



Teaching Guide

| Identifying Data | | | | | 2024/25 |
|----------------------------|--|---------------|-------------------------|----------------|---------|
| Subject (*) | Physics for Architecture 2 | | Code | 630G02013 | |
| Study programme | Grao en Estudos de Arquitectura | | | | |
| Descriptors | | | | | |
| Cycle | Period | Year | Type | Credits | |
| Graduate | 1st four-month period | Second | Basic training | 6 | |
| Language | Spanish | | | | |
| Teaching method | Face-to-face | | | | |
| Prerequisites | | | | | |
| Department | Construcións e Estruturas Arquitectónicas, Cívís e AeronáuticasEnxeñaría Civil | | | | |
| Coordinador | López César, Isaac | E-mail | isaac.lopez@udc.es | | |
| Lecturers | Dominguez Diez, Javier Faustino | E-mail | javier.dominguez@udc.es | | |
| | López César, Isaac | | isaac.lopez@udc.es | | |
| Web | | | | | |
| General description | <p>The subject Physics for Architecture 2 provides an introduction to physical phenomena relevant to architectural design and how they are included in current regulations.</p> <p>The behavior of fluids is studied, both moving and at rest, as well as heat transfer focused to building envelopes. It also includes contents of applied acoustics, electricity and, finally, theory of light and color.</p> <p>The subject Physics for Architecture 2 provides an introduction to physical phenomena relevant to architectural design and how they are included in the current mandatory regulations.</p> <p>This is, therefore, a course of physics applied to architecture which includes an approach to hydrostatic contents - that will allow the students, for example, to determine hydrostatic thrusts on walls or slabs-; hydrodynamics - focusing especially on the behavior of fluids inside ducts; concepts of thermodynamics and hygrometry focused on the study of the envelopes of buildings and the thermal conditioning of architectural spaces; acoustics applied to the insulation and conditioning of premises; besides contents about electricity and theory of light and color. Whenever possible, the concepts explained apply to real architectural situations, underscoring the relationship between physics and architecture.</p> | | | | |

Study programme competences / results

| Code | Study programme competences / results |
|------|---|
| A8 | "Knowledge of the principles of thermodynamics, acoustics and optics adapted and applied to architecture and urbanism " |
| A9 | "Knowledge of the principles of fluid mechanics, hydraulics, electricity and electromagnetism adapted and applied to architecture and urbanism " |
| A63 | Development, presentation and public review before a university jury of an original academic work individually elaborated and linked to any of the subjects previously studied |
| B1 | Students have demonstrated knowledge and understanding in a field of study that is based on the general secondary education, and is usually at a level which, although it is supported by advanced textbooks, includes some aspects that imply knowledge of the forefront of their field of study |
| B2 | Students can apply their knowledge to their work or vocation in a professional way and have competences that can be displayed by means of elaborating and sustaining arguments and solving problems in their field of study |
| B3 | Students have the ability to gather and interpret relevant data (usually within their field of study) to inform judgements that include reflection on relevant social, scientific or ethical issues |
| B4 | Students can communicate information, ideas, problems and solutions to both specialist and non-specialist public |
| B5 | Students have developed those learning skills necessary to undertake further studies with a high level of autonomy |
| B6 | Knowing the history and theories of architecture and the arts, technologies and human sciences related to architecture |
| B10 | Knowing the physical problems, various technologies and function of buildings so as to provide them with internal conditions of comfort and protection against the climate factors in the context of sustainable development |



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| B11 | "Knowing the industries, organizations, regulations and procedures involved in translating design concepts into buildings and integrating plans into planning " |
| B12 | Understanding the relationship between people and buildings and between these and their environment, and the need to relate buildings and the spaces between them according to the needs and human scale |
| C1 | Adequate oral and written expression in the official languages. |
| C3 | Using ICT in working contexts and lifelong learning. |
| C4 | Exercising an open, educated, critical, committed, democratic and caring citizenship, being able to analyse facts, diagnose problems, formulate and implement solutions based on knowledge and solutions for the common good |
| C5 | Understanding the importance of entrepreneurial culture and the useful means for enterprising people. |
| C6 | Critically evaluate the knowledge, technology and information available to solve the problems they must face |
| C7 | Assuming as professionals and citizens the importance of learning throughout life |
| C8 | Valuing the importance of research, innovation and technological development for the socioeconomic and cultural progress of society. |

