

Course guide 280660 - 280660 - Electric Propulsion and Power Electronics

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Unit in charge: Teaching unit:	Barcelona School of Nautical Studies 709 - DEE - Department of Electrical Engineering.		
Degree:	BACHELOR'S DEGREE IN MARINE TECHNOLOGIES (Syllabus 2010). (Compulsory subject).		
Academic year: 2024	ECTS Credits: 4.5 Languages: Catalan, Spanish		
LECTURER			
Coordinating lecturer:	MARC GIRONA BADIA		
	Primer quadrimestre: MARC GIRONA BADIA - Grup: GTM		
Others:	Primer quadrimestre: MARC GIRONA BADIA - Grup: GTM		

JOAN NICOLAS APRUZZESE - Grup: GTM

REQUIREMENTS

Subjet 280641

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

GTM.CE28. Knowledge of the fundamentals of power electronics and its application to board. GTM.CE27. Knowledge of electric propulsion systems and their operation and maintenance. GTM.CE30. Ability to design and manage energy optimization systems applied to marine installations.

Transversal:

URI N2. EFFECTIVE USE OF INFORMATION RESOURCES - Level 2. Designing and executing a good strategy for advanced searches using specialized information resources, once the various parts of an academic document have been identified and bibliographical references provided. Choosing suitable information based on its relevance and quality.



STCW:

ME.1. A-III/1-2. Function: Electrical, electronic and control engineering at the operational level ME.2. A-III/1-2.1 Operate electrical, electronic and control systems ME.3. A-III/1-KUP 2.1.1.1 Basic configuration and operation principles of the following electrical, electronic and control equipment: .1 electrical equipment: .a) generator and distribution systems, .b) preparing, starting, paralleling and changing over generators, .c) electrical motors including starting methodologies,.d) highvoltage Installations, .e) sequential control circuits and associated system devices ME.4. A-III/1-KUP 2.1.1.2 Basic configuration and operation principles of the following electrical, electronic and control equipment: .2 electronic equipment: .a) characteristics of basic electronic circuit elements, .b) flowchart for automatic and control systems, .c) functions, characteristics and features of control systems for machinery items, including main propulsion plant operation control and steam boiler automatic controls ME.5. A-III/1-2.2 Maintenance and repair of electrical and electronic equipment ME.6. A-III/1-KUP 2.2.3 Detection of electric malfunction, location of faults and measures to prevent damage ME.7. A-III/1-KUP 2.2.4 Construction and operation of electrical testing and measuring equipment ME.8. A-III/1-KUP 2.2.5.1 Function and performance tests of the following equipment and their configuration: .1 monitoring systems ME.9. A-III/1-KUP 2.2.5.2 Function and performance tests of the following equipment and their configuration: .2 automatic control devices ME.10. A-III/1-KUP 2.2.5.3 Function and performance tests of the following equipment and their configuration: .3 protective devices ME.11. A-III/1-KUP 2.2.6 The interpretation of electrical and simple electronic diagrams 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 1.1.4 Knowledge of Fundamentals of electronics and power electronics

ETO.4. A-III/6-KUP 1.1.5 Knowledge of: Electrical power distribution boards and electrical equipment

ETO.5. A-III/6-KUP 1.1.8 Knowledge of: Electrical drives

ETO,6. A-III/6- 1.3 Operate generators and distribution systems

ETO.7. A-III/6-KUP 1.3.1 Coupling, load sharing and changing over generators

ETO.8. A-III/6-KUP 1.3.2 Coupling and breaking connection between switchboards and distribution

ETO.9. A-III/6-1.4 Operate and maintain power systems in excess of 1,000 volts

ETO,10. A-III/6-KUP 1.4.3 Theoretical knowledge: Electrical propulsion of the ships, electrical motors and control systems

TEACHING METHODOLOGY

Real applications analysis. Application of theoretical knowledge to the laboratory practices. Attitude and skills development for power plants operation. Case studies and articles on the subject. Perform work individually.

LEARNING OBJECTIVES OF THE SUBJECT

 \cdot Understanding the basics of electrical machines.

 \cdot Understand the schemes and connections of different types of machines and applications.

· Understand the regulation systems of V, f, P, Q in synchronous generators in island and parallel.

 \cdot Understand the regulation and control systems of electrical motors.

· Having the ability to do calculations and solve problems of electrical machines, using the corresponding equivalent circuits.

Moreover, one objective of this course is to provide knowledge, understanding and proficiency of skills STCW A-III/1:

1. Having knowledge about the operation of electrical distribution systems, generation plant, generators and their synchronization, and motors starting associated control circuits.

