Course guide
2400156 - 240MER61 - Smart District Heating and Cooling Networks

Last modified: 01/07/2026

Unit in charge: Barcelona School of Industrial Engineering
Teaching unit: 724 - MMT - Department of Heat Engines.

Degree: MASTER'S DEGREE IN RENEWABLE ENERGY ENGINEERING (Syllabus 2025). (Optional subject).

Academic year: 2026 **ECTS Credits:** 5.0 **Languages:** English

LECTURER

Coordinating lecturer: De Medina Iglesias, Vicente César

Others: De Medina Iglesias, Vicente César

PRIOR SKILLS

Self-directed learning, mathematical calculations, and the use of simulation tools.

REQUIREMENTS

Knowledge in heat trasnfer, fluid mechanics and energies.

TEACHING METHODOLOGY

The course employs the following teaching methodologies:

- Lectures (L):** Classroom sessions delivered by the instructor and/or invited guest lecturers.
- Problem-Based Learning (PBL):** Resolution of case studies of sufficient scope to enable students to reason about and apply the main concepts covered in the course.

LEARNING OBJECTIVES OF THE SUBJECT

The main objective of this course is to provide students with a comprehensive understanding of smart grids for district heating and cooling (DHC) systems, focusing on the technologies, methodologies, and operational strategies required to design, operate, and optimize modern thermal energy networks. The course introduces the evolution of district heating and cooling from conventional systems to fourth- and fifth-generation networks, emphasizing the integration of renewable energy sources, waste heat recovery, thermal energy storage, and large-scale heat pumps. By the end of the course, students will be able to evaluate the performance of smart thermal grids, assess their contribution to energy efficiency and decarbonization, and understand their role within integrated smart energy systems and sustainable urban energy infrastructures.

STUDY LOAD

Type	Hours	Percentage
Hours large group	30,0	66.67
Hours small group	15,0	33.33

Total learning time: 45 h

CONTENTS

Introduction to district heating/cooling

Description:
Description of the operation of district heating and cooling networks and their role in the context of sustainability and energy efficiency.
Description of their main components, the associated energy sources, and the use of waste heat.

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

DHC historical evolution

Description:
District heating and cooling networks are classified into different generations according to the technologies they employ. This topic introduces the historical evolution that has led to the current state of development.

Full-or-part-time: 3h
Theory classes: 3h

Heat transport networks components

Description:
Theory and calculation of heat transport networks components.

Full-or-part-time: 6h
Theory classes: 6h

Heat demands and offers

Description:
Demand and offer description, roles and market.

Full-or-part-time: 6h
Theory classes: 6h

Substations

Description:
Heat transfer technologies between the grid and the producer or consumer.

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

Global system operation

Description:
Desciption of network operation.

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

Planning and economy

Description:
Assessment of the implementacion costs and operation and management.

Full-or-part-time: 3h
Theory classes: 3h

Smart grids concepts aplication

Description:
Smart grid concepts application to the DHC grids.

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

Computer modeling of DHC grids.

Description:
Simulation of DHC grids using software, introducion to apps and applied cases.

Full-or-part-time: 10h
Laboratory classes: 10h

Work on the course application project

Description:
Course assignment project.

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

GRADING SYSTEM

One assignment along the course (AS1) and an exam (EX).
The final grade (GR) is obtained through:

GR = 0.,5*AS1 + 0,5*EX

BIBLIOGRAPHY

Basic:
- Svend Frederiksen, Sven Werner. District Heating & Cooling. Studentlitteratur AB, 2013. ISBN 9144085303.