



COURSE: Foundations of Electrical Engineering (for Mechanical engineering)

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Language Italian

ECTS: 6+3

n. of hours: 60+30

Academic year: 2014-2015

Campus: Potenza

Semester: II

TOPICS

A brief overview of electrical circuit basics. Classification of the bipols. Fundamental bipols: voltage and current sources, resistance, capacitor, inductor. The Kirchhoff laws. Solutions of DC and AC circuits. AC circuits concept, alternating currents - sinusoids, RMS values, phase, phasors, complex number representation of voltages and currents, impedance, admittance, AC power, DC and AC circuit analysis, nodal and mesh analysis for DC and AC circuits, Circuits theorems: superposition, Thevenin's theorem, Norton's theorem, source transformation, maximum power transfer theorem. Resonance, 3-phase circuits, 3-phase power. Transient circuits of the 1st order.

General information on electrical machines. Joule effect losses, due to hysteresis and eddy currents, and for mechanical ventilation in electrical machines. Single phase transformers. Three-phase transformers. Transformers in parallel. Asynchronous motors and generators. Current machines: motors and generators.

TEACHING METHODS (please tick one or more options)

- Theoretical lessons
- Tutorials in classroom
- Tutorials in laboratory
- Project works
- Technical visits

Other activities (please specify): Introductory seminar on the technical software "COMSOL Multiphysics".

TEXTBOOKS

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. Sammarco, "Macchine Elettriche", Petrini Editore - Torino.

ON-LINE EDUCATIONAL MATERIAL

web address: <http://www.elettrotecnica.unina.it/files/common/LibroMiano/libro/Libro/indice.pdf>

LEARNING OUTCOMES

To provide students with a firm foundation in electrical DC and AC circuit analysis; understanding of elementary and the ability to use computer software for schematics and circuit simulation and analysis. It also address basic knowledge, methodological and operational for the study of the main electrical machines and of their operating characteristics in different operating environments.

REQUIREMENTS

It is suggested to support Calculus I and II, Geometry, Physics I and II, Mathematical Physics.

EVALUATION METHODS (please tick one or more options)

- Intermediate verifications
- Written examination
- Discussion of a project work
- Practical test
- Oral examination

Other methods (please specify) _____

DETAILED CONTENT

1. Basic concepts, units and laws of circuit theory - Properties of the electrical circuit - The lumped circuit model -



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- Charge and current - Potential difference, energy and power - Kirchhoff's laws.
2. Bipols - Classification - Fundamental bipols: Ideal voltage and current sources, resistance, capacitance, inductance - Power dissipation in resistance – Resistances in combination - Voltage and current dividers - Circuit reduction.
 3. Techniques of linear circuit analysis - Mesh analysis - The general mesh equations - - The star-delta transformation - Nodal analysis - Comparison of mesh and nodal analysis - Analysis of networks containing dependent generators.
 4. Theorems of linear circuit analysis - The superposition and reciprocity theorems - Thevenin's theorem - Network transformations – The Thevenin-Norton transformation - Miscellaneous theorems and techniques - The substitution and compensation theorems - Maximum power transfer theorem
 5. Transient and steady-state analysis - Qualitative analysis of the RL circuit - Mathematical analysis of the RL circuit - Time constant - Natural response of some basic series circuits - RL and RC circuit driven with sinusoidal and constant sources
 6. Alternating current circuits - A.C. voltage-current relationships for the linear circuit elements - representation of a.c. voltage and current by the complex exponential: Phasors - Voltage-current relationships for the general network branch: Impedance - Phasor and impedance diagrams - Linear circuit theorems and techniques in a.c. circuit analysis – Admittance - Frequency response: transfer function - Series and parallel resonant circuits -Q-factor. Power in single-phase circuits: Average power, Reactive power and apparent power -Power factor - Complex power
 7. Three-phase alternating current circuits – Advantages - Phase and line voltages - Balanced load - Star and delta connections - Use of Y-A transformation - Unbalanced loads - Power, reactive power and apparent power in balanced loads - Power factor correction - Three-phase power measurement - AC meters. Methods of power measurement
 8. Bullets on the laws of electromagnetism and the main properties of conductors, dielectrics and ferromagnetic materials used in the production of electric machines. Outline of transient thermal phenomena in electrical machines, rules and regulations.
 9. Transformers: Form and realization of the magnetic circuit and the windings. Definitions relating to the cash missing. The equivalent electric circuit, the iron losses, saturation of the magnetic core. Operation in sinusoidal, vector diagram. Load operation, rated power and performance. Voltage change from no load to load. Evidence-load and short-circuit, determination of the characteristic parameters. Parallel operation, determination of the ideal conditions. Three-phase transformer, magnetic circuits, connection type of the primary and secondary windings, group. Operation in sinusoidal symmetrical and balanced.
 10. Rotating machinery – General: Types of construction of rotating machinery, nomenclature, the magnetic circuit. Windings for AC. Magnetic field distribution in the gap. The rotating magnetic field. Calculation of the induced electromotive force. Windings, winding factor.
 11. Asynchronous machine: General, structure and nomenclature. Principle of operation. Operation in sinusoidal, load and load. The equivalent electric circuit. Energy balances, performance. Vector diagrams. Expression of the couple, torque, stability. Tests on the machine. Induction motors with squirrel-cage rotor.
 12. Direct current machine: General, structure and nomenclature. The armature drum, brushes and commutator. Work on the windings for current machines. The load operation. The load operation and the armature. Equations of the machine under dynamic and steady. Electromagnetic torque. The switching in the ideal case. Connections of the excitation circuit. Exterior Features of generators, voltage regulation, compound excitation. Mechanical properties of the motors. Reversibility of the operation of the machines.

SEMINARS BY EXTERNAL EXPERTS YES ■ NO ☐

FURTHER INFORMATION