2. Understand the use of measuring equipment and electrical testing for locating common faults and maintenance and repair.

3. Having the basic knowledge for the maintenance of electrical machines and their control systems. Use and safe operation of electrical equipment.

Competencies required and defined in Section A-III/1 (Minimum requirements for certification of officers in charge of the watch in unattended machinery or service engineers designated camera unattended machinery (propulsion power of 750 kW or more) of the International Convention on Standards of Training, Certification and Watchkeeping for seafarers.

This competence are assessed according to the section "evaluation" of this record.



STUDY LOAD

Туре	Hours	Percentage
Hours small group	15,0	13.33
Hours large group	30,0	26.67
Self study	67,5	60.00

Total learning time: 112.5 h

CONTENTS

1. DC machine

Description:

Having knowledge about the operation of electrical distribution systems, generation plant, generators, motors and starter. Construction and operational systems and DC electrical equipment on board properties. Having the basic knowledge for the maintenance of electrical machines and their control systems.

Related competencies :

A36-1.1.4. A-III/6-KUP 1.1.4 Knowledge of Fundamentals of electronics and power electronics

A31-2.1.1a. A-III/1-KUP 2.1.1.1 Basic configuration and operation principles of the following electrical, electronic and control equipment: .1 electrical equipment: .a) generator and distribution systems, .b) preparing, starting, paralleling and changing over generators, .c) electrical motors including starting methodologies,.d) highvoltage Installations, .e) sequential control circuits and associated system devices

A31-2.2.6. A-III/1-KUP 2.2.6 The interpretation of electrical and simple electronic diagrams A31-2.2.3. A-III/1-KUP 2.2.3 Detection of electric malfunction, location of faults and measures to prevent damage A31-2.2.4. A-III/1-KUP 2.2.4 Construction and operation of electrical testing and measuring equipment A36-1.1.8. A-III/6-KUP 1.1.8 Knowledge of: Electrical drives

Full-or-part-time: 3h Theory classes: 2h Laboratory classes: 1h

2. Synchronous machine

Description:

Having knowledge about the operation of electrical distribution systems, generation plant, generators and their synchronization, associated control circuits. Operational and construction in the AC electrical systems and equipment onboard features. Having the basic knowledge for the maintenance of electrical machines and their control systems.

Related competencies :

A31-2.1.1a. A-III/1-KUP 2.1.1.1 Basic configuration and operation principles of the following electrical, electronic and control equipment: .1 electrical equipment: .a) generator and distribution systems, .b) preparing, starting, paralleling and changing over generators, .c) electrical motors including starting methodologies,.d) highvoltage Installations, .e) sequential control circuits and associated system devices

A31-2.2.3. A-III/1-KUP 2.2.3 Detection of electric malfunction, location of faults and measures to prevent damage A31-2.2.4. A-III/1-KUP 2.2.4 Construction and operation of electrical testing and measuring equipment A36-1.1.8. A-III/6-KUP 1.1.8 Knowledge of: Electrical drives

Full-or-part-time: 9h Theory classes: 6h Laboratory classes: 3h



3. Asynchronous machine

Description:

Having knowledge about the operation of electrical distribution systems, motors and starters, associated control circuits. Operational and construction in the AC electrical systems and equipment onboard features. Having the basic knowledge for the maintenance of electrical machines and their control systems.

Related competencies :

A31-2.1.1a. A-III/1-KUP 2.1.1.1 Basic configuration and operation principles of the following electrical, electronic and control equipment: .1 electrical equipment: .a) generator and distribution systems, .b) preparing, starting, paralleling and changing over generators, .c) electrical motors including starting methodologies,.d) highvoltage Installations, .e) sequential control circuits and associated system devices

A31-2.2.3. A-III/1-KUP 2.2.3 Detection of electric malfunction, location of faults and measures to prevent damage A31-2.2.4. A-III/1-KUP 2.2.4 Construction and operation of electrical testing and measuring equipment A36-1.1.8. A-III/6-KUP 1.1.8 Knowledge of: Electrical drives

Full-or-part-time: 6h

Theory classes: 4h Laboratory classes: 2h

4. Start systems

Description:

Having knowledge about the operation of electrical distribution systems, motors and starters, associated control circuits. Operational and construction in the AC electrical systems and equipment onboard features. Having the basic knowledge for the maintenance of electrical machines and their control systems.

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 A36-1.1.5. A-III/6-KUP 1.1.5 Knowledge of: Electrical power distribution boards and electrical equipment

A31-2.1.1a. A-III/1-KUP 2.1.1.1 Basic configuration and operation principles of the following electrical, electronic and control equipment: .1 electrical equipment: .a) generator and distribution systems, .b) preparing, starting, paralleling and changing over generators, .c) electrical motors including starting methodologies,.d) highvoltage Installations, .e) sequential control circuits and associated system devices

A31-2.2.6. A-III/1-KUP 2.2.6 The interpretation of electrical and simple electronic diagrams

A31-2.2.3. A-III/1-KUP 2.2.3 Detection of electric malfunction, location of faults and measures to prevent damage

A31-2.2.4. A-III/1-KUP 2.2.4 Construction and operation of electrical testing and measuring equipment

A31-2.1.1b. A-III/1-KUP 2.1.1.2 Basic configuration and operation principles of the following electrical, electronic and control equipment: .2 electronic equipment: .a) characteristics of basic electronic circuit elements, .b) flowchart for automatic and control systems, .c) functions, characteristics and features of control systems for machinery items, including main propulsion plant operation control and steam boiler automatic controls

A36-1.3.2. A-III/6-KUP 1.3.2 Coupling and breaking connection between switchboards and distribution

A36-1.3.1. A-III/6-KUP 1.3.1 Coupling, load sharing and changing over generators

Full-or-part-time: 3h

Theory classes: 2h Laboratory classes: 1h



5. Electrical Equipment

Description:

Automation, static converters, Protection, Measuring Equipment.

Having knowledge about the operation of electrical distribution systems, generation plant, generators and their synchronization, motors and starting associated control circuits.

Related competencies :

A31-2.1.1a. A-III/1-KUP 2.1.1.1 Basic configuration and operation principles of the following electrical, electronic and control equipment: .1 electrical equipment: .a) generator and distribution systems, .b) preparing, starting, paralleling and changing over generators, .c) electrical motors including starting methodologies,.d) highvoltage Installations, .e) sequential control circuits and associated system devices

A31-2.2.6. A-III/1-KUP 2.2.6 The interpretation of electrical and simple electronic diagrams

A31-2.2.5c. A-III/1-KUP 2.2.5.3 Function and performance tests of the following equipment and their configuration: .3 protective devices

A31-2.2.3. A-III/1-KUP 2.2.3 Detection of electric malfunction, location of faults and measures to prevent damage

A31-2.2.4. A-III/1-KUP 2.2.4 Construction and operation of electrical testing and measuring equipment

A31-2.2.5b. A-III/1-KUP 2.2.5.2 Function and performance tests of the following equipment and their configuration: .2 automatic control devices

A31-2.1.1b. A-III/1-KUP 2.1.1.2 Basic configuration and operation principles of the following electrical, electronic and control equipment: .2 electronic equipment: .a) characteristics of basic electronic circuit elements, .b) flowchart for automatic and control systems, .c) functions, characteristics and features of control systems for machinery items, including main propulsion plant operation control and steam boiler automatic controls

A31-2.2.5a. A-III/1-KUP 2.2.5.1 Function and performance tests of the following equipment and their configuration: .1 monitoring systems

Full-or-part-time: 3h

Theory classes: 2h Laboratory classes: 1h

6. Energy balance

Description:

Having knowledge about the operation of electrical distribution systems, power plant.

Related competencies :

A31-2.1.1b. A-III/1-KUP 2.1.1.2 Basic configuration and operation principles of the following electrical, electronic and control equipment: .2 electronic equipment: .a) characteristics of basic electronic circuit elements, .b) flowchart for automatic and control systems, .c) functions, characteristics and features of control systems for machinery items, including main propulsion plant operation control and steam boiler automatic controls

A36-1.3.2. A-III/6-KUP 1.3.2 Coupling and breaking connection between switchboards and distribution A36-1.3.1. A-III/6-KUP 1.3.1 Coupling, load sharing and changing over generators

Full-or-part-time: 2h

Theory classes: 2h



7. Harmonic and transient

Description:

Having knowledge about the operation of electrical distribution systems, generation plant, generators and their synchronization, and start motors.

Related competencies :

A31-2.1.1a. A-III/1-KUP 2.1.1.1 Basic configuration and operation principles of the following electrical, electronic and control equipment: .1 electrical equipment: .a) generator and distribution systems, .b) preparing, starting, paralleling and changing over generators, .c) electrical motors including starting methodologies,.d) highvoltage Installations, .e) sequential control circuits and associated system devices

A36-1.3.2. A-III/6-KUP 1.3.2 Coupling and breaking connection between switchboards and distribution A36-1.3.1. A-III/6-KUP 1.3.1 Coupling, load sharing and changing over generators

Full-or-part-time: 2h

Theory classes: 2h

8. Faults and troubleshooting

Description:

Understand the use of measuring equipment and electrical testing for locating common faults, power failures and maintenance and repair. Safety requirements for work on electrical systems on board. Use and safe operation of electrical equipment. Having the basic knowledge for the maintenance of electrical machines and their control systems.

Related competencies :

A31-2.2.6. A-III/1-KUP 2.2.6 The interpretation of electrical and simple electronic diagrams

A31-2.2.5c. A-III/1-KUP 2.2.5.3 Function and performance tests of the following equipment and their configuration: .3 protective devices

A31-2.2.3. A-III/1-KUP 2.2.3 Detection of electric malfunction, location of faults and measures to prevent damage

A31-2.2.4. A-III/1-KUP 2.2.4 Construction and operation of electrical testing and measuring equipment

A31-2.2.5b. A-III/1-KUP 2.2.5.2 Function and performance tests of the following equipment and their configuration: .2 automatic control devices

A31-2.2.5a. A-III/1-KUP 2.2.5.1 Function and performance tests of the following equipment and their configuration: .1 monitoring systems

Full-or-part-time: 4h Theory classes: 2h Laboratory classes: 2h

ACTIVITIES

Laboratory Practices

Description:

Practice 1. Testing Machines CC. System start, speed control and hand drawing. Converters.

Practice 2. Synchronous Machine Tests. Generator in island: Vacuum curves and short circuit. Voltage and frequency regulation. Generator in parallel: Synchronization. Regulation of P and Q. Transients.

Practice 3. Asynchronous Machine (Induction Motor). Connections and behavior in vacuum and in charge.

Practice 4. Asynchronous Machine (Induction Motor). Systems start, rotation change and speed control. Converters.

Practice 5. Reviews and equipment for locating faults in electrical machines.

Full-or-part-time: 10h

Laboratory classes: 10h



GRADING SYSTEM

During the course there will be continuous evaluations, according to the following percentages:

Continuous evaluations 20% (Lab. practices, Lab. exams, Works, Expositions) Partial Exam 40% Final Exam 40%

Reevaluation: Test that includes the concepts and objectives set for the final test.

EXAMINATION RULES.

Attendance and completion of the hands-on labs, is a compulsory requirement.

BIBLIOGRAPHY

Basic:

- Casals Torrens, Pau; Bosch Tous, Ricard. Máquinas eléctricas: aplicaciones de ingeniería eléctrica a instalaciones navales y marinas.
Prácticas [on line]. Barcelona: Edicions UPC, 2005 [Consultation: 06/10/2020]. Available on: <u>http://hdl.handle.net/2099.3/36708</u>.
ISBN 8483018136.

- Wildi, Théodore. Electrical machines, drives, and power systems. 6tn ed. Essex: Pearson Education, 2014. ISBN 9781292024585.

- International Maritime Organization. Electro-technical officer. IMO model course 7.08. London: IMO, 2014. ISBN 9789280115802.

Complementary:

- Sainz Sapera, Luis; Córcoles López, Felipe; Suelves Joanxich, Francesc J. Tecnología eléctrica. Barcelona: Ceysa, 2002. ISBN 9788486108236.

- Fitzgerald, A. E; Kingsley, C.; Umans, S. D. Máquinas eléctricas. 6a ed. México: McGraw-Hill, 2004. ISBN 970104052X.

- Chapman, Stephen J. Máquinas eléctricas [on line]. 5a ed. Mexico: McGraw-Hill Education, 2012 [Consultation: 01/09/2022]. Available on:

https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=4297. ISBN 9781456218454.

- Fraile Mora, Jesús. Máquinas eléctricas. 8a ed. Madrid: Ibergarceta, 2016. ISBN 9788416228669.

- Sanjurjo Navarro, R. Máquinas eléctricas [on line]. Madrid: García-Maroto, 2011 [Consultation: 29/07/2024]. Available on: https://www.ingebook.com/ib/NPcd/IB_BooksVis?cod primaria=1000187&codigo libro=193. ISBN 9788415214144.

- Weedy, B.M. Electric power systems [on line]. 5th ed. Chichester: John Wiley & Sons, 2012 [Consultation: 01/09/2022]. Available on:

https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=9783 79. ISBN 9781118361092 .

- Sanjurjo Navarro, Rafael. Máquinas eléctricas : 51 problemas útiles [on line]. Edición estudiante (EEES). Madrid: García-MarotoE ditores,[2019][Consultation:29/07/2024].Atrailableon:https://www.ingebook.com/ib/NPcd/IBBooksVis?codprimaria=1000187&codigoIbro=8435.ISBN 9788417969073.

RESOURCES

Other resources:

Notes and technical articles contributed by teachers in ATENEA