Università degli Studi della Basilicata
Scuola di Ingegneria

COURSE: Foundations of Electrical Engineering (Electrotechnology for Mechanical Engineering)			
ACADEMIC YEAR: 2018-2019			
TYPE OF EDUCATIONAL ACTIVITY: Basic			
TEACHER: PADULOSI OTTORINO			
e-mail: ottorino.padulosi@gmail.com		web:	
phone: 0971 441399		mobile (optional): 335 6789124	
Language: ITALIAN			
ECTS: 9	n. of hours: 90 (54 lessons and 36 exercises)	Campus: Potenzaa School: Engineering School	Semester: II

EDUCATIONAL GOALS AND EXPECTED LEARNING OUTCOMES

The main objective of the course is to provide students with the foundation for studying and solving electrical networks comprising resistors, capacitors and inductors in steady state, both unsteady sinusoidal or transient type. Subsequently, the course aims to provide basic knowledge, methodological and operational, for the study of the main electrical machinery. It is also examined their operating characteristics in different operating environments.

The main knowledge and skills required by students at the end of the course, consist in being able to identify the operating system of an electric network, identify the unknowns of the problem and be able to find the solution. Having the ability to evaluate the energy-related issues associated with the operation of electrical machines. Have the skill in the use of mathematical models that underlie the operation of electrical machines for the calculation of benefits. Having the ability to analyze the different operating conditions of the machines themselves. Also have the ability to be able to explain in a simple manner without special skills, the operation of any electrical machine using properly the scientific and literary language.

PRE-REQUIREMENTS

Has acquired and assimilated the following knowledge provided by the courses of Mathematics I and II and Physics II:

- knowledge of the basic concepts of algebraic system written in matrix form;
- methods of resolution of algebraic systems with a number of unknowns equal to or greater than four and their practical application;
- be able to solve the differential equations of the first and second order with constant coefficients;
- knowledge of the fundamental concepts of electric and magnetic fields.

SYLLABUS

1. Basic concepts, laws of circuit theory. electrical properties of circuits. Electrical and electricity charges. potential difference, energy and power, Kirchhoff's laws.
2. Bipoles: classifications. fundamental bipoles ideal generator voltage and current, resistance, capacitance, inductance. power dissipation in a resistor. Resistor combinations. Voltage and current dividers. Simplification of circuits.
3. Technical analysis of linear circuits. Analysis to the mesh. mesh analysis equations. Star Transformation - triangle and vice versa. nodal analysis. Comparison of nodal analysis and mesh. Analysis of networks containing dependent sources.
4. Analysis of theorems of linear circuits: superposition theorem and reciprocity. Thevenin's theorem and Norton. network transformations. Equivalence between Thevenin and Norton. Theorem of substitution and compensation. Theorem on the maximum power transfer.
5. Analysis of the transition in the first order circuits. Qualitative analysis and mathematics of an RL circuit. Time constant. Response of an RC circuit and RL generators fueled by constant (DC).
6. Alternating current circuits. current-voltage relationship in elementary linear circuits. Representation of sinusoidal voltages and currents by complex exponential: phasor. Impedances. Magnitude and phase diagrams. Theorems on linear circuits and analysis techniques in a.c. circuits Admittances. Frequency response: transfer function. Series and parallel resonant circuits. Factor of merit (Q). Power single-phase circuits. active, reactive and apparent. power factor. complex power.
7. Circuits in three-phase AC. Advantages. phase voltages and line voltage. balanced loads. Star connection and delta. star-delta transformations. unbalanced loads. active, reactive and apparent power in balanced loads. Power factor correction. Three-phase power measurement. Voltmeters. Methods for the measurement of power.
8. Recalls on laws of electromagnetism and the main characteristics of the conductors, dielectrics and ferromagnetic materials used in the production of electric cars. thermal transient of electrical machines heating, rules and regulations.
9. Transformers: embodiments of the magnetic circuits. equivalent electrical circuit. Iron losses. of the magnetic circuit saturation phenomena. load operation. transferred to the load power. Voltage variation in load from empty. Load test and short-circuit for the determination of the equivalent circuit parameters. Parallel connection of two transformers and determination of co0ndizioni perfect pairing. three-phase transformers. magnetic circuit. Connection types of primary and secondary windings. Group of a three-phase transformer. Operation with sinusoidal and balanced load power.