| Learning outcomes | | | |
|--------------------------------|---------------------------------------|---|----------------------------------|
| Learning outcomes | Study programme competences / results | | |
| FLUID MECHANICS AND HYDRAULICS | A8 A9 A63 | B1 B2 B3 B4 B5 B6 B10 | C1 C3 C5 C6 C7 C8 |
| HEAT TRANSFER IN REAL WALLS | A8 A9 A63 | B1 B2 B3 B4 B5 B6 B10 B11 B12 | C1 C3 C4 C6 C7 C8 |
| ACOUSTICS | A8 A9 A63 | B1 B2 B3 B4 B5 B6 B10 | C1 C3 C5 C6 C7 C8 |
| ELECTRICITY | A8 A9 A63 | B1 B2 B3 B4 B5 B6 B10 | C1 C3 C5 C6 C7 C8 |



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|----------------------------|-----|-----|----|
| THEORY OF LIGHT AND COLOUR | A8 | B1 | C1 |
| | A9 | B2 | C3 |
| | A63 | B3 | C5 |
| | | B4 | C6 |
| | | B5 | C7 |
| | | B6 | C8 |
| | | B10 | |

| Contents | |
|--------------------------------|--|
| Topic | Sub-topic |
| FLUID MECHANICS AND HYDRAULICS | INTRODUCTION HISTORY PROPERTIES OF FLUIDS HYDROSTATICS PRESSURE AT A POINT BASIC PRINCIPLES FUNDAMENTAL EQUATION SUBMERGED SURFACE PRESSURES HYDROSTATIC THRUST PRESSURE CENTER PRISMA PRESSURE FUNDAMENTALS OF FLUID FLOW CLASSIFICATION OF FLOWS LINES, POWER WIRES AND TUBES FLOW. DIMENSIONAL EQUATION. UNITS ENERGY IN A MOVING FLUID BERNOULLI THEOREM IDEAL FLUID REAL FLUID HYDRAULIC POWER FLUID FLOW MEASUREMENT FLUID FLOW IN PIPES INTRODUCTION. LAMINAR AND TURBULENT FLOWS DISTRIBUTION OF SPEED. BOUNDARY LAYER ADIMENSIONASL NUMBERS. REYNOLDS NUMBER SURFACE RESISTANCE. PRIMARY LOAD LOSSES GENERAL EQUATION MOODY CHART HIGH LOAD LOSSES BRANCHED, SERIAL AND PARALLEL PIPING SYSTEMS MESHES OPEN CHANNEL FLOW MANNING AND CHÉZY FORMULA FORCES DEVELOPED BY FLUID MOTION PRINCIPLES OF MOMENTUM - MOMENTUM FORCES ON ELBOWS WATER HAMMER |



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| HEAT TRANSFER IN REAL WALLS | COMBINED ACTION OF THREE MECHANISMS OF HEAT TRANSFER WINTER CONDITIONS HEAT TRANSFER THROUGH OPAQUE WALLS TEMPERATURE DISTRIBUTION IN THE ENCLOSURE HEAT TRANSFER ARISING FROM INFILTRATIONS AND ROOM VENTILATION SUMMER CONDITIONS HEAT TRANSFER THROUGH OPAQUE WALLS THERMAL INERTIA OF THE ENCLOSURE HEAT TRANSFER THROUGH SEMITRANSSPARENT WALLS |
| ACOUSTICS | SOUND. FUNDAMENTAL CONCEPTS AUDITORY PHYSIOLOGY PHYSICAL ASPECTS OF SOUND SOUND INSULATION SOUND DAMPING ACOUSTIC CONDITIONING SOUND ENERGY ABSORBING SYSTEMS SOUND ENERGY ABSORBING MATERIALS ARCHITECTURAL ACOUSTICS CTE - DB-HR |
| ELECTRICITY | INTRODUCTION ELECTRIC CHARGE COULOMB LAW CONCEPT OF ELECTRIC FIELD. LINES OF FORCE ELECTRIC POTENTIAL. ELECTRIC POTENTIAL DIFFERENCE ELECTRICITY OHM'S LAW RESISTIVITY ENERGY IN ELECTRICAL CIRCUITS. ELECTRIC POWER CURRENT. AC POWER. C. A. PHASE. C. A. PHASE DISTRIBUTION NETWORKS FEATURES. TYPES LOW VOLTAGE ELECTRICAL INSTALLATIONS LOW VOLTAGE SUPPLY TO BUILDING PROTECTION SYSTEMS |
| THEORY OF LIGHT AND COLOUR | INTRODUCTION. HISTORY ELECTROMAGNETIC WAVES. FEATURES. CLASSIFICATION SPREAD OF LIGHT. FRESNEL-HUYGENS PRINCIPLE. REFLECTION AND REFRACTION PHOTOMETRIC QUANTITIES PURKINJE EFFECT LIGHT FIGURES FLOW. INTENSITY. ILLUMINANCE. LUMINANCE REFLECTANCE, ABSORPTANCE AND TRANSMISSION. LIGHT AND VISION THE HUMAN EYE VISUAL PERFORMANCE FACTORS GLARE COLOR TEMPERATURE OF LIGHT THEORY OF COLOUR |



