COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Agricultural Sciences		
ACADEMIC UNIT	Biosystems & Agricultural Engineering		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	BAE_540	**SEMESTER**	5th
COURSE TITLE	ELECTRICAL CIRCUIT & ELECTRICAL MACHINES		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	
Tutorials	2	
Laboratory	0	
TOTAL	**5**	**5**
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Background (Fundamental Principles of Electrical Circuit & Electrical Machines) Skills Development (Experimental Electrical Engineering - Electrical Machines)
PREREQUISITE COURSES:	There are no prerequisite courses.
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek .-For Erasmus students in English
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	

(2) LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

Upon completion of the course, students will have:

1. In-depth knowledge and critical understanding of circuit theory through the application of techniques and principles of electrical circuit analysis to common circuit problems.
2.Develop an understanding of the fundamental laws and elements of electric circuits
3.Knowledge and skills to respond to tasks requiring wiring circuits using electric components / multimeter / oscilloscope to measure currents and voltages.
4.Knowledge and ability to analyze and evaluate measurements
5. An overall background of the dynamic and static behavior of electric machines in order to design systems with an ultimate control efficiency and power management.

Specifically, students will be able :

1.To understand basic electrical properties
2.To apply Kirchhoff's laws, linearity, superposition, and Thevenin's theorem in the design and analysis of DC circuits.
3.To handle Electric sourses, multimeters, oscilloscope and make independent measurements.

4.To make measurements of current and voltage, correlate electrical quantities and calculate or estimate errors
5.To evaluate whether the measurements are within the experimental uncertainties and detect systematic errors
6. To develop and analyze fundamental principles and phenomena related to electric machines operation as well as their mathematical simulation

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Production of new research ideas	*Others…*
	…….

The course will provide the foundations of Electrical Circuit & Electrical Machines, with a strong focus on developing a skill base necessary for the construction, analysis, and interpretation of experimental data, as well as a practical understanding and use of predictive models.
At the end of this course the student will have further developed the following skills (general skills):
• Ability to identify and name utensils and instruments of an Electrical Circuit & Electrical Machines laboratory
• Ability to record and keep a proper laboratory diary
• Ability to process experimental measurements and yield results in the correct format
• Ability to find information from any book of physical chemical as well as from sources on the internet

In general, upon completion of this course the student will have further developed the following general skills (from the list above):
Search, analysis and synthesis of data and information, using the necessary technologies
Adaptation to new situations
Decision making
Autonomous work
Teamwork
Respect for the natural environment
Exercise criticism and self-criticism

(3) SYLLABUS

1. Electric charge. Coulomb's law. Electric work, Potential. Potential difference. Electric current, Power. Energy.
2. Resistance. Resistivity, Ohm's law. Kirchoff's law, Circuit elements in series. Circuit elements in parallel,Ideal current source.-Ideal Voltage generator. Internal resistance, Mesh current method. Node voltage method.
3. Thevenin's theorem. Norton's theorem, Superposition's theorem.
4. Capacity. Inductors.
5. Electromagnetic flux.
6. Fundamentals in the magnetic field, production of a magnetic field, induced voltage from a time-changing magnetic field, production of induced force on a wire and induced voltage on a conductor moving in a magnetic field

7. Electromechanical energy transformation, systems with simple and multiple triggering of a single output and dynamical equations
8. Types and construction of transformers, the ideal transformer, power in an Ideal transformer, circuits containing ideal transformers, theory of operation of real single-phase transformers and the equivalent circuit of a transformer
9. Basic principles of electric machines, basic parts, operation on 4 quadrants, windings, rotary magnetic field, generation of voltage and torque. Electric machines in solid state, construction description, mechanisms of power and torque generation, dead zone, magnetic poles, methods of triggering, kinds of DC machines and efficiency ratio maximization. DC electric machines, dynamic analysis, fundamental DC electric machine, parallel triggering, linear triggering and multiple triggering
10. The synchronous motor from a magnetic field perspective, basic principles of motor operation, the equivalent circuit of a synchronous motor, steady-state synchronous motor operation, the synchronous motor torque-speed characteristic and the effect of field changes on a synchronous motor
11. The development of induced torque in an induction motor, the concept of rotor slip, the electrical frequency on the rotor, the equivalent circuit of an induction motor and the transformer model of an induction motor
12. Power and torque in induction motors, induction motor torque-speed characteristics, induced torque from a physical status point and the derivation of the induction Motor
13. Commutation and armature construction in real DC machines, a simple rotating loop between curved pole faces, getting DC voltage out of the rotating loop and connections to the commutation segments. Pole and frame construction in DC machines, rotor or armature construction, commutation and Brushes, winding insulation and Problems with commutation in real machines.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face deliveries. Laboratory exercises in Electrical Circuit & Electrical Machines
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Use of ICT (power point) in Teaching • Use of ICT (power point) in Laboratory Training • Use of ICT in Communication with students (Learning process support through the electronic platform e-class).
TEACHING METHODS	

