Teaching Guide				
Identifying Data				2023/24
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, Civís e AeronáuticasEnxeñaría Civil			
Coordinador	López César, Isaac	E-mail	isaac.lopez@udc.es	
Lecturers	Dominguez Diez, Javier Faustino López César, Isaac	E-mail	javier.dominguez@udc.es isaac.lopez@udc.es	
Web				
General description	The subject Physics for Architecture 2 provides an introduction to physical phenomena relevant to architectural design and how they are included in current regulations. 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. 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. 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.			

Study programme competences	
Code	Study programme competences
A8	"Knowledge of the principles of thermodynamics, acoustics and optics adapted and applied to architecture and urbanism "
A9	"Knowledge of 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

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		
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

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

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

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 SEMITRANSPARENT 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, ABSOTANCE AND TRANSMISSION. LIGHT AND VISION THE HUMAN EYE VISUAL PERFORMANCE FACTORS GLARE COLOR TEMPERATURE OF LIGHT THEORY OF COLOUR

Planning				
Methodologies / tests	Competencies	Ordinary class hours	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.

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	Teachers will support, solve and explain personally any doubts that may arise at class, when students are proposed to completely or partially solve problems. 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. 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.

Assessment			
Methodologies	**Competencies**	**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	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. 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. The result will be given in a clearly visible way, indicating the numeric value with precision and appropiate units. Invalid parts must be clearly cancelled.	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 dissagregation (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 condicions:
- 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 dissagregation 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.

Sources of information

Basic	- 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, Higini (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.
Complementary	- 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 (). Aislameinto 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 - Zwikker, 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 Españ

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 studens: - Logical Reasoning. - Unit systems. - Geometry and Trigonometry. - Derivation and integration. - Solving systems of equations. - Basic knowledge of building materials.