| Planning | | | | |
|---------------------------------|--|--------------------------------------|-------------------------------|-------------|
| Methodologies / tests | Competencies / Results | Teaching hours (in-person & virtual) | Student?s personal work hours | Total hours |
| Introductory activities | A8 A9 A63 B1 B2 B3 B4 B5 B6 B10 C1 C3 C5 C6 C7 C8 | 2 | 0 | 2 |
| Guest lecture / keynote speech | A8 A9 B1 B2 B3 B4 B5 B6 B10 B11 C4 C8 | 23 | 23 | 46 |
| Problem solving | A8 A9 B1 B2 B3 B4 B5 B6 B10 B11 B12 C1 C3 C4 C7 C8 | 23 | 23 | 46 |
| Diagramming | A8 A9 B1 B2 B3 B4 B10 | 1 | 0 | 1 |
| Glossary | A8 A9 B1 B3 B6 B10 B11 C1 | 0 | 1 | 1 |
| Workbook | A8 A9 B1 B2 B3 B4 B5 B6 B10 B11 B12 C1 C3 C7 C8 | 0 | 28 | 28 |
| Supervised projects | A8 A9 B1 B2 B3 B4 B5 B6 B10 B11 B12 C1 C3 C4 | 1 | 15 | 16 |
| Mixed objective/subjective test | A8 A9 B1 B2 B3 B4 B5 B6 B10 B11 C8 | 4 | 0 | 4 |
| Multiple-choice questions | A8 A9 B1 B2 B3 B4 B5 B6 B10 B11 C8 | 1 | 0 | 1 |
| Objective test | A8 A9 B1 B2 B3 B4 B5 B6 B10 B11 B12 C1 C3 C8 | 4 | 0 | 4 |
| Personalized attention | | 1 | 0 | 1 |

(*)The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

| Methodologies | |
|--------------------------------|--|
| Methodologies | Description |
| Introductory activities | Presentation on the subject, explaining its operating issues and objectives. |
| Guest lecture / keynote speech | Lessons in which the teacher will present theoretical or practical contents of the subject on the board or through audiovisual resources, and/or solves doubts about readings that students have carried out. |
| Problem solving | A series of case studies will be presented at class and solved, partially or totally, by the students, with help and advice from the teacher. |
| Diagramming | Scheme-based brief introductions to each topic aim at relating the contents within the knowledge map of the degree. |
| Glossary | The students prepare a summary sheet with definitions, formulation and physical units related to each of the topics of the subject. |
| Workbook | The students select and analyze exercises and/or theory about the subject from the basic and complementary bibliography, or from the materials provided by teachers. |
| Supervised projects | Students will turn in problems on each of the topics of the subject. They must be solved individually and personally, manuscript in paper format A4. They will allow, along with meeting attendance requirements, to have access to additional marks for the course. |



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|---------------------------------|---|
| Mixed objective/subjective test | Individual solving, at class, theoretical or practical exercises proposed by the teacher throughout the course. |
| Multiple-choice questions | A multiple choice test will assess the level of learning of theoretical and practical aspects of the subject. |
| Objective test | Numerical and graphical problems on the contents of the subject and the support bibliography will be presented. It will assess the level of learning of practical aspects of the subject. |

Personalized attention

| Methodologies | Description |
|--|--|
| Supervised projects Problem solving | <p>Teachers will support, solve and explain personally any doubts that may arise at class, when students are proposed to completely or partially solve problems.</p> <p>Personalized attention to the supervised works will be carried out according to the tutoring schedule of the teachers. In this sense, the tutoring schedules will be displayed on the platform provided for this purpose by the UDC.</p> <p>Continued study of the subject is considered fundamental. Therefore, it is especially advisable to attend tutorials, in order to clarify any doubts that may arise during the development of the course.</p> |

