EEE-A.8.1.2 HIGH VOLTAGE ENGINEERING II

COURSE OUTLINE

(1) GENERAL

SCHOOL	ENGINEERING SCHOOL			
ACADEMIC UNIT	DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING			
LEVEL OF STUDIES	UNDERGRADUATE			
COURSE CODE	EEE-A.8.2	SEMESTER	8th	
COURSE TITLE	HIGH VOLTAGE ENGINEERING II			
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 and practice exercises			4	5
Total			4	
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*	Specialty Course			
PREREQUISITE COURSES:				
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek			
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes (In English)			
COURSE WEBSITE (URL)	https://eclass.uniwa.gr/courses/EEE252/			

(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*

The main objectives of the course are:

- In depth knowledge of the design of high voltage devices in relation to the basic principles governing the behavior of electrical insulating materials under the application of high electric fields.
- Getting familiar with modern technologies and materials used in high voltage equipment.
- Getting familiar with the basic principles, analysis, design and applications of the high voltage engineering technology in important electrotechnical applications.
- Developing the knowledge and critical competence, in order for the student to acquire all the necessary skills required for using his/her theoretical background in practice.

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

- Understand the importance of the electrical field distribution in high voltage equipment and the methodologies for analyzing and controlling this distribution for optimal operation of the various high voltage equipment components.
- Develop awareness of the standard tests carried out for the evaluation of electrotechnical equipment through the application of various high voltage waveform types.
- Develop awareness of the importance of applying rated insulation protection in relation to the type of over-voltages that appear on the network.
- Broaden his/her knowledge on the properties and applications of the different types of electrical insulating materials used in high voltage equipment. Also be aware of the techniques used for homogenizing the potential distribution across high voltage components, thus ensuring reliable operation.
- Get familiar with the operational principles and applications in a series of important electrostatic industrial processes based on high voltage use.
- Understand the electrohydrodynamic phenomenon and its modern applications such as electric propulsion, cooling without the use of moving mechanical parts, control of aerodynamic behaviour, etc.
- Develop his/her ability to apply the knowledge described above in the analysis, study and evaluation of the operation of high voltage equipment/devices in various fields of interest.

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 aims in developing the following skills:

- Search for analysis and synthesis of data and information, using the necessary technologies
- Decision making
- Working independently
- Team work
- Working in an interdisciplinary environment
- Promoting free, creative and inductive thinking

(3) SYLLABUS

The course comprises the following topics:

- The importance of electric field stress control in high voltage equipment. Methods of calculating and analyzing the electric field distribution in complex geometric structures or high voltage electrodes. Application of different numerical techniques in high electric field analysis. Techniques for optimizing the distribution of electric field and the electrical potential in high voltage structures.
- Use of high voltages in standard laboratory tests to assist the quality control of electrotechnical equipment. Insulation testing. Testing on cables. Transformer testing.
- Origins and propagation of network overvoltage pulses along high voltage overhead lines. Travelling waves on the transmission lines. Bewley diagram.
- Surges and insulation coordination. Correlation between insulation level and protection level.
- Applications of typical electrical insulating materials in modern high voltage equipment. Properties of the most common inorganic, polymeric and composite materials. Special requirements for high voltage cable insulation. Transmission line insulators. Special requirements for high voltage transformer winding insulation. Winding techniques to ensure homogeneous potential distribution across transformer windings during surge incidence. Special requirements in high-voltage insulation of rotating machines. Insulation techniques in high-voltage power switches and effective control of the generated electric arc during switching operation. Techniques for homogenizing the potential distribution across multiple break-contacts in high-voltage switches.
- Special industrial electrostatic processes using high voltage. Electrostatic filtering. Electrostatic separation of materials. Electrostatic deposition. Ion implantation systems for semiconductor doping.
- The electrohydrodynamic (EHD) effect for generating and controlling bulk flow in dielectric fluids through high electric fields without any mechanical moving parts. Modern developments in electrohydrodynamic applications in industry and their prospects. Introduction to electrical propulsion devices. Introduction to electrohydrodynamic cooling applications by using electric field forced air flow or liquid dielectric flow. Introduction to aerodynamic control and optimization by implementing electro-hydrodynamics.

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr><td>DELIVERY
Face-to-face, Distance learning, etc.</td><td>Face-to-face</td></tr>
<tr><td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td><td>• Teaching using ICT infrastructure in the room
• Use of ICT in practice exercises by using special software for electric field analysis
• Use of ICT through the course's website for the distribution of educational materials in electronic form or other supplementary informative materials. The available e-class platform provides synchronous or asynchronous communication capabilities, as well as electronic submission of exercises or assignments.</td></tr>
<tr><td>TEACHING METHODS
The manner and methods of teaching are described in detail.</td><td><table><tr><th>Activity</th><th>Semester workload</th></tr><tr><td>Lectures</td><td>36</td></tr></table></td></tr>
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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*	Practice exercises: 12 Educational visits: 4 Study of learning materials: 48 Preparation of assignments/projects: 20 **Course total: 120**
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.*	Evaluation Languages: Greek, English (for Erasmus students) Methods of evaluation: • Final Written Examination on the theoretical part of the course including solving exercises and problems of graded difficulty (70%) • Assignments/projects (30%) The final mark of the course is: 70% x of final written examination mark + 30% x of average assignments/projects mark Full information on how to evaluate is announced at the beginning of the semester at the course website.

(5) ATTACHED BIBLIOGRAPHY

1. E. Kuffel, J. Kuffel and W. Zaengl, High Voltage Engineering, 2013 .
2. C.L. Wadhwa, High Voltage Engineering, New Age International Publishers, 2007.
3. M. A. Salam, H. Anis, A. El-Morshedy, R. Radwan, High Voltage Engineering Theory and Practice, Marcel Dekker, 2000.
4. Haddad, D. Warne, Advances in High Voltage Engineering, IET Power and Energy Series, 2007.
5. J. S. Chang, A.J. Kelly, J. M. Crowley, Handbook of Electrostatic Processes, Marcel Dekker, 1995.
6. D.M. Goebel, I. Katz, Fundamentals of Electric Propulsion, J. Wiley, 2008.
7. A. Moronis, Lecture Notes in Special Chapters of High Voltage Engineering, 2019.