Syllabus

Course Description

Course Title	Electrical circuits and machines
Course Code	42130
Course Title Additional	
Scientific-Disciplinary Sector	IIND-08/A
Language	Italian
Degree Course	Bachelor in Industrial and Mechanical Engineering
Other Degree Courses (Loaned)	
Lecturers	
Teaching Assistant	
Semester	Second semester
Course Year/s	2
CP	6
Teaching Hours	36
Lab Hours	24
Individual Study Hours	90
Planned Office Hours	18
Contents Summary	- Electrical phenomena and circuit components (resistors, capacitors, inductors); - Circuit topology (graphs, Kirchhoff's laws) and general theorems of circuits; - Electrical networks analysis methods with exercises; - Analysis of DC circuits, magnetic circuits and sinusoidal AC circuits; - Electrical machines: transformers and electro-mechanical conversion principles
Course Topics	1- Elements of electrical engineering Electric charges and electric currents, electric field and electric voltage, conduction phenomena and resistors, conducting materials, electric generators, bipoles, double bipoles and electric

	power, general properties of electrical networks, networks in steady state, theorems and methods of solving networks electrical phenomena, electrostatic phenomena and capacitors, dielectric materials, magnetic phenomena and inductors, magnetic materials, magnetic circuits, principles of electromechanics, sinusoidal functions and phasors, networks in sinusoidal regime, networks three-phase, advantages of three-phase networks and rotating magnetic field. 2- Electrical machines and applications Basic principles of electromechanical conversion; classification of electrical machines, transformers and rotating electrical machines. General information and structure of electric machines. Analysis of the transformer and equivalent circuit. Principle of operation of the main rotating machines operating as generators and motors. 3- References to industrial applications During the course some applications will be mentioned such as: general information on electrical energy systems, references to power lines and components of electrical systems, references to the main problems and technical aspects relating to the production, distribution and use of electrical energy.
Keywords	Electrical and magnetic phenomena, electrical networks, bipoles, electrical machines
Recommended Prerequisites	
Propaedeutic Courses	Recommended lectures: Fisica 1 e 2, Analisi Matematica 1 e 2, Geometria.
Teaching Format	Topics are presented in the form of frontal lectures using the blackboard for theory and exercises.
Mandatory Attendance	Not compulsory but strongly recommended.
Specific Educational Objectives and Learning Outcomes	The course is mainly dedicated to the study of electrotechnics and the operating principles of electrical machines (transformers, motors and generators). The course aims to provide the student with the knowledge that allows them to move from a discussion based on electrical phenomena to a discussion based on electrical networks, in order to be able to analyze and understand both simple and complex circuits, at the basis of numerous applications. The student will also be able to numerically solve, with the various methods proposed, electrical networks in steady state and

	sinusoidal regime, as well as solve simple energy balance problems in electromechanical conversion applications. The subject is addressed with attention to the main industrial applications, which are mentioned as examples during the course. The principles of electromechanical conversion, which are the basis of the operating principles of electric machines, are part of the course; their discussion aims to provide the student with the basis for understanding the functioning of transformers, motors and generators in such a way as to facilitate the analysis of more complex systems where these machines find application. Intended Learning Outcomes (ILO) Knowledge and understanding 1. To know and understand the basic laws of electrical engineering and electrical phenomena, with particular attention to industrial applications. 2. To know the theory of electric machines and understand the principle of electromechanical conversion. Applying knowledge and understanding 3. To be able to solve numerical exercises of electrical networks also relating to practical applications. 4. To be able to design small systems and real applications, and to understand the technical choices that underlie the main electrical applications. Making judgements 5. To be able to choose the most suitable and advantageous technological solution for a specific application. Communication skills 6. Ability to to present the skills acquired with own vocabulary relevant to the discipline. Ability to learn 7. To be able to extend one's knowledge through tools for acquiring technical information and updating. 8. To be able to analyze more complex systems.
Specific Educational Objectives and Learning Outcomes (additional info.)	
Assessment	The exam consists of a written test divided into two parts: 1)- the first part concerns the development of 4 exercises which may concern the resolution of electrical networks in steady state, in

	sinusoidal regime, the resolution of magnetic circuits or problems of energy balances; 2)- the second part consists of a quiz of 20 questions regarding the theoretical part of the course, of the following types: multiple choice, true/false, short open-ended questions. - Formative assessment: not foreseen. - Summative assessment: 50% written exam, exercises: 4 exercises (max 2.5 hours); ILOs assessed: 3, 4, 5, 8; 50% written exam, theory: Multiple-choice questionnaire about the theoretical concepts (20 questions) (max 1 hour); ILOS assessed: 1, 2, 6.
Evaluation Criteria	Assignment of a single final grade, given by the average of the written and quiz grades (50% written and 50% quiz). The exam is considered passed if both parts have been passed satisfactorily. It is possible to keep the grade of one of the two parts valid for an exam session if the other was not sufficient. Grade attribution criteria: - Correctness of the exercises and of the answers given, in terms of correct numerical value and unit of measurement, with particular attention to the solution procedure adopted. - Clarity of the answer (also in relation to the order in carrying out the exercises) and language properties (use of terms specific to the subject). Autonomy of judgement. Rework ability. - Correctness of answers in the quiz and ability to communicate the knowledge acquired (for open questions).
Required Readings	• Lecture notes • Some slides covering some parts of the course • M. Guarnieri, A. Stella “Principi ed applicazioni di elettrotecnica” Volumi 1 e 2, 3^ edizione, Edizioni Progetto Padova.
Supplementary Readings	• Chales K. Alexander, Matthew N.O. sadiku “Circuiti Elettrici”, 4^ edizione, McGraw-Hill Education Italia • M. Guarnieri, D. Desideri, F. Dughiero, F. Gnesotto, A. Maschio; Esercizi di Elettrotecnica – Reti elettriche Societa´ editrice Esculapio, 2013
Further Information	
Sustainable Development	Quality education, Industry, innovation and infrastructure,

Goals (SDGs)	Affordable and clean energy