Assessment

| Methodologies | Competencies / Results | Description | Qualification |
|---------------------------------|--|--|---------------|
| Supervised projects | A8 A9 B1 B2 B3 B4 B5 B6 B10 B11 B12 C1 C3 C4 | It is required to individually and personally pose and solve exercises on the items described in the content section of the subject. The teacher will establish the time and form along the course, as well as its deadline for handing in. | 5 |
| Multiple-choice questions | A8 A9 B1 B2 B3 B4 B5 B6 B10 B11 C8 | Accuracy in answering ten questions about theoretical and practical aspects will be assessed. Each of them will have four options, at least one being correct. The conditions for wrong answers will be set in the formulation of the exercise | 20 |
| Objective test | A8 A9 B1 B2 B3 B4 B5 B6 B10 B11 B12 C1 C3 C8 | <p>Problems or case studies based on the syllabus and bibliography will arise, and students will give numerical answer to each of them. They may even have to represent the results graphically.</p> <p>Each exercise will be answered and will qualify in a separate DIN A3 sheet. Each exercise will be handed in independently, written in indelible ink and folded in A4 size. The student name and group must be written in every paper, including the exam sheet, in order to be assessed.</p> <p>The result will be given in a clearly visible way, indicating the numeric value with precision and appropriate units. Invalid parts must be clearly cancelled.</p> | 60 |
| Mixed objective/subjective test | A8 A9 B1 B2 B3 B4 B5 B6 B10 B11 C8 | It will be necessary to pass the individualized control tests raised by the teacher throughout the academic year. These will be held without prior notice. These control tests can be both theoretical and practical. | 15 |

Assessment comments



EVALUATION CRITERIA

For a favorable assessment, the student must obtain five point out of ten, according to this disaggregation (equal for both 1st and 2nd opportunities):

- Multiple-choice questions: 2 points.
- Objective practical test: 6 points.
- Course mark: supervised projects 0,5 points; objective/subjective test 1,5 points.

a)First opportunity: at the end of the four-month teaching period, students will have access to assessment as long as they comply with the following conditions:

- Having attended to at least 80% of the lessons of the subject.
- Having scored at least 1 point (out of 2) in the course mark (supervised projects + objective/subjective test).

b)Second opportunity: open to all students who have signed up for the subject, regardless of their percentage of attendance and fulfilment of course mark requirements. The disaggregation will remain as indicated above.

During the development of the theoretical questionnaire no materials of any kind will be allowed beyond pens, while for the realization of the practical part, forms, calculator and drawing materials can be used. The exam is individual. Non-compliance with this requirement will result in expulsion and implementing regulations. Mobile phones, smart watches or any other devices for storage, photography, sharing or accessing information are strictly prohibited during the examination. All these devices must remain switched off and off the table. Taking pictures of the examen, during the examination, will lead to expulsión.

Marks will be announced within the legally established time limits. The day and time for the revision will be indicated on the list of marks. This date will meet the requirements of the Academic Regulation for Assessment, Qualifications and Claims.

CORRECTION CRITERIA

The correction criteria are adapted to those derived from professional reality. As a general rule, misconceptions will be valued according to their severity, and may nullify the exercise. The commission of a numerical error is also relevant, given that the professional practice seeks concrete results. In this regard, it is pointed out that a mistaken sign means an error of 200%.

CONDITIONS FOR PART-TIME MODALITY STUDENTS

Students enrolled in the part-time modality (having proved this upon presentation of the enrollment receipt or the resolution of acceptance of this condition from the study centre) will have access to both opportunities, being exempted from the minimum attendance to lessons and the minimum of the course mark. In these cases, the exam will be the only evaluation element, scoring from 0 to 10 points, being necessary to obtain at least 5 points to pass the subject. **CONDITIONS FOR STUDENTS WITH ACADEMIC EXEMPTION FROM ATTENDANCE:** Students who have been recognized by the UDC as having the right to an academic exemption from attendance exemption (which they demonstrate, upon presentation of the resolution granting such a condition) may appear at the two opportunities, being exempt from compliance with the minimum class attendance and the minimum course grade. In these cases, the exam will be the only evaluable element, scoring from 0 to 10 points, being necessary to obtain at least 5 points to pass the subject. This circumstance must be communicated to the teacher as soon as possible. **CONDITIONS FOR ADVANCED OPPORTUNITY:** In this case, the exam will be the only evaluable element, scoring from 0 to 10 points, being necessary to obtain at least 5 points to pass the subject.

FINAL CLARIFICATIONS: In any case, all aspects related to "academic dispensation", "dedication to study", "permanence" and "academic fraud" will be governed in accordance with the current academic regulations of the UDC.



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| <p>Basic</p> | <ul style="list-style-type: none"> - López César, I.; Freire Tellado, M.; Muñoz Vidal, M. (2020). Fundamentos de Física para Arquitectos. Universidade da Coruña. Reprografía Noroeste - Freire Tellado, M.; Muñoz Vidal, M (2007). Introducción a las condiciones Térmicas en Edificación . Departamento de Tecnología de la Construcción . UDC - Mataix, Claudio (1982). Mecánica de fluidos y máquinas hidráulicas (2ª edición). México: Alfaomega - Varios (2008). Fundamentos Físicos de la Arquitectura I. Departamento de Tecnología de la Construcción. ETSAC - Guerrero, A (). Instalaciones eléctricas en las edificaciones. Editorial McGraw-Hill - Ramírez Vázquez, J (). Luminotecnia. Editorial Ceac - Arau Puchades, Higiní (1999). ABC de la acústica arquitectónica. Barcelona: Planeta - Roca Vila, M (1980). Introducción a la mecánica de los fluidos. México: Limusa - Beranek Leo (1986). Acoustics. McGraw-Hill: New York - Varios (2009). Código Técnico de la Edificación. Documento básico HR. Protección frente al ruido.. Ministerio de Fomento, Gobierno de España. - Varios (2009). Código Técnico de la Edificación. Documento básico HE. Ahorro de energía. Ministerio de Vivienda, Gobierno de España. |
| <p>Complementary</p> | <ul style="list-style-type: none"> - Augé, R. (). Curso de electricidad general. Editorial Paraninfo - Agüera Soriano (). Mecánica de fluidos. Editorial Ciencia y Distribución - Giles, R. V, Evett, J., Liu, C. (1995). Mecánica de los fluidos e hidráulica. Editorial McGraw-Hill Interamericana. Mexico - López Hernández, E; Muñoz Vidal, M (1994). Introducción a las instalaciones de edificación. Departamento de Tecnología de la Construcción. A Coruña - Bueche, F. J (). Física para estudiantes de ciencias e ingeniería. Editorial McGraw-Hill. - Manuel Margarida (). Aislamiento térmico. Editorial Etasa. - Llinares, J.; Lloppis Regna (). Fundamentos de acústica. Universidad Politécnica de Valencia - Guillón, López Rodríguez (1999). Problemas de física (volumen 2). Madrid: Editorial Limusa - Avilés López, R., Perera Martín, R. (2017). Manual de acústica ambiental y arquitectónica. Madrid: Paraninfo. - Carrión Isbert, A. (1998). Diseño acústico de espacios arquitectónicos. Barcelona: Edicions UPC. - Varios (2009). Catálogo de elementos constructivos del CTE.. Redacción: Instituto Eduardo Torroja. Ministerio de vivienda, Gobierno de España. - Colina Tejeda, C., Moreno Arranz, A. (1999). Acústica de la edificación.. Madrid: Fundación Escuela de la Edificación. - López César, I.; Freire Tellado, M.; Muñoz Vidal, M. (2020). Fundamentos de Física para Arquitectos.. Universidade da Coruña. Reprografía Noroeste - Recuero López, M (1999). Ingeniería acústica.. Madrid: Paraninfo - Zwicker, C. Kosten, C.W. (). Sound absorbing materials. Amsterdam: Elsevier Publishing Company. - Varios (2007). Guía técnica para la rehabilitación de la envolvente térmica de los edificios. Soluciones de aislamiento con vidrios y cerramientos.. Instituto para la diversificación y ahorro de la energía. Ministerio de Industria. Gobierno de España |

Recommendations

Subjects that it is recommended to have taken before

Physics 1/630G01008

Construction 1/630G02010

Mathematics for Architecture 1/630G02004

Mathematics for Architecture 2/630G02009

Subjects that are recommended to be taken simultaneously



Projects 3/630G01011

Architectural Analysis 1/630G01012

Geometry of Architectural Form/630G01014

Construction 2/630G02020

Subjects that continue the syllabus

Structures 1/630G01019

Other comments

For properly following the subject prior mastery of the following topics is required to the students: - Logical Reasoning. - Unit systems. - Geometry and Trigonometry. - Derivation and integration. - Solving systems of equations. - Basic knowledge of building materials.

(*)The teaching guide is the document in which the URV publishes the information about all its courses. It is a public document and cannot be modified. Only in exceptional cases can it be revised by the competent agent or duly revised so that it is in line with current legislation.