## EEE.8-1.8 Ship and Port Electric Power Systems

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|---|---|---|---|
| **SCHOOL** | ENGINEERING SCHOOL | | |
| **ACADEMIC UNIT** | DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING | | |
| **LEVEL OF STUDIES** | UNDERGRADUATE | | |
| **COURSE CODE** | **EEE.8-1.8** | **SEMESTER** | 8 |
| **COURSE TITLE** | Ship and Port Electric Power Systems | | |
| **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 | 4 |
| | **Laboratory** | 0 | |
| | **Total** | 3 | |
| *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* | Special background course – Elective mandatory | | |
| **PREREQUISITE COURSES:** | Electrical mechanical energy conversion, Automatic Control Systems I, Power Electronics I, Introduction to electric power systems, Electric Power Systems I, Industrial electrical installations | | |
| **LANGUAGE OF INSTRUCTION and EXAMINATIONS:** | Greek (official) | | |
| **IS THE COURSE OFFERED TO ERASMUS STUDENTS** | NO | | |
| **COURSE WEBSITE (URL)** | www.eee.uniwa.gr | | |

## 1. 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 successful completion of this course, students will possess highly specialized knowledge, some of which is at the forefront of knowledge in electric power networks for ships and ports, and will be enabled to:

1. Critically understand current trends in the field of electric power systems for ships and ports and its interrelation with Electrical and Electronics Engineering,
2. Understand, describe and apply specific technical data employed in the design and operation of electric power systems for ships and ports.
3. Choose correctly any electrical installation, i.e. boards, switches, motors, generators, with the supplementary & mechanical installation,
4. Understand the particularities of ships and ports, such as room limitation, autonomous systems, and reliability issues

5. Collaborate with engineers / scientists' teams (such as naval engineers for ship stability) to comprehensively address a complex problem through analysis and synthesis, critically evaluate alternative solutions and make decisions
6. Work in complex professional contexts that require collaboration with scientists from fields other than electrical power systems, e.g., ships, submarines, floating constructions, ports, etc., and contribute to professional knowledge, practice and assessment of the team performance.

**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?*

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|---|---|
| *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…* |
| | *……* |

1. Search for, analysis and synthesis of data and information, with the use of the necessary technology
2. Adapting to new situations
3. Decision-making
4. Working independently
5. Team work
6. Production of free, creative and inductive thinking
7. Criticism and self-criticism

## 2. SYLLABUS

1. Introduction to operation issues for ships with emphasis on electric power systems
2. Power production & propulsion for a ship– energy transformation in ships – propulsion categories
3. Electric power plants: prime movers, generators, other electric production systems (fuel cells), excitation systems, voltage control systems, protection components, parallelism components, supplementary generator's systems, failures, electric power room configuration
4. Energy storage system: kind of energy storage, charging – uncharging, emergency storage system (for uninterrupted power systems), storage systems for demand side management
5. General purpose motors: motors categories & standardization from load behavior & electrical point of view, dimensioning and technical issues, start-up problems & locked-rotor current, power electronics
6. Other electrical loads: lighting, cooling-heating-ventilation air condition system, refrigerators, accommodation loads, containers loads, etc.
7. Electric power delivery network, grounding & no-grounding networks, failures (short-circuits & open-circuits), automatic circuit breakers, disconnectors, load break switch, fuses, etc., power transformers, measurement transformers. Electrical installation and relative components. Ship cables' kinds and selection. Main board, control board, sub-boards, measurements instruments.
8. Special issues: cathodic protection, servo-synchro system, special loads and protection measures for liquid gas, oil and chemical tankers, ferries according to SOLAS. High voltage electrical installations. Emergency supply. Lighting protection. Automatic control systems. Fire protection system, evacuation systems etc.
9. Electric propulsion: Propulsion demand, motors categories & standardization, voltage supply levels, motor selection – propeller, control, power converters, protection issues

for installation & crew, issues for high voltage installations, motors start-up and brake, harmonics, auxiliary services, consignment and operation tests / sea trials etc.
10. Protection and maintenance issue (electric shock, insulation tests, voltage – current measurements, connection test etc.)
11. Power plants' operation issues (fuel consumption, emissions with respect to IMO)
12. Electrical / power balance sheet – power generation design techno-economical criteria.
13. Short-circuit & protection studies. High voltage particularities.
14. Cables & bus-bars dimensioning. Transformers and protection components dimension.
15. Regulations, technical standardization and requirements for cables, electrical installation, lighting protection.
16. Particularities for electrical power delivery network of ports – shore connection. Similarities and differences. Issues with neural, grounding, frequency and voltage levels.
17. Rest electrical installation's issues for ports.
18. Techno-economical study for shore connection – cold ironing.

## 3. TEACHING and LEARNING METHODS - EVALUATION

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|---|---|
| **DELIVERY**<br>*Face-to-face, Distance learning, etc.* | • Lectures |
| **USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY**<br>*Use of ICT in teaching, laboratory education, communication with students* | • Teaching using ICT Communication and Electronic Submission (supplementary teaching data, exercises, etc.)<br>• Use computer programs for power balance, network simulation, etc. based on Matlab |
| **TEACHING METHODS**<br>*The manner and methods of teaching are described in detail.*<br>*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.*<br><br>*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* | Teaching uses lectures, exercises / projects and study.<br><br>***Activity*** / ***Semester workload***<br>Lectures: 39<br>Personal study for lectures: 68<br>Exercises /projects: 13<br>Visits: 2<br>Personal study for exams: 13<br>Course total: **135** |
| **STUDENT PERFORMANCE EVALUATION**<br>*Description of the evaluation procedure*<br><br>*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*<br><br>*Specifically-defined evaluation criteria are given, and if and where they are accessible to students.* | Final written exam of theoretical part includes (100% of the total score):<br>- Solving theoretical problems relating to the subject of the course<br>- Description / evidence theory data<br>- Interim written assessments during the semester.<br>Weekly individual written exam<br>- Individual technical reports<br>- Grouping technical reports |

## 4. ATTACHED BIBLIOGRAPHY

*-Proposed bibliography*

1. Φραγκόπουλος Χ., Προυσαλίδης Ι. (2019). Ενεργειακά συστήματα πλοίου. 1η έκδοση, DA VINCI Μ.Ε.Π.Ε, σελ. 623, ISBN: 978-960-9732-26-0, [*ΚΩΔ. EUDOXUS:* 77112815]

2. Προυσαλίδης Ι. (2012). ΗΛΕΚΤΡΟΤΕΧΝΙΚΕΣ ΕΦΑΡΜΟΓΕΣ ΣΕ ΠΛΟΙΑ ΚΑΙ ΠΛΩΤΕΣ ΚΑΤΑΣΚΕΥΕΣ. 1η έκδοση, Εκδόσεις Συμμετρία- Σ.ΑΘΑΝΑΣΟΠΟΥΛΟΣ & ΣΙΑ Ι.Κ.Ε, ISBN: 978-960-266-361-5, [*ΚΩΔ. EUDOXUS:* 22769188] .
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9. Χατζηλάου Ι.Κ. , Κοντόδιος Π. (1999). ΔΥΝΑΜΙΚΗ ΚΑΙ Σ.Α.Ε. ΗΛΕΚΤΡΙΚΩΝ ΜΗΧΑΝΩΝ. Έκδοση 2010, Σχολή Ναυτικών Δοκίμων.
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23. IEC 60092 (2002-2018) International Standards concerning electrical installations in seagoing ships and fixed or mobile offshore units for cables with voltages up to and including 15 kV