Università degli Studi della Basilicata

DIPARTIMENTO DI MATEMATICA, INFORMATICA ED ECONOMIA

COURSE: **Foundations of Electrical Engineering**	
ACADEMIC YEAR: 2019/2020	
TYPE OF EDUCATIONAL ACTIVITY: Affine	
TEACHER: Prof. Raffaele Fresa	
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Language: Italian	

ECTS: (lessons e tutorials/practice) 9	n. of hours: (lessons e tutorials/practice) 78 (60/18)	Campus: Potenza Department: DIMIE Program: Computer Science and Information Technology	Semester: II

EDUCATIONAL GOALS AND EXPECTED 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.

PRE-REQUIREMENTS

- Complex numbers
- Derivation and integration rules
- Differential equations
- Maxwell equations
- Fundamentals of electrical, magnetic and electro-magnetic fields

SYLLABUS

1. Basic concepts, units and laws of circuit theory - Properties of the electrical circuit - The lumped circuit model - 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 transiormations – 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, reactive and apparent powers. -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. Electromagnetic fields. Scalar and vectorial fields. Coordinate systems. Definition of E and B

fields. Elementary sources of the electromagnetic field: electrical charges and currents. Volume, surface and linear charge density; electrical currents and current density fields.

9. Maxwell equations. Vectorial field representation. Flux and line integral. Circulation of a vectorial field. Electrical voltage. Charge conservation law for closed and open systems. Local and integral Maxwell equations in the empty space. Conductive materials: electrical currents. Ohm Law. Electromotive field. Dielectric materials: polarization charge and field. Magnetic materials: magnetization current and field, linear and ferromagnetic materials. Maxwell equations in the matter.
10. Electrostatics. Field eqs. Super-position. Distributions of charge with planar, cylindrical and spherical symmetry. DDP. Gradient operator. Poisson equation. Scalar potential, electrical field and charge allocation in conductive media. Image method. Capacity of an insulated conductor and of two coupled conductors. Planar, cylindrical and spherical capacitor. Capacitance in presence of dielectrics. Energy associated to an electrical field.
11. Stationary density field. Field eqs. Ideal electrical conductor. Ideal insulator. Flux tube. Linear resistor. Electromotive sources. Electrical circuit. Kirchhoff laws. Energy consideration: power losses, Joule law. Ground resistor.
12. Stationary and QSM magnetic field. Field eqs. Current density with planar and cylindrical symmetry. Long linear solenoid. Auto and mutual coefficients. Circuits magnetically coupled. Energy of the magnetic field. Forces. Inductance of co-axial and bifilar lines. Inductance of a long solenoid. Magnetic circuits. FMM. Electromagnets. Calculation of auto and mutual coefficients by magnetic circuits. Permanent magnets. Faraday-Neumann-Lenz law. Eddy currents and skin effect in conductive materials

TEACHING METHODS
Theoretical lessons, Classroom tutorials

EVALUATION METHODS
Written examination, Oral examination

TEXTBOOKS AND ON-LINE EDUCATIONAL MATERIAL
L. De Menna. Elettrotecnica. Vittorio Pironti Editore.
S. Bobbio, Esercizi di Elettrotecnica, Cuen, Napoli
S. Bobbio,E. Gatti – Elettromagnetismo, ottica. Bollati Boringhieri, Napoli
Other learning material

INTERACTION WITH STUDENTS
At the start of the course the students will receive information and other learning material.
Professor's office hour: Wednesday 11.30-12.30 in his office located on the fifth floor of the "Engineering school" in "Macchia Romana" Campus.

EXAMINATION SESSIONS (FORECAST)[1]
22/01/2020, 26/02/2020; 8/04/2020; 13/05/2020; 24/06/2020; 9/07/2020; 22/07/2020; 16/09/2020; 14/10/2020; 11/11/2020

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.