Activity	***Semester workload***
Lectures	39

The manner and methods of teaching are described in detail. Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc. *The student's study hours for each learning activity are given as well as the hours of non directed study according to the principles of the ECTS*	<table><tr><td>Tutorials</td><td>26</td></tr><tr><td>Writing short reports of laboratory exercises</td><td>13</td></tr><tr><td>Final Exams</td><td>3</td></tr><tr><td>Study hours and preparation for the laboratory exercises and the final examination</td><td>44</td></tr><tr><td>Course total</td><td>125</td></tr></table>
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple* *choice questionnaires, short-answer questions,* *open-ended questions, problem solving, written* *work, essay/report, oral examination, public* *presentation, laboratory work, clinical examination of patient, art interpretation,* *other* *Specifically-defined evaluation criteria are* *given, and if and where they are accessible to* *students.* 1	1. The main assessment criteria focus on understanding and correlating the knowledge that students gain from the course with other knowledge. Particular emphasis is placed on whether they have developed the ability to apply this knowledge to crop selection and to assess the impact of these changes on the environment. Emphasis is also placed on demonstrating critical ability and justifying the choices they make in each problem. 2. Evaluation is dynamic. It mainly involves problem solving. is done orally or in writing or with a combination of the two, with or without pre-examination on the basic principles of the course, with or without exculpatory advances and with other test or inventive methods, depending on the composition of the dynamics and the needs of the audience. 3. The above are done in the Greek language. For foreign language students (eg Erasmus students) conducted in English

(5) RECOMMENDED LITERATURE

-Προτεινόμενη Βιβλιογραφία :

1. Sadiku-Alexander, Εισαγωγή στα Ηλεκτρικά Κυκλώματα, Εκδόσεις Τζιόλα, 2013, ISBN 9604182625.
2. John O'Malley, Schaum's Outline of Basic Circuit Analysis, (2nd Ed.), McGraw-Hill, 2011,
3. Chapman Stephen J. Ηλεκτρικές μηχανές, Εκδ. Τζιόλα 2009, ISBN 9789604181926
4. Ηλεκτρικές Μηχανές, Παντελής Μαλατέστας, ΕΚΔΟΣΕΙΣ ΤΖΙΟΛΑ, ΘΕΣΣΑΛΟΝΙΚΗ 2013.
5. Ηλεκτρικές Μηχανές, Charles I. Hubert, ΕΚΔΟΣΕΙΣ ΙΩΝ, Αθήνα 2008
6. Ηλεκτρικές Μηχανές AC-DC, Stephen J. Chapman, ΕΚΔΟΣΕΙΣ ΤΖΙΟΛΑ, ΘΕΣΣΑΛΟΝΙΚΗ 2010

-Εκδ. Κάλλιπος

ΧΡΙΣΤΟΦΟΡΟΥ, Ε., 2016. ΗΛΕΚΤΡΟΤΕΧΝΙΑ ΚΑΙ ΗΛΕΚΤΡΟΝΙΚΗ ΤΕΧΝΟΛΟΓΙΑ. [ηλεκτρ. βιβλ.] Αθήνα:Σύνδεσμος Ελληνικών Ακαδημαϊκών Βιβλιοθηκών. Διαθέσιμο στο: http://hdl.handle.net/11419/6422

Βλάχος, Δ., 2015. Βασικά στοιχεία ηλεκτρομαγνητισμού. [ηλεκτρ. βιβλ.] Αθήνα:Σύνδεσμος Ελληνικών Ακαδημαϊκών Βιβλιοθηκών. Διαθέσιμο στο: http://hdl.handle.net/11419/5039