Course guide
310707 - 310707 - Physics of Installations and Energy Efficiency

Last modified: 09/05/2025

Unit in charge: Barcelona School of Building Construction
Teaching unit: 748 - FIS - Department of Physics.

Degree: BACHELOR'S DEGREE IN ARCHITECTURAL TECHNOLOGY AND BUILDING CONSTRUCTION (Syllabus 2019). (Compulsory subject).

Academic year: 2025 **ECTS Credits:** 4.5 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: Carlota E. Auguet Sangrá

Others: Inmaculada Rodríguez
Miguel Ángel Gutierrez
Óscar Lorente Espín
M. Luisa Perea Ibáñez
Laureano Ramírez-Piscina
Adrià Tauste
Blas Echebarria
Julián Álvarez

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. FE-4 Knowledge of the materials and traditional or prefabricated construction systems used in construction, their varieties and physical and mechanical features which define them.
4. FB-5 Knowledge of the theoretical basis and the basic principles applied to the construction, of the fluid mechanics, the hydraulics, the electricity and electromagnetism, the calorimetry and thermal comfort, and the acoustics.

Transversal:
5. SUSTAINABILITY AND SOCIAL COMMITMENT - Level 2. Applying sustainability criteria and professional codes of conduct in the design and assessment of technological solutions.
6. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 2. Using strategies for preparing and giving oral presentations. Writing texts and documents whose content is coherent, well structured and free of spelling and grammatical errors.
7. TEAMWORK - Level 2. Contributing to the consolidation of a team by planning targets and working efficiently to favor communication, task assignment and cohesion.
8. 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.
9. 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.

TEACHING METHODOLOGY

- Theory master classes
- Problem sessions conducted by the teacher
- Problem sessions made by the students and authorized by the professor

LEARNING OBJECTIVES OF THE SUBJECT

The student must be able to acquire and to apply the theoretical bases of the fluid mechanics and transport of energy in building. Also they have to be able to understand and to apply the concepts and methods of hygrothermy and the heat flow to the conditioning and isolation in building. Finally, they have to be able to do analysis and evaluations of the energetic requirements of a building that allows determine its energetic efficiency. Short introduction to the electricity.

STUDY LOAD

Type	Hours	Percentage
Hours medium group	6,8	6.04
Hours large group	22,5	19.98
Hours small group	15,8	14.03
Self study	67,5	59.95

Total learning time: 112.6 h

CONTENTS

Fluid dynamics

Description:
Steady state. Continuity equation. Bernouilli's theorem. Venturi effect. Real fluids. Viscosity. Laminar and turbulent regime. Reynolds number. Poiseuille's Law. Loss of load. Applications: Pumps, water hammer.

Specific objectives:
Understand the energy balance of pressures.
Acquire and apply the theoretical foundations and basic principles of fluid mechanics in buildings

Related activities:
Problem resolution

Full-or-part-time: 8h
Theory classes: 3h 30m
Practical classes: 4h 30m

Temperature and heat

Description:
Temperature and heat. Thermal expansion. Thermal stresses. Specific heat. Latent heat.

Specific objectives:
Understand the effects of thermal expansion on the stresses that occur.

Related activities:
Resolution of exercises on the subject.

Full-or-part-time: 5h
Theory classes: 2h
Practical classes: 3h

Heat spread

Description:
Heat transmission by conduction: Fourier's Law. Thermal conductivity. Thermal resistance Association of thermal resistances Equivalent thermal resistance.
Heat transmission by convection.
Radiation heat transmission: Electromagnetic radiation. Stefan-Boltzmann law. Black body. Kirchoff's law of thermal radiation. Wien's displacement law (thermal camera). Newton's law of cooling.

Specific objectives:
Acquire and apply the theoretical foundations and basic principles of energy transport in buildings.
Interpret and apply the concepts and methods of heat transmission to conditioning and insulation in buildings.

Related activities:
Solve exercises and problems posed in class

Full-or-part-time: 11h
Theory classes: 5h
Practical classes: 6h

Fundamentals of hygrometry

Description:
Absolute and relative humidity. Hygrometers. Humidity in construction. Psychometric diagram. dew temperature. Water vapor diffusion of materials. Vapor pressure. Saturation pressure. Condensation.

Specific objectives:
Interpret and apply the concepts and methods of hygrothermia.
Know how to identify pathologies related to humidity in buildings.

Related activities:
Solve exercises proposed in class

Full-or-part-time: 6h
Theory classes: 3h
Practical classes: 3h

Energy demand

Description:
Global transmission coefficient: Thermal transmittance. Thermal inertia. Construction application: ventilated chambers. Trombe walls. Energy balance of buildings. Limitation of energy demand. Energy rating: Ce3x. Calculation of CO_2 emissions.

Specific objectives:
Carry out analysis and evaluations of the building's energy demand to determine its energy efficiency, using current computer tools.

Related activities:
Realization of practical exercises in class.

Full-or-part-time: 12h
Theory classes: 6h
Practical classes: 6h

Introduction to the electricity

Description:
Continuous current. Ohm's Law. Joule effect. Induction of altern current. RLC circuits.

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

ACTIVITIES

First midterm exam

Description:
Evaluation that counts 20%

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

Second midterm exam

Description:
Second part of the subject, counts 20%

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

Final exam

Description:
Final exam, 50% of final qualification

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

C2.EN.1.X Ce3x work

Description:
At the end of the subject of Energy demand it will be a session out of time schedule to explain the Ce3x program.
This corresponds to the tranversal competence C2.EN.1.X

Specific objectives:
To know the going on of the Ce3x and its apply.

Material:
Personal computer.

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

GRADING SYSTEM

There will be a homework with the Ce3x program (T) (10%), an exam with the first part of contents (PE1) (20%), an exam with the second part of contents (PE2) (20%) and a final exam including all the contents. (ExFin) (50%)

According to Normativa Académica de Estudios de Grado y Máster de la UPC and EPSEB, the final evaluation of the subject will be done as it is described.

The final grade of the subject will be the larger between these two grades:

a) m: Arithmetic mean of the pertinent marks of T, PE1, PE2 and ExFin.

m = 0.10 t + 0.25p + 0.15s + 0.5f
where
t = T mark
p = PE1 mark
s = PE2 mark
f = ExFin final exam mark.

b) f: Final exam mark.

To achieve the HM it is compulsory to present the Ce3x work.
Reappraisal

The student who has failed the subject with a numerical mark between 3.5 and 4.9 will have the opportunity to do an unique reappraisal exam, which will include all the contents of the subject and will be done in a settled term. If the student pass the exam, his final mark of the subject will be 5.0. It is compulsory to have done the final examen and the Ce3x exercise to be able to do the reappraisal exam.
The student won't be able to do this reappraisal exam if:
i) The student has already passed the subject.
ii) The student's final mark is less than 3.5 (including NP).

EXAMINATION RULES.

- The teacher will provide the students with the formulary at the time of the exam.
- It is not allowed to enter the room once the exam has started.
- It is not allowed to have a phone during the exam.

BIBLIOGRAPHY

Basic:
- Tipler, Paul A.. Física para la ciencia y la tecnología Vol. 1. quarta. Espanya: Reverté S.A., 1999. ISBN 84-291-4381-5.
- Llinares, J., Llopis, A., Sancho, J., Gómez, V.. Térmica en la edificación. Valencia: Guada Impresores S. L., 2000. ISBN 84-931209-2-8.
- Auguet, C., Cami, E., Ramírez, L., Rodríguez, I.. Temperatura i calor. Teoria i problemes [on line]. Edicions UPC. Barcelona: UPC commons, 1995Available on: http://hdl.handle.net/2099.3/36369. ISBN 9788498802993.
- Gordejuela, F., Alonso, R., del Ama, F., Aramburu, F., Bautista, J. et al. ABECÉ de las instalaciones. Munilla-Lería, 2012. ISBN 978-84-89150-80-5.

RESOURCES

Other resources:
Audiovisual Material

·DVD Humitats per capil·laritat
Rodríguez Cantalapiedra, I.; Lacasta, A; Sarró, P.