S. Crepaz, Macchine Elettriche, CLUP, Milano.
M. Perez de Vera, Macchine elettriche (Vol. I e II), Liguori, Napoli.
M. Andriollo, G. Martinelli, A. Morini: " I Trasformatori. Esercizi con elementi di teoria + Macchine elettriche rotanti. Teoria ed esercizi". - Libreria Cortina. Padova.

AMBIT	50298-Ingegneria elettrica
INDIVIDUAL STUDY (Hrs)	153
COURSE ACTIVITY (Hrs)	72

EDUCATIONAL OBJECTIVES OF THE MODULE

Knowledge of the working principles, mode of operation and construction of transformers and alternating and direct current machines.

SYLLABUS

Hrs	Frontal teaching
2	Introduction on electrical machines
2	Elementary knowledge on magnetic materials, conductors and insulation materials for electrical machines
4	Operation principle of the transformer
4	Mathematical models of the transformer
2	Parallel operation of transformers
4	Operation principle of the synchronous machine
3	Mathematical models of of the synchronous machine with linear and non-linear magnetic circuits
2	Characteristics of synchronous machine
2	Parallel operation of synchronous machines on an infinite power bus
4	Synchronous motors
4	Stability of synchronous machines
2	Operation principle of the induction machine
2	Construction characteristics of the induction machines
4	Mathematical model of the induction machine
4	Operation principle of the direct current machine
4	Direct current generator
4	Windings of electrical rotating machines
2	Direct current motor

Hrs	Practice
26	Numeric exercises on transformers, synchronous machines and induction motors. No-load and short circuit tests on a transformer