

Course guide

280683 - 280683 - Operation and Maintenance of High Voltage Systems

Last modified: 17/01/2024

Unit in charge: Barcelona School of Nautical Studies
Teaching unit: 709 - DEE - Department of Electrical Engineering.
Degree: BACHELOR'S DEGREE IN MARINE TECHNOLOGIES (Syllabus 2010). (Optional subject).
Academic year: 2023 **ECTS Credits:** 6.0 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: RICARDO BOSCH TOUS
Others: Segon quadrimestre:
RICARDO BOSCH TOUS - GTDT

REQUIREMENTS

To register this subject, it must be approved:
280641 Electricity and Electrotechnical
280660 Electric propulsion and power electronics, or, 280665 Vessel Power Plant.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

GTM.CE24. Knowledge of the organization and project management of repair, installation, modification, redesign and maintenance of machines and systems of ships, within the scope of its special ad, ie, operation and exploitation.

Generical:

CG8. IDENTIFY I resolre Capacitat PER L'Ambit problemes IN MARINA DE L'ENGINYERIA.
Capacitat per the plantejament i resolució of problemes de l'àmbit enginyeria assumint marina iniciatives, prenent decisions i aplicant solucions creatives in the marc d'a systematic methodology.

Transversal:

AAT N2. SELF-DIRECTED LEARNING - Level 2: Completing set tasks based on the guidelines set by lecturers. Devoting the time needed to complete each task, including personal contributions and expanding on the recommended information sources.

STCW:

ETO.1. A-III/6-1. Function: Electrical, electronic and control engineering at the operational level
ETO.2. A-III/6-1.1 Monitor the operation of electrical, electronic and control systems
ETO.3. A-III/6-KUP 1.1.11 Knowledge of: Appreciation of the hazards and precautions required for the operation of power systems above 1,000 volts
ETO.4. A-III/6-1.4 Operate and maintain power systems in excess of 1,000 volts
ETO.5. A-III/6-KUP 1.4.1 Theoretical knowledge: Highvoltage technology
ETO.6. A-III/6-KUP 1.4.2 Theoretical knowledge: Safety precautions and procedures
ETO.7. A-III/6-KUP 1.4.3 Theoretical knowledge: Electrical propulsion of the ships, electrical motors and control systems
ETO.8. A-III/6-KUP 1.4.4 Safe operation and maintenance of high voltage systems, including knowledge of the special technical type of high voltage systems and the danger resulting from operational voltage of more than 1,000 volts

TEACHING METHODOLOGY

- Receive, understand and synthesize knowledge.
- Analysis of real applications.
- Define and solve problems.
- Application of theoretical knowledge to the operation of HV systems.
- Laboratory practices of HV.
- Study of cases and articles on topics of the subject.
- Perform work individually.

LEARNING OBJECTIVES OF THE SUBJECT

- Know the high voltage technology (installations > 1000 V)
- Know the insulating materials used
- Know and apply the regulations and regulations of Classification Societies
- Establish and apply security procedures
- Have the ability to perform premature fault detection
- Understand the effects of surges in AT systems
- Identify system typology
- Use equipment and materials for the detection, location and repair of faults

STUDY LOAD

Type	Hours	Percentage
Hours medium group	15,0	10.00
Hours large group	30,0	20.00
Guided activities	5,0	3.33
Hours small group	10,0	6.67
Self study	90,0	60.00

Total learning time: 150 h

CONTENTS

Topic 1. High Voltage Systems

Description:

Introduction, high voltage power systems, electric discharge, electric arc, grounded. Insulating materials. How to read electrical diagrams, representation of circuits and electrical appliances.

Related competencies :

A36-1.4.1. A-III/6-KUP 1.4.1 Theoretical knowledge: Highvoltage technology

Full-or-part-time: 25h

Theory classes: 5h

Laboratory classes: 5h

Guided activities: 5h

Self study : 10h

Topic 2. High voltage safety regulations

Description:

Risks and electrical precautions, security operations. Standards and regulations. Security isolation procedures, the safe use of test equipment, Energized electrical work permit. Procedures that must be followed before, during and after performing any high voltage work.

