COURSE OUTLINE

(1) GENERAL

SCHOOL	Engineering		
ACADEMIC UNIT	Mechanical Engineering		
LEVEL OF STUDIES	*Undergraduate*		
COURSE CODE	ΓΕ0106	**SEMESTER**	5th
COURSE TITLE	Electric 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, Practical Exercises	5	6
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, specialized general knowledge, skills development*	Core
PREREQUISITE COURSES:	-
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	No
COURSE WEBSITE (URL)	https://www.mie.uth.gr/?page_id=17890

(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*

This course aims to equip undergraduate students with all the necessary knowledge that will enable them to understand the basic principles of electrical engineering, the methods for solving direct current (DC) and alternating current (AC) circuits in both time and frequency domains, as well as the structure and analysis of the operation of DC and AC electric machines. Initially, fundamental knowledge of the study and analysis of DC and AC circuits in steady and transient states of operation is presented, which is considered essential for analyzing the operation of electric machines. The course content then focuses on the study of the steady and transient states of operation of the examined electric machines during no-load operation and full-load operation.

A detailed analysis is made of the creation of the rotating magnetic field, power flow, efficiency, and the development of voltages and torques in the machine. The analysis of operation is carried out based on the electrical equivalent circuits of the machines. Power electronics configurations used for controlling the operation of DC and AC machines are also examined.

The final part of the course material covers calculations and sizing of the individual components of drive systems, as well as the development of basic industrial automation configurations for motors.

Upon successful completion of the course, the student will be able to:

- Analyze and solve direct current (DC) and alternating current (AC) circuits in both steady and transient states of operation.

- Understand the magnetic circuits of DC and AC electric machines and the magnetic behavior of ferromagnetic materials.
- Understand and analyze the operation of single-phase and three-phase transformers in both steady and transient states of operation under no-load and full-load conditions.
- Understand and analyze the operation of rotating electric machines, the creation of rotating magnetic fields, the development of voltages and torques, power distribution, and machine efficiency.
- Analyze the operation of DC machines in both steady and dynamic states of operation.
- Understand the construction and operational control of asynchronous AC machines and analyze their operation in steady and transient states based on equivalent circuits.
- Understand the construction of synchronous alternators and motors and analyze the operation of synchronous machines in both steady and transient states based on equivalent circuits.
- Understand the structure and operation of special type motors, including single-phase motors with commutators, stepper motors, Universal motors, etc.
- Simulate the operation of DC and AC electric machines using computer software.
- Calculate and size the individual components of drive installations.
- Understand the power electronics configurations used for controlling the operation of DC and AC machines.

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

- Retrieve, analyze and synthesize data and information, with the use of necessary technologies
- Autonomous Work
- Team Work

(3) **SYLLABUS**

1. Electrical quantities, active and passive components of direct and alternating current circuits. Kirchhoff, Ohm, and Thevenin laws used for solving electrical circuits.
2. Electrical quantities of alternating current expressed in the time and frequency domains.
3. Analysis of direct current (DC) circuits. Analysis of single-phase and three-phase alternating current (AC) circuits.
4. Magnetic circuits of DC and AC machines. Magnetic behavior of ferromagnetic materials.
5. Single-phase and three-phase power transformers. Special categories of transformers. Operation analysis, transformer testing, equivalent electrical circuits, measurements, and applications of transformers.
6. Rotating electrical machines. Basic parts of electrical machines. Creation of rotating magnetic fields. Generation of voltages in the machine windings. Development of torques in the machine. Losses and efficiency of the machine.
7. Direct current (DC) machines. Operation analysis of DC generators and motors in steady and transient (dynamic) states.
8. Induction (asynchronous) machines. Construction of three-phase and single-phase induction motors. Equivalent circuits, operation analysis in steady and dynamic states, power flow, motor starting, torque and speed control of induction motors.

9. Synchronous machines. Structure of synchronous generators (alternators) and synchronous motors. Equivalent circuits, operation analysis in steady and transient states, power flow, paralleling of alternators, operation of synchronous motors as synchronous, rotating capacitors.
10. Special types of motors. Single-phase induction motors, commutator AC motors, Universal motors, stepper motors, etc.
11. Simulation of operation of DC and AC motors using computer software.
12. Drive system calculations. Calculation of wire cross-sections for motor supply. Sizing of starting and speed/torque control arrangements for motors. Basic industrial automation systems for motors.
13. Power electronics configurations, inverters, rectifiers, cycloconverters, DC voltage choppers used for controlling the operation of DC and AC machines. Simulation of motor control using power converters.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY ***Face-to-face, Distance learning, etc.***	Teaching is conducted in both the classroom and the laboratory.
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Support of the learning process through the e-class electronic platform. Use of presentation slides. Uploading of educational material on the course webpage. Laboratory exercises.

TEACHING METHODS

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

Activity	*Semester workload*
Lectures	52
Practical exercises related to solving problems in electrical circuits and electrical machines, aiming at the understanding of the material. Laboratory exercises.	26
Autonomous work	72
Course Total	***150***

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.*	I. Written final examination (60%). Covers the material on electrical machines. II. Midterm examination (Progress test, 40%). Covers the analysis and solving of direct current (DC) and alternating current (AC) circuits. III. Laboratory exercises (20%). Laboratory exercises on DC and AC circuits, and on low-power transformers.

(5) **ATTACHED BIBLIOGRAPHY**

- Suggested bibliography:
- Related scientific journals:

1. Ηλεκτρικές Μηχανές, S. J. Chapman, 4η Έκδοση, Εκδόσεις ΤΖΙΟΛΑ, 2010, Θεσσαλονίκη.
2. Ηλεκτρικές Μηχανές, Π. Μαλατέστας, Εκδόσεις ΤΖΙΟΛΑ, 2012, Θεσσαλονίκη.
3. Electrical Machines, Drives, and Power Systems, T. Wildi, Sixth Edition, Prentice Hall, 2006.
4. Electric Machinery, A. E. Fitzgerald, Charles Kingsley, JR, Stephen D. Umans, Sixth Edition, McGraw Hill, 2003