10. Rotating machinery. General: construction type of rotating machinery, nomenclatures, magnetic circuit. Windings for AC. Distribution of the magnetic field in the air gap. rotating magnetic field. Calculation of e.m.f. induced. Windings and winding factors.
11. Asynchronous machines: overview, structure and nomenclature. equivalent electrical circuit. Energy balance. vector diagrams. Expression of the couple. Stability. Tests on the machine. asynchronous motors with rotors with single and double cage.
12. DC machines: general, structures and nomenclatures. The reaction armature, brushes and commutator. The windings for machines in the d.c. The load operation. The machine equations in no-load operation and load. electromagnetic torque. Transition from ideal machine to physical machines. Connections of the excitation circuit. Mechanical properties of the motors. Reversibility of the operation of a machine in the d.c.

TEACHING METHODS

The course includes 90 hours of teaching in lectures and tutorials. In particular it is provided 54 hours of lessons in the classroom and 36 hours of numerical exercises both on the resolution of electric networks on the resolution of exercises specific to the operation of electrical machines.

EVALUATION METHODS

The aim of the examination is to test the level of achievement of the previously mentioned educational goals. The exam is taken in two ways:

A. examination on three written tests held during the semester. If the outcome of the two tests will be enough globally (Global rating of at least 18 points out of 30), but none of the three tests will be grossly inadequate, the student claims an oral test in which it will be evaluated the ability to link and compare aspects several covered during the course; to pass the test you must acquire at least 18 points out of 30. The final grade is given by an average of two votes.
B. if the outcome of the tests performed during the semester does not meet the minimum required, or the student is absent from a single piece of evidence, is required to take a written test on at least two issues of the course and, if overcome with success (overall mark of at least 18 points out of 30), it supports an oral test in which it will be evaluated the ability to link and compare different aspects covered during the course; to pass the test you must acquire at least 18 points out of 30. The final grade is given by an average of two votes.

TEXTBOOKS AND ON-LINE EDUCATIONAL MATERIAL

Notes provided by the teacher

Reference documents:

- L. De Menna “Elettrotecnica” Vittorio Pironti Editore
- G. Miano. Lezioni di Elettrotecnica, Cuen, Napoli
- S. Bobbio, Esercizi di Elettrotecnica, Cuen, Napoli
- L. Olivieri, E. Ravelli, “Principi e Applicazioni di Elettrotecnica”, vol. 2, CEDAM Editrice, Padova 1990.
- S. J. Chapman, “Macchine Elettriche”, Gruppo Editoriale Jackson.
- G. Biasutti, “Macchine Elettriche”, Hoepli – Milano.
- G. Bobbio, S. Sammmarco, “Macchine Elettriche”, Petrini Editore – Torino.

INTERACTION WITH STUDENTS

At the beginning of the course, after describing the objectives, program and methods of verification, the teacher provides students educational materials. Simultaneously, it collects a list of students who intend to enroll in the course, together with name, serial number and e-mail.

Office hours: Wednesday from 17.00 to 19.00 and on Friday from 17.00 to 19.00 in a Room available on campus. In addition to weekly reception, the instructor is available at all times for a contact with the students, through their e-mail or by phone.

EXAMINATION SESSIONS (FORECAST)[1]

04/02/2019, 08/03/2019, 15/04/2019, 17/05/2019, 14/06/2019, 19/07/2019, 19/09/2019, 18/10/2019, 16/12/2019

SEMINARS BY EXTERNAL EXPERTS YES ☐ NO ☒

FURTHER INFORMATION

[1] Subject to possible changes: check the web site of the Teacher or the Department/School for updates.