Related competencies :

A36-1.4.2. A-III/6-KUP 1.4.2 Theoretical knowledge: Safety precautions and procedures

A36-1.1.11. A-III/6-KUP 1.1.11 Knowledge of: Appreciation of the hazards and precautions required for the operation of power systems above 1,000 volts

Full-or-part-time: 25h

Theory classes: 5h

Laboratory classes: 5h

Guided activities: 5h

Self study : 10h

Topic 3. Distribution tables and protections

Description:

Main and emergency switchboards. Energy Distribution. Protections Opening principle, arc breaking. Vacuum switches. SF6 switches. High voltage distribution room, Measuring transformers. The role and purpose of protection systems. Protection relays. Protection of feeders or connections. Protection of transformers, motors, generators. Bus-bar protection. Preconditions for closing switches.

Related competencies :

A36-1.4.3. A-III/6-KUP 1.4.3 Theoretical knowledge: Electrical propulsion of the ships, electrical motors and control systems

Full-or-part-time: 27h

Theory classes: 7h

Laboratory classes: 5h

Guided activities: 5h

Self study : 10h

Topic 4. Maintenance

Description:

Periodic reviews: ground connection, protection verification. Inspections by thermographies. Electrical equipment for hazardous areas: types of protection and equipment. Interlocked systems. Recognition of failure levels. Marine applications of electrical protection. Selection of suitable equipment for the isolation and testing of HV equipment. 5 kV insulation resistance tests and polarization index tests on HV equipment.

Related competencies :

A36-1.4.4. A-III/6-KUP 1.4.4 Safe operation and maintenance of high voltage systems, including knowledge of the special technical type of high voltage systems and the danger resulting from operational voltage of more than 1,000 volts

Full-or-part-time: 26h

Theory classes: 6h

Laboratory classes: 5h

Guided activities: 5h

Self study : 10h

Topic 5. Operation of AT systems

Description:

The synchronization and control of the generators. Introduction to energy management systems. The operation of the energy systems during planned situations and failure, including abrupt stop of electric propulsion engines.

Measures to be taken during the loss of high voltage control installations. Carry out a switching and isolation procedure in an AT system.

Related competencies :

A36-1.4.4. A-III/6-KUP 1.4.4 Safe operation and maintenance of high voltage systems, including knowledge of the special technical type of high voltage systems and the danger resulting from operational voltage of more than 1,000 volts

Full-or-part-time: 27h

Theory classes: 7h

Laboratory classes: 5h

Guided activities: 5h

Self study : 10h

GRADING SYSTEM

The final grade is the sum of the following partial grades:

$$N_{\text{final}} = 0.2 \cdot N_f + 0.2 \cdot N_p + 0.6 \cdot N_c$$

N_{final} : final grade.

N_f : final evaluation note.

N_p : partial evaluation note.

N_c : note continuous evaluation and directed activities.

The continuous evaluation consists of different cumulative activities, both individual and group, of a formative nature, made during the course (in the classroom and outside of it), work, presentations, practical laboratory activities, etc.

Competency demonstration method: .4 approved training with laboratory equipment.

Competency assessment criteria: Operations are planned and carried out in accordance with the training received, so as to guarantee operational safety.

EXAMINATION RULES.

- Assistance and completion of laboratory practices is mandatory.
- If any of the laboratory or continuous assessment activities are not carried out, it will be considered as not scoring.
- Will be considered Not Submitted: Who has not attended or have a global grade lower than 0.5 points.
- In no case you can have forms in the learning controls or exams.
- In exams only calculator and pens are allowed.
- The use of mobile phones is prohibited.

BIBLIOGRAPHY

Complementary:

- Electro-technical officer : IMO model course 7.08. 2014. London: International Maritime Organization, 2014. ISBN 9789280115802.
- Haddad, A; Warne, D. F. Advances in high voltage engineering. London: Institution of Electrical Engineers, 2004. ISBN 0852961588.
- Kuffel, E.; Zaengl, W.S.; Kuffel, J. High voltage engineering : fundamentals [on line]. 2nd ed. Oxford ; Boston: Butterworth-Heinemann, cop. 2000 [Consultation: 01/09/2022]. Available on: <https://www-sciencedirect-com.recursos.biblioteca.upc.edu/book/9780750636346/high-voltage-engineering-fundamentals>. ISBN 0750636343.



RESOURCES

Other resources:

Notes and technical articles provided by the teacher.

Regulations of the Classification Societies.

Dossiers of electrical equipment manufacturers: Electra Molins, ABB, Siemens, Rolls Royce, Schneider Electric, etc.