Teaching Guide				
Identifying Data				2021/22
Subject (*)	Energy Technology		Code	730497206
Study programme	Mestrado Universitario en Enxeñaría Industrial (plan 2018)			
Descriptors				
Cycle	Period	Year	Type	Credits
Official Master's Degree	2nd four-month period	First	Optional	4.5
Language	Spanish			
Teaching method	Face-to-face			
Prerequisites				
Department	Ciencias da Navegación e Enxeñaría MariñaEnxeñaría Naval e Industrial			
Coordinador	Arce Ceinos, Alberto	E-mail	alberto.arce@udc.es	
Lecturers	Arce Ceinos, Alberto	E-mail	alberto.arce@udc.es	
Web				
General description	Nowadays, energy is our most valuable natural commodity. The modern world generates power in increasingly large quantities from coal, oil and natural gas, due to an increasing demand. The finite nature of such fossil fuels, combined with an increasing worry about the concomitant greenhouse effect, has led to research into renewable sources of energy such as wind, sun, tides and waves. These alternatives will take much time and money to explore fully and require a very large capital investment. In the immediate future, therefore, the most direct and cheapest way to tackle the problem is to use existing energy sources more efficiently. This subject concentrates on this theme. It looks at energy conversion, giving and analytical treatment of methods of energy saving and recovery. This subject is aimed to settle and complete the student?s knowledge of energy technology.			
Contingency plan	1. Modifications to the contents 2. Methodologies *Teaching methodologies that are maintained *Teaching methodologies that are modified 3. Mechanisms for personalized attention to students 4. Modifications in the evaluation *Evaluation observations: 5. Modifications to the bibliography or webgraphy			

Study programme competences / results	
Code	Study programme competences / results
A1	ETI1 - Knowledge and capacity for the analysis and design of electricity generation, transport and distribution systems.
A6	ETI6 - Knowledge and abilities that allow to understand, analyze, exploit and manage the different sources of energy.
B2	CB7 - That students know how to apply the knowledge acquired and their ability to solve problems in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their area of ??study.
B3	CB8 - That students are able to integrate knowledge and face the complexity of making judgments based on information that, being incomplete or limited, includes reflections on the social and ethical responsibilities linked to the application of their knowledge and judgments.
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.
B6	G1 - Have adequate knowledge of the scientific and technological aspects in Industrial Engineering.
B7	G2 - Project, calculate and design products, processes, facilities and plants.

B13	G8 - Apply the knowledge acquired and solve problems in new or unfamiliar environments within broader and multidisciplinary contexts.
B14	G9 - Be able to integrate knowledge and face the complexity of making judgments based on information that, being incomplete or limited, includes reflections on social and ethical responsibilities linked to the application of their knowledge and judgments.
B16	G11 - Possess the learning skills that allow to continue studying in a self-directed or autonomous way.
C1	ABET (a) - An ability to apply knowledge of mathematics, science, and engineering.
C3	ABET (c) - An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
C5	ABET (e) - An ability to identify, formulate, and solve engineering problems.
C6	ABET (f) - An understanding of professional and ethical responsibility.
C8	ABET (h) - The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.
C9	ABET (i) - A recognition of the need for, and an ability to engage in life-long learning.
C11	ABET (k) - An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Learning outcomes			
Learning outcomes	Study programme competences / results		
Se espera que os alumnos adquiran coñeocimentos sobre análisis e deseño de todos os procesos relacionados coa enerxía, xeneración, almacenamento, conversión, distribución e explotación.	AJ1 AJ6	BJ2 BJ3 BJ5 BJ6 BJ7 BJ13 BJ14 BJ16	CJ1 CJ3 CJ5 CJ6 CJ8 CJ9 CJ11

Contents	
Topic	Sub-topic
0 Os temas seguientes desenrolan os contidos establecidos nas fichas da Memoria de Verificación que son:	Análisis e deseño de: -Sistemas de xeración de enerxía -Sistemas de almacenamento e distribución de enerxía -Sistemas de conversión de enerxía Explotación e xestión de fontes de enerxía
1 Introduction	1.1 The energy problem 1.2 Combustion theory 1.3 Heat transfer 1.4 Electricity
2 The economics of energy-saving schemes	2.1 Costs 2.2 Investing in new energy-saving projects
3 Energy conversion	3.1 Fuels and combustion 3.2 Efficient combustion 3.3 Waste as fuel 3.4 Steam and gas cycles 3.5 Refrigeration, heat pumps and air conditioning 3.6 Electric conversion

4 Energy recovery	4.1 Insulation 4.2 Recuperative heat exchangers 4.3 Run-around coil systems 4.4 Regenerative heat exchangers 4.5 Heat pumps 4.6 Heat pipes 4.7 Selection of energy recovery methods
5 Process integration: Pinch technology	5