Course guide
280654 - 280654 - Marine Turbomachines and Steam Generators

Last modified: 25/10/2023

Unit in charge: Barcelona School of Nautical Studies
Teaching unit: 742 - CEN - Department of Nautical Sciences and Engineering.

Degree: BACHELOR'S DEGREE IN MARINE TECHNOLOGIES (Syllabus 2010). (Compulsory subject).

Academic year: 2023 **ECTS Credits:** 9.0 **Languages:** Spanish

LECTURER

Coordinating lecturer: GERMAN DE MELO RODRIGUEZ

Others: Segon quadrimestre:
GERMAN DE MELO RODRIGUEZ - DT, GTM
ALICIA PICAZO CARREÑO - DT, GTM

REQUIREMENTS

To Have knowledge of applied thermodynamics.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
GTM.CE30. Ability to design and manage energy optimization systems applied to marine installations.
GTM.CE25. Knowledge of the fundamentals of Fluid Mechanics machines and systems, internal combustion engines, steam turbines and gas, steam generators, cooling and air conditioning.

STCW:
ME.1. A-III/1-1. Function: Marine engineering at the operational level
ME.2. A-III/1-1.4 Operate main and auxiliary machinery and associated control systems
ME.3. A-III/1-KUP 1.4.1.2 Basic construction and operation principles of machinery systems, including: .2 marine steam turbine
ME.4. A-III/1-KUP 1.4.1.3 Basic construction and operation principles of machinery systems, including:: .3 marine gas turbine
ME.5. A-III/1-KUP 1.4.1.4 Basic construction and operation principles of machinery systems, including: .4 marine boiler
ME.6. A-III/1-KUP 1.4.1.6 Basic construction and operation principles of machinery systems, including: .6 other auxiliaries, including various pumps, air compressor, purifier, fresh water generator, heat exchanger, refrigeration, airconditioning and ventilation systems
ME.7. A-III/1-KUP 1.4.1.7 Basic construction and operation principles of machinery systems, including: .7 steering gear
ME.8. A-III/1-KUP 1.4.2 Safety and emergency procedures for operation of propulsion plant machinery, including control systems
ME.9. A-III/1-KUP 1.4.3.1 Preparation, operation, fault detection and necessary measures to prevent damage for the following machinery items and control systems: .1 main engine and associated auxiliaries
ME.10. A-III/1-KUP 1.4.3.2 Preparation, operation, fault detection and necessary measures to prevent damage for the following machinery items and control systems: .2 steam boiler and associated auxiliaries and steam systems
ME.11. A-III/1-KUP 1.4.3.3 Preparation, operation, fault detection and necessary measures to prevent damage for the following machinery items and control systems: .3 auxiliary prime movers and associated systems
ME.12. A-III/1-3. Function: Maintenance and repair at the operational level
ME.13. A-III/1-3.2 Maintenance and repair of shipboard machinery and equipment
ME.14. A-III/1-KUP 3.2.2 Appropriate basic mechanical knowledge and skills
ME.15. A-III/1-KUP 3.2.3 Maintenance and repair, such as dismantling, adjustment and reassembling of machinery and equipment
ME.16. A-III/1-KUP 3.2.6 Interpretation of machinery drawings and handbooks

TEACHING METHODOLOGY

Teaching method is class work with the possibility of individual or grupal work and its presentation, practical exercises and individual work with the material in ATENEA.

LEARNING OBJECTIVES OF THE SUBJECT

Cognitive and comprehensive analysis of the work cycles of steam and gas turbines
Knowledge of the different parts that make up a steam and gas turbine.
Knowledge of the calculation of the triangles of speeds of the blades and nozzels-blades.
Knowledge of the calculation of powers, works, efficiency, etc.
Knowledge of the different types of turbines and their installation on board.
Use of the knowledge acquired for the design and dimensioning of the turbines.
Know the fundamentals of fluidomechanical systems and machines.
Demonstrates knowledge of the operation, calculation and applications in marine systems of steam and gas turbines and steam generators.
It is capable of designing and managing energy optimization systems applied to marine facilities.
Know the concept of a product's life cycle and apply it to the development of products and services in the field of marine engineering, using the appropriate regulations and legislation.
Plan and use the necessary information for a project or academic work based on a critical reflection on the information resources used.
This course will evaluate the following STCW competences:

4. Operate main and auxiliary machinery and associated control systems

7. Maintenance and repair of electrical and electronic equipment

9. Maintenance and repair of shipboard machinery and equipment

Steam generators
Achieve, understand and synthesise knowledge
Lay out and solve problems
Develop technical reports.
Take solutions for practical cases.
Develop the memory of a workshop or laboratory practice
Analyse results
Relate and connect knowledges of different subjects
Develop reasoning and critical ability and defend it in oral and written form

Show knowledge about the working, calculation and appliances in marine systems of steam and gas turbines and steam generators.
Ability of design and manage energetic optimization of marine steam installations.
Knowledge of the concept of life cycle of a product and apply to development of products and services in the marine engineering, using the proper legislation
Ability of planning and using the information for a project or academical work over a critical reflection about the information resources used.
This course will evaluate the following STCW competences:

4. Operate main and auxiliary machinery and associated control systems

7. Maintenance and repair of electrical and electronic equipment

9. Maintenance and repair of shipboard machinery and equipment

STUDY LOAD

Type	Hours	Percentage
Self study	135,0	60.00
Hours large group	70,0	31.11
Hours medium group	20,0	8.89

Total learning time: 225 h

CONTENTS

(ENG) Ciclos de trabajo de las turbinas de vapor.

(ENG) Clasificación de las turbinas.

(ENG) Partes de las turbinas: paletas, toberas, directrices y tobero-paletas.

(ENG) Estudio dinámico de las turbinas de flujo axial y radial.

(ENG) studio de las turbinas de acción.

(ENG) Estudio de las turbinas de reacción.

(ENG) Estatores de las turbinas.

(ENG) Rotores de las turbinas.

(ENG) Paletas o álabes de las turbinas.

(ENG) Regulación de la potencia de las turbinas de vapor.

(ENG) Condensadores.

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Description:
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Full-or-part-time: 1h
Theory classes: 1h

(ENG) Ciclos de trabajo de las turbinas de gas.

(ENG) Partes de un grupo motor de turbinas de gas: compresor, cámara de combustión y turbina.

(ENG) Combustión y combustibles de las turbinas de gas.

(ENG) Ciclos combinados.

Types of Steam generators.

Description:
Types of Steam generators. Parts of steam generators

Full-or-part-time: 5h
Theory classes: 5h

Boiler mountings.

Description:
Boiler mountings. Safety valves. Level indicators. Level sensors. Soot blowers.

Full-or-part-time: 5h
Theory classes: 5h

Fuels used in steam generators.

Description:
Fuels used in steam generators. Solid, liquid, gas fuels.

Full-or-part-time: 5h
Theory classes: 5h

Combustion

Description:
Combustion. Required air. Produced gases. Air excess. Combustion diagnose.

Full-or-part-time: 5h
Theory classes: 5h

Burners

Description:
Burners for solid fuels: Travelling Stokers, Pulverised coal, Fluidised bed
Burners for liquid fuels
Burners for gas. Pressure reduction equipment.

Full-or-part-time: 5h
Theory classes: 5h

Pollution emission and its reduction.

Description:
NOx. Means to avoid its formation. Ways to its elimination
SOx. Elimination
Other pollutants

Full-or-part-time: 5h
Theory classes: 5h

Water analysis and treatment

Description:
Alcaline treatment. Degasification. Ion exchange. Other treatments. Typical water analysis in the ships.

Full-or-part-time: 5h
Theory classes: 5h

Thermal balance and efficiency of steam generators.

Description:
Thermal balance: Direct and indirect methods.

Full-or-part-time: 5h
Theory classes: 5h

Operation and maintenance of steam generators.

Description:
Boiler starting, connecting, putting out of service, basic typical actions of operation and maintenance

Full-or-part-time: 5h
Theory classes: 5h

GRADING SYSTEM

Nfinal=0.5Nfinal TVG+NfinalGV
NfinalTVG = 0.7 Npf + 0.3 Nec
Nfinal GV = 0.7 Npf + 0.3 Nec
Nfinal:final qualification.
Npf: final exam qualification.
Nec: continuous assessment qualification.
Nelt: laboratory and works qualification.

EXAMINATION RULES.

If none of the exams is made, the qualification will be not pressented.

BIBLIOGRAPHY

Basic:

- Sánchez Naranjo, Consuelo. Teoría de la combustión [on line]. Madrid: UNED - Universidad Nacional de Educación a Distancia, 2007 [Consultation: 01/09/2022]. Available on: https://lectura-unebook-es.recursos.biblioteca.upc.edu/viewer/9788436263039. ISBN 9788436263039.
- Cohen, H.; Rogers, G. F. C.; Saravanamuttoo, H. I. H. Teoría de las turbinas de gas. Barcelona: Marcombo Boixareu, 1983. ISBN 8426704581.
- Harrington, Roy L. Marine engineering. Jersey City: Society of Naval Architects and Marine Engineers, 1992. ISBN 0939773104.
- Pérez del Río, José. Tratado general de máquinas marinas. Vol. 7 [on line]. Barcelona: Planeta, 1959-1970 [Consultation: 24/02/2020]. Available on: http://hdl.handle.net/2117/130277.
- Polo Encinas, Manuel. Turbomáquinas de fluidos compresibles. México DF: Limusa, 1984. ISBN 9681816137.
- Saarlas, Maido. Steam and gas turbines for marine propulsion. 2nd ed. Annapolis: Naval Institute Press, 1987. ISBN 0870216902.
- Segura Clavell, José. Termodinámica técnica. Barcelona: Reverté, 1988. ISBN 8429143521.
- Annaratone, Donatello. Generatori di vapore : calcolo, progettazione costruzione. Milano: Tamburini, 1975.
- Milton, James Hugh. Marine steam boilers. 4th ed. London: Butterworths, 1985. ISBN 0408004169.
- Perthuis, Edmond. La combustion industrielle. Paris: Technip, 1983. ISBN 2710804387.
- Port, Robert D.; Herro, Harvey M. The Nalco guide to boiler failure analysis. New York NY: McGraw-Hill, 1991. ISBN 0070458731.
- Steam: its generation and use. New Yok: Badcock & Wilcox, 2005. ISBN 0963457012.
- Stodola, A. Turbines à vapeur et à gaz. París: Dunod, 1925.
- Clark, George H. Industrial and marine fuels reference book. London: Butterworths, 1988. ISBN 0408014881.
- Cumo, Maurizio; Naviglio, Antonio. Thermal hydraulics. Vol. 1. Boca Raton FL: CRC Press, 1988. ISBN 0849367891.
- Cumo, Maurizio; Naviglio, Antonio. Thermal hydraulic design of components for steam generating plants. Boca Raton: CRC Press, 1991. ISBN 0849367921.
- Chigier, Norman. Energy, combustion, and environment. New York: McGraw-Hill, 1981. ISBN 0070107661.
- ASM handbook. Vol. 11, Failure analysis and prevention. 9th ed. Metals Park: ASM International, 1992. ISBN 0871707047.
- Guillermic, A. Chauffage par les combustibles liquides : caractéristiques des combustibles. Paris: Technip, 1979. ISBN 2710803240.
- Boilers, evaporators & condensers. Wiley: New York, 1991. ISBN 0471621706.
- Kohan, Anthony Lawrence; Spring, Harry Mortimer. Boiler operator's guide. New York: McGraw-Hill, 1991. ISBN 0070356971.
- Lokshin, V.A.; Peterson, D.F.; Schwarz, A.L. Standard methods of hydraulic design for power boilers. Washington: Hemisphere, 1988. ISBN 089116359X.
- Molina Igartua, Luis Alfonso; Molina Igartua, Gonzalo. Manual de eficiencia energética térmica en la industria. Bilbao: Ente Vasco de la Energía, 1993. ISBN 848129022X.
- Carroll, Dyer E. The ASME code simplified : power boilers. New York: Mc Graw-Hill, 1997. ISBN 0070116369.
- Bernstein, Martin D.; Yoder, Lloyd W. Power boilers : a guide to section I of the ASME boiler and pressure vessel code. New York: Asme Press, 1998. ISBN 0791800563.
- VDI e. V. (ed.). VDI Heat Atlas [on line]. 2nd ed. Berlin: Springer, 2010 [Consultation: 22/10/2018]. Available on: http://dx.doi.org/10.1007/978-3-540-77877-6. ISBN 9783540778776.
- Basu, Prabir [et al.]. Boilers and burners : design and theory. Berlin: Springer, 2000. ISBN 0387987037.
- Ganapathy, V. Industrial boilers and heat recovery steam generators : design, applications, and calculations. New York: Marcel Dekker, 2003. ISBN 082470814.
- VDI-Gesellschaft Energietechnik. Energietechnische Arbeitsmappe. Berlin: Springer, 2000. ISBN 9783642630804.
- Port, Robert D; Herro, Harvey M. Guía Nalco para el análisis de fallas en calderas. México [etc.]: McGraw-Hill, cop. 1997. ISBN 970101345X.