

COURSE OUTLINE

(1) GENERAL

SCHOOL	ENGINEERING SCHOOL		
ACADEMIC UNIT	DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	EEE-A.7.8	SEMESTER	7 th
COURSE TITLE	ELECTRICAL GROUNDING SYSTEMS		
INDEPENDENT TEACHING ACTIVITIES <i>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</i>		WEEKLY TEACHING HOURS	CREDITS
Lectures and practice exercises		3	4
Total		3	
<i>Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).</i>			
COURSE TYPE <i>general background, special background, specialised general knowledge, skills development</i>	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/EEE254/		

(2) LEARNING OUTCOMES

<p>Learning outcomes</p> <p><i>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.</i></p> <p>Consult Appendix A</p> <ul style="list-style-type: none"> • 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
<p>The main objectives of the course are:</p> <ul style="list-style-type: none"> • Understanding the importance of grounding systems for proper operation of electrical power systems and installations. • Getting familiar with the concepts, predictions and requirements of the technical standards that regulate the design and operation of electrical grounding systems. • Understanding the principles and parameters that determine the reliable and safe operation of electrical grounding systems. • Getting familiar with the different types of grounding electrodes and the way they are used in electrical grounding systems, according to the requirements of each application. • Developing knowledge in the study, analysis and design of different types of electrical

- grounding systems, according to the technical requirements of each application.
- Enhancing the theoretical background and critical thinking of students in order to help them transfer their theoretical knowledge into practice.

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

- Understand the general principles of electrical grounding and evaluate the impact that different technical parameters have on the reliable and safe operation of electrical grounding systems.
- Develop awareness of the different types of electrical grounding that are used, according to their operation and the way they are implemented by using suitable grounding electrode setups.
- Know the methodologies and instruments used for measuring soil resistivity and grounding (or earthing) resistance in electrical grounding installations of different types.
- Carry out analytical calculations for the analysis, study and application of standard grounding systems in relation to the critical technical parameters that determine their operation.
- Apply international and national standards for the design and operation of grounding systems.
- Apply the theoretical knowledge that has been acquired in the design of substation grounding.

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?

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

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:

- Introduction to the importance of electrical grounding systems. General concepts and definitions.

- The contribution of electrical grounding to protection. The limits of tolerable electrical current through the human body when faults occur.
- Grounding types depending on the function they perform (operation grounding, protection grounding etc.)
- Grounding resistance and the parameters on which it is depending. Soil resistivity. Effect of temperature and humidity on grounding resistance.
- Corrosion in grounding electrodes and anti-corrosion protection. Grounding enhancement materials.
- Grounding electrode types and standard grounding setups.
- The flow field of a grounding electrode and its effect on the grounding resistance.
- Step voltage and touch voltage. Definitions and applications.
- Standard grounding systems according to national and international standards. Operational features. Calculations.
- Grounding systems and special grounding applications. Main grounding.
- Methods of measuring soil resistivity and grounding resistance for the design and control of grounding systems. Electrical grounding resistance and soil resistivity measuring instruments.
- Design and analysis of typical grounding electrodes (rods, grids, ground straps, ground plates etc.).
- Design of electrical grounding systems in accordance with national and international standards. The model of the multi-layer soil.
- Substation grounding in accordance with international standards.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY <i>Face-to-face, Distance learning, etc.</i>	Face-to-face	
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY <i>Use of ICT in teaching, laboratory education, communication with students</i>	<ul style="list-style-type: none"> • Teaching using ICT infrastructure in the room • Use of ICT in practice exercises by using special software and by carrying out demonstration measurements with special electrical ground measuring equipment. • 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. 	
TEACHING METHODS <i>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.</i>	Activity	Semester workload
	Lectures	27
	Practice excersises	12
	Study of learning materials	63
	Preparation of assignments/projects	18
	Course total	120

<p>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</p>	
<p>STUDENT PERFORMANCE EVALUATION Description of the evaluation procedure</p> <p>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</p> <p>Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</p>	<p>Evaluation Languages: Greek, English (for Erasmus students)</p> <p>Methods of evaluation:</p> <ul style="list-style-type: none"> • Final Written Examination on the theoretical part of the course including solving exercises and problems of graded difficulty (75%) • Assignments/projects (25%) <p>The final mark of the course is: 75% x of final written examination mark + 25% x of average assignments/projects mark</p> <p>Full information on how to evaluate is announced at the beginning of the semester at the course website.</p>

(5) ATTACHED BIBLIOGRAPHY

<ol style="list-style-type: none"> 1. Π. Ντοκόπουλος, Ηλεκτρικές Εγκαταστάσεις Καταναλωτών, Εκδόσεις Ζήτη, 2005. 2. Πρότυπο ΕΛΟΤ HD-384, ΕΛΟΤ, 2η έκδοση, 2004. 3. Πρότυπο ΕΛΟΤ 1197, 2002. 4. Md. A. Salam, Q. M. Rahman, Power Systems Grounding, Springer, 2016. 5. H. W. Beaty, Handbook of Electric Power Calculations, Mc Graw Hill, 3rd edition, 2001. 6. IEEE Std 80-2013, Guide for Safety in AC Substation Grounding, 2013. 7. A. Moronis – Lecture notes on Electrical Grounding Systems, 2019.
