

Course guide

280653 - 280653 - Refrigeration and Air Conditioning Facilities

Last modified: 27/05/2024

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: 2024 **ECTS Credits:** 4.5 **Languages:** Spanish

LECTURER

Coordinating lecturer: SERGIO IVÁN VELASQUEZ CORREA

Others: Primer quadrimestre:
SERGIO IVÁN VELASQUEZ CORREA - DT, GTM

PRIOR SKILLS

It is advisable that the students have passed 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-KUP 1.4.3.4 Preparation, operation, fault detection and necessary measures to prevent damage for the following machinery items and control systems: .4 other auxiliaries, including refrigeration, airconditioning and ventilation systems

ME.3. A-III/1-3. Function: Maintenance and repair at the operational level

ME.4. A-III/1-KUP 3.2.1 Safety measures to be taken for repair and maintenance, including the safe isolation of shipboard machinery and equipment required before personnel are permitted to work on such machinery or equipment

ME.5. A-III/1-KUP 3.2.2 Appropriate basic mechanical knowledge and skills

ME.6. A-III/1-KUP 3.2.3 Maintenance and repair, such as dismantling, adjustment and reassembling of machinery and equipment

ME.7. A-III/1-KUP 3.2.4 The use of appropriate specialized tools and measuring instruments

ME.8. A-III/1-KUP 3.2.5 Design characteristics and selection of materials in construction of equipment

ME.9. A-III/1-KUP 3.2.6 Interpretation of machinery drawings and handbooks

ME.10. A-III/1-KUP 3.2.7 The interpretation of piping, hydraulic and pneumatic diagrams

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

Knowledge of cycles and theoretical basics of refrigeration.
 Thorough knowledge of the elements of marine refrigeration devices and refrigerants used.
 Marine HVAC systems.
 Recovery and recycling of refrigerants.
 Knowledge of refrigeration and HVAC devices and ability to apply it for the calculation of these installations.
 Knowledge of the life cycle of a product related with refrigeration and application to the development of products and services in the marine engineering.
 Planning and use of the required information for a project or academical work.
 STCW competences:
 Appropriate use of hand tools, machine tools and measuring instruments for fabrication and repair on board
 Project characteristics and selection of materials for the building of equipment.
 Interpretation of instructions books and drawings.
 Operational functions of systems and equipments.
 Main and auxiliary machinery operation and their control systems.
 Maintenance of marine machinery systems including control devices.
 Other competences:
 Obtain, understand and synthesise knowledge.
 Lay out and resolve technical problems.
 Prepare technical reports.
 Find solutions for practical problems.
 Prepare the report of laboratory practices or works.
 Analyse results.
 Relate knowledges of different subjects.
 Develop the evaluating and reasoning capacity.

STUDY LOAD

Type	Hours	Percentage
Hours large group	45,0	40.00
Self study	67,5	60.00

Total learning time: 112.5 h

CONTENTS

Fundamental principles.

Description:

1. Historical context of refrigeration and air conditioning
2. Thermodynamic principles applied to refrigeration and air conditioning

Specific objectives:

To know the empirical, scientific and technical concepts of refrigeration and air conditioning processes throughout history

Related activities:

Masterclasses and recommended readings on the subject

Full-or-part-time: 5h

Theory classes: 5h



Refrigeration cycles.

Description:

Thermodynamical cycles used in refrigeration, their representation in diagrams and main characteristics and elements.

Specific objectives:

To understand the different states of working substances in the stages of simple, cascade, compound and absorption refrigeration cycles.

Related activities:

Master classes, readings on related texts and applied problem-solving.
Assignment of exercises as part of continuous assessment

Full-or-part-time: 5h

Theory classes: 5h

3. Refrigerant fluids.

Description:

Environmental impact. Safety.

Specific objectives:

To know the chemical, performance and environmental disposition characteristics of the different substances used in refrigeration processes.

Related activities:

To Use the reference HVAC and refrigeration manuals.
To know the substance diagrams and tables to obtain working data in different situations and practical problems

Full-or-part-time: 11h

Theory classes: 5h

Guided activities: 1h

Self study : 5h



Mechanical compression installations.

Description:

Refrigerants used. Classifications. Toxicity, flammability and environmental pollution.

Primary and secondary refrigerants.

Elements of the single and compound mechanical compression installations. Flooded and dry evaporators. Direct and secondary fluid installations.

Compound cycles.

Types of compressor and capacity control devices.

Condensers. Evaporative condensers. Towers.

Evaporators. Defrosting systems.

Expansion devices. Capilar tubes. Thermostatic, level and electronic valves.

Control and automation devices.

Auxiliary devices. Piping.

Specific objectives:

To know the devices, mechanisms and physical elements integrated in gas compression refrigeration systems.

To identify the working conditions and parameters of the different devices integrated in the refrigeration systems depending on the thermal loads and the working conditions.

Related activities:

Master classes and applied problem solving.

Use of thermodynamic diagrams of the working substances.

Use of specific software for the calculation and sizing of vapor compression refrigeration systems

Full-or-part-time: 13h

Theory classes: 13h

5. Refrigerant recovery and recycling.

Description:

Systems for the recovery of all the refrigerant and oil from an installation prior to wrecking.

Specific objectives:

To know the regulatory requirements in the use and recovery of refrigerant substances

Related activities:

Master classes and presentation of practical cases

Full-or-part-time: 7h

Theory classes: 1h

Guided activities: 1h

Self study : 5h



Marine refrigeration installations.

Description:

Modern ammonia installations.
Refrigeration installations with brine.
Refrigeration chambers in the ships.
Reefers.
Refrigerated containers.

Specific objectives:

To know the specific applications of refrigeration systems in the maritime sector:

- * refrigerated transport of products
- * Freezing and deep-freezing of products and merchandise
- * Special transportation (liquefied natural gas and other special merchandise)
- * Air conditioning and conditioning of special cargo and spaces for the crew

Related activities:

Master classes and applied problem solving
Recommended reading and assignment of tutored practical work

Full-or-part-time: 5h

Theory classes: 5h

HVAC

Description:

Diagrams. Processes.
HVAC in ships.
Operation and maintenance.

Specific objectives:

To know the different practical aspects of air conditioning and its applications in the maritime sector

Related activities:

Masterclasses and application problems
Use of the psychrometric chart in different practical applications of air conditioning preparation of work environments

Full-or-part-time: 5h

Theory classes: 5h

Absorption systems.

Description:

Absorption systems.

Specific objectives:

To know other refrigeration and cooling methods based on absorption systems beyond systems that use vapour compression and its potential industrial and maritime applications

Related activities:

Masterclasses and resolution of practical and applied problems

Full-or-part-time: 2h 30m

Theory classes: 2h 30m



9. Calculation of refrigeration systems.

Description:

Calculation of refrigeration systems.

Specific objectives:

Dimension the size, geometry and energy needs of a refrigeration and air conditioning installation with an emphasis on maritime applications.

Related activities:

Master classes and problem solving applied in the calculations of thermal loads and sizing of refrigeration and air conditioning installations

Full-or-part-time: 4h 30m

Theory classes: 2h 30m

Guided activities: 1h

Self study : 1h

ACTIVITIES

Tutored work (refrigeration and / or air conditioning installation project)

Description:

Tutored work (refrigeration and / or air conditioning installation project)

Delivery:

Written project

Full-or-part-time: 8h 20m

Theory classes: 8h 20m

GRADING SYSTEM

Final exam with a value of 70% of the qualification, partial exams or another works with a total value of 30% of the qualification. Reevaluation is made with an exam.

EXAMINATION RULES.

If a student does not make any exam, his qualification will be not presented.

BIBLIOGRAPHY

Basic:

- Curso de ingeniería del frío. 2a ed. Madrid: Madrid Vicente, 1993. ISBN 848744041X.
- Stoecker, W. F. Refrigeration and air conditioning,. 2nd ed. New York NY: McGraw-Hill, 1982. ISBN 0070616191.

Complementary:

- ASHRAE Handbook : Heating, ventilating, and air-conditioning: applications2003. Atlanta: American Society of Heating, Refrigerating and Air-Conditioning Engineers,, 1989. ISBN 1931862230.
- ASHRAE handbook : refrigeration systems and applications. Atlanta: American Society of Heating, Refrigerating and Air-Conditioning Engineers, 1994.
- Vademécum de la recuperación de los CFC y otros fluidos frigorígenos. Madrid: A. Madrid Vicente., 1995. ISBN 8487440657.
- Réfrigération et congélation à bord des navires de pêche : Cooling and freezing aboard fishing vessels. Paris: International Institute of Refrigeration, 1974.



- Pinazo Ojer, José Manuel. Manual de climatización. Valencia: Universidad Politécnica de Valencia, 1995. ISBN 8477213399.
- Progrès technologiques dans l'entreposage et le transport frigorifiques. Paris: International Institute of Refrigeration, 1985. ISBN 2903633325.
- Torrella Alcaraz, Enrique. La Producción de frío. Valencia: Universidad Politécnica de Valencia, 1996. ISBN 8477213674.
- Alders, A. W. C. Marine refrigeration manual. Rotterdam: Marine Chartering Agents, 1987. ISBN 9090015760.
- Andrés y Rodríguez-Pomatta, Juan A. de. Calor y frío industrial I 2 vol. Madrid: UNED, 1987. ISBN 8436215974 (O.C.).
- ASHRAE handbook : Fundamentals. Atlanta: American Society of Heating, Refrigerating and Air-Conditioning Engineers, 1989. ISBN 0910110964.
- Curso de ingeniería del frío,. 2a ed. Madrid: A. Madrid Vicente, 1993. ISBN 848744041X.
- Stoecker, W. F. Refrigeration and air conditioning. 2a ed. New York NY: McGraw-Hill, 1982. ISBN 0070616191.