Teaching Guide				
Identifying Data				2022/23
Subject (*)	Cogeneration and Biomass Systems		Code	730547003
Study programme	Máster Universitario en Eficiencia Enerxética e Sustentabilidade			
Descriptors				
Cycle	Period	Year	Type	Credits
Official Master's Degree	1st four-month period	First	Obligatory	4.5
Language	Spanish			
Teaching method	Face-to-face			
Prerequisites				
Department	Enxeñaría Industrial			
Coordinador	Casteleiro Roca, José Luis	E-mail	jose.luis.casteleiro@udc.es	
Lecturers	Casteleiro Roca, José Luis	E-mail	jose.luis.casteleiro@udc.es	
Web				
General description	This subject aims to give the student knowledge about the various Thermal Systems used today; In addition, the different Cogeneration Systems used to increase the efficiency of the facilities will also be explained; and Biomass will be presented as an option to switch to renewable energy.			

Study programme competences / results	
Code	Study programme competences / results
A5	CE5 - Analyze energy consumption and its associated costs
A7	CE7 - Have knowledge of the fundamentals, potential, technology, applications and regulations of renewable energy sources
A8	CE8 - Analyze and include renewable energies in different facilities
A9	CE9 - Make decisions in a technological environment where materials are used in efficiency applications
A11	CE11 - Design and analyze cogeneration systems
A12	CE12 - Design and analyze biomass systems
A13	CE13 - Analyze, apply and optimize energy use systems
B2	CB7 - That students know how to apply the knowledge acquired and their ability to solve problems in new or little-known environments within broader (or multidisciplinary) contexts related to their area of study
B5	CB10 - That students have the learning skills that allow them to continue studying in a way that will be largely self-directed or autonomous
B11	CG6 - Acquire new knowledge and skills related to the professional field of the master's degree
B14	CG9 - Apply knowledge of advanced sciences and technologies to professional or research practice of efficiency
C3	CT3 - Use the basic tools of information and communication technologies (ICT) necessary for the exercise of their profession and for learning throughout their lives
C5	CT5 - Understand the importance of entrepreneurial culture and know the means available to entrepreneurs
C6	CT6 - Gain life skills and healthy habits, routines, and lifestyles
C8	CT8 - Value the importance of research, innovation and technological development in the socioeconomic and cultural progress of society

Learning outcomes			
Learning outcomes	Study programme competences / results		
Know the environmental problems related to the generation of electrical energy	AC5 AC7 AC9	BC5 BC11	CC3 CC8
Analyze and know how to design systems based on heat pump	AC7 AC9 AC13	BC2 BC11	CC3 CC6

Analyze and know how to design cogeneration systems	AC8 AC9 AC11	BC5 BC14	CC5 CC6
Analyze and know how to design biomass generation systems	AC5 AC8 AC12	BC2 BC14	CC5 CC8

Contents	
Topic	**Sub-topic**
Contents described in the verification report	Environmental problems in generation. Systems based on heat pump. Use of residual heat. Biomass cogeneration.
Topic 1: Environmental considerations	1.1. Environmental problems 1.2. Solutions to environmental problems. Renewable energy
Topic 2: Systems based on heat pump	2.1. Operating principle of a heat pump 2.2. Installations based on heat pump 2.3. Facilities sizing
Topic 3: Use of waste heat. Cogeneration	3.1. General aspects of cogeneration 3.2. Technology applied to cogeneration and trigeneration 3.3. Cogeneration and trigeneration power stations
Topic 4: Biomass	4.1. Energy sources 4.2. Municipal Solid Waste 4.3. Process of using biomass 4.4. Domestic applications

Planning				
Methodologies / tests	**Competencies / Results**	**Teaching hours (in-person & virtual)**	**Student?s personal work hours**	**Total hours**
Workshop	A11 A12 A13 B14 C8	1	25	26
Mixed objective/subjective test	A8 A9 B5 C5	2	12	14
Guest lecture / keynote speech	A11 A12 A13 B2 C3	14	25	39
Problem solving	A5 A7 B11 C6	20	25	45
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**
Workshop	Realization of an individual work of a specific subject of the subject and sharing in a group to share knowledge. Later the works will be joined in a common one that will be presented in class by groups.
Mixed objective/subjective test	It consists in carrying out an objective test of approximately 3 hours, in which the acquired knowledge will be evaluated.

Guest lecture / keynote speech	Keynote speech complemented with the use of audiovisual media and the introduction of some questions to students, in order to transmit knowledge and facilitate learning. The order of the topics covered will not have to be the one described in the teaching guide. In addition, there will be topics that can be seen together on the development of others, and the division between them may not be strict.
Problem solving	Solving exercises and specific problems in the classroom, from the knowledge explained.

Personalized attention	
Methodologies	**Description**
Workshop	The student has the relevant meetings of personalized tutorials, to resolve the concerns arising from the matter.

Assessment			
Methodologies	**Competencies / Results**	**Description**	**Qualification**
Problem solving	A5 A7 B11 C6	Some tasks established in the subject, within the framework of this methodology	5
Workshop	A11 A12 A13 B14 C8	Accomplishment of an individual and group work, as well as its exhibition in class	35
Mixed objective/subjective test	A8 A9 B5 C5	Exam type objective test	60

Assessment comments
As part of the "Laboratory practice" may include aspects such as attendance, personal work, attitude, etc., to help to pass the subject. The "Mixed test" will be divided into a multiple choice and some questions. It is necessary to exceed 15% of the score in the "Mixed test" to pass, as well as to approve the works proposed in "Workshop". Students with recognition of part-time dedication and academic waiver of attendance exemption, second establishes the "NORMA QUE REGULA O RÉXIME DE DEDICACIÓN AO ESTUDO DOS ESTUDANTES DE GRAO NA UDC (Arts. 2.3; 3.b e 4.5) (29/5/212)", will be evaluated in the same way, allowing one more week of margin in the assignments. For the second opportunity, there will be no second deadline for assignments, and the evaluation will be done in a similar way to the first opportunity. The evaluation criteria of the early December call will be the same as those of the second opportunity of the previous year.

Sources of information	
Basic	- Sala Lizarraga, José María (1994). Cogeneración: aspectos termodinámicos, tecnológicos y económicos. Bilbao: Universidad del País Vasco, Servicio Editorial - García Garrido, Santiago (2012). Centrales termoeléctricas de biomasa. Fuenlabrada: Renovetec
Complementary	- Boyce, Meherwan P. (2010). Handbook for cogeneration and combined cycle power plants. New York: ASME - Villares Martín, Mario (2003). Cogeneración. Madrid: Fundación Confemetal

Recommendations
Subjects that it is recommended to have taken before
Subjects that are recommended to be taken simultaneously
Subjects that continue the syllabus
Other comments

To help achieve an immediate sustainable environment and meet the objective of action number 5: "Healthy and sustainable environmental and social teaching and research" of the "Green Campus Ferrol Action Plan":1. The delivery of the documentary works that are made in this matter: 1.1. They will be requested in virtual format and / or computer support   1.2. They will be made through Moodle, in digital format without the need to print them