Course guide
310401 - 310401 - Physical Phenomena in Building Construction

Last modified: 25/09/2025

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

Degree: MASTER'S DEGREE IN ADVANCED BUILDING CONSTRUCTION (Syllabus 2014). (Compulsory subject).

Academic year: 2025 **ECTS Credits:** 5.0 **Languages:** Catalan, Spanish, English

LECTURER

Coordinating lecturer: INMACULADA RODRIGUEZ CANTALAPIEDRA

Others: Lacasta Palacio, Ana Maria
Rodriguez Cantalapiedra, Inmaculada
Ramirez De La Piscina Millan, Laureano
Vásquez Paredes, Rodrigo Antonio

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
6. Use the physic principles in the thermic, luminic and acoustic scope.
7. Recognise the materials and construction techniques of each historical period and value its influence in the architecture design.
8. Manage the installations, its costs and maintenance.

Generical:
9. Provide to the student the capacity to apply the knowledge acquired in the resolution of complex problems in any sector of the building construction.
11. Obtain results that can be transfered to the building construction sector, through the applied investigation, the technological developement and the innovation.
10. Analyse, evaluate and synthesise critically, new and difficult ideas of promotion, in academic and professional contexts, cientific advances, technologics, socials or culturals in the society of knowledge.

Transversal:
12. EFFECTIVE USE OF INFORMATION RESOURCES. Managing the acquisition, structure, analysis and display of information from the own field of specialization. Taking a critical stance with regard to the results obtained.

Basic:
2. Possess and understand knowledge which provide a basis or opportunity to be original in the development and/or application of ideas, usually in a context of research.
3. The students must be able to apply the acquired knowledges and their ability of resolution of problems in new or little known environments inside more wide environments (or multidisciplinary) related with their study field.
4. The students must be able to integrate knowledges and front to the complexity to formulate opinions from an information which, being incomplete or limited, includes reflections about the social and ethical responsabilities linked to the application of their knowledges and opinions.
5. The students must be able to communicate their conclusions and the knowledges and ultimate reasons which support to specialised and non-specialised audiences in a clear mode and without ambiguities.
1. The students must possess the learning abilities which allow them to continue studying in a way which should be to a large extent self-directed and autonomous.

TEACHING METHODOLOGY

Blackboard classes: theory and problems.
Two lab practices.
Promotion of group work.

LEARNING OBJECTIVES OF THE SUBJECT

- Acquisition of basic physical knowledge in thermal, lighting and acoustic fields.
- Acquiring knowledge on the modeling of physical processes and their resolution using numerical simulation methods.
- Learning about heat exchange, thermal perception, indoor air quality, ventilation, lighting conditions and propagation and noise control.
- Development of practices to assess the degree of comfort of a particular room or building, identifying and resolving problems caused by improper use or design skills.
- Acquisition of generic skills to integrate studies of comfort within generic architectural projects.

STUDY LOAD

Type	Hours	Percentage
Self study	90,0	72.00
Hours small group	5,0	4.00
Hours large group	17,5	14.00
Hours medium group	5,0	4.00
Guided activities	7,5	6.00

Total learning time: 125 h

CONTENTS

Fundamentals of heat and water vapor transfer

Description:
Temperature and heat. Specific heat and latent heat. Physics of humid air: Relative humidity and psychometrics. Mechanisms of heat transfer: radiation, convection and conduction. Condensations. Transient regime and thermal inertia. Numerical simulations.

Full-or-part-time: 42h
Theory classes: 8h
Practical classes: 2h
Guided activities: 2h
Self study : 30h

Thermal comfort and indoor air quality

Description:
Environmental factors. Instruments and methods for measuring environmental factors. Personal factors: physical activity (Met) and clothing (Clo). Fanger evaluation method of thermal comfort. Adaptive Methods. Indoor air pollutants. Renewal of indoor air. Specifications and recommendations.

Related activities:
Practice on thermal comfort and indoor air quality at the Laboratory of Acoustics and Energy Saving

Full-or-part-time: 23h
Theory classes: 4h
Practical classes: 1h
Laboratory classes: 3h
Self study : 15h

Basic concepts for natural ventilation of buildings

Description:
Natural Ventilation: Single-Sided Ventilation, Cross-Ventilation, Stack Ventilation, Windcacthers, Solar-Induced Ventilation, Hybrid Ventilation. Airflow in Natural Ventilation: Factors Influencing the airflow through openings, Indoor Environmental considerations. Wind Speed. Wind and Stack(Buoyancy) Pressures. Surface Coefficients(Cp). Flow through an Opening. Effective area of multiple openings. Flow through a centre pivoted window. Combined Flow through an Opening. Computer Fluid Simulation (CFD) for Natural Ventilation.

Full-or-part-time: 20h
Theory classes: 2h
Practical classes: 1h
Laboratory classes: 1h
Guided activities: 1h
Self study : 15h

Fundamentals of Lighting

Description:
Characterization of light: quantities and units. Spectrum and color temperature. Luminous material behavior: reflection, absorption and transmission. Indoor lighting. Perception and visual comfort: light level, glare. Natural and artificial lighting.

Related activities:
Practical work on lighting, at the Laboratory of Acoustics and Energy Saving EPSEB

Full-or-part-time: 20h
Theory classes: 2h
Practical classes: 1h
Laboratory classes: 1h
Guided activities: 1h
Self study : 15h

Fundamentals of acoustics

Description:
Nature and characteristics of sound. Spectral analysis of noise and weighting sound pressure level. Acoustic behavior of materials: reflection, absorption and transmission. Fitness and acoustic insulation.

Full-or-part-time: 20h
Theory classes: 2h
Practical classes: 1h
Laboratory classes: 1h
Guided activities: 1h
Self study : 15h

GRADING SYSTEM

The qualification system constist of a final exam (EF) and a course evaluation including problems (P), works in group (TG) and lab practices (PL). The final mark is given by:
0.40*EF + 0.15*P + 0.15*TG + 0.30*PL

BIBLIOGRAPHY

Basic:
- Martín Monroy, Manuel. Calidad ambiental en la edificación para Las Palmas de Gran Canaria, Islas Canarias [on line]. Las Palmas de Gran Canaria: Ayuntamiento de Las Palamas, 2006 [Consultation: 22/07/2014]. Available on: http://editorial.dca.ulpgc.es/ftp/icaro/Inicio.htm. ISBN 8469006584.
- Hegger, Manfred; Zeumer, Martin; Stark, Thomas; Fuchs, Matthias. Energy Manual: Sustainable Architecture. Basel: Birkhäuser, 2008. ISBN 9783764388300.
- Proyecto EU TAREB. Energía, confort y arquitectura : proyecto EU TAREB / TAREB. London: London Metropolitan University, 2004.
- Ventilación natural en edificios : fundamentos y métodos de cálculo para aplicación de ingenieros y arquitectos [on line]. Buenos Aires: Nobuko, 2005 [Consultation: 28/08/2023]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=5308055. ISBN 987584036X.
- Rodriguez Rodríguez, Francisco Javier. Guía acústica de la construcción. 2a ed. Madrid: CIE Inversiones Editoriales Dossat 2000, 2008. ISBN 9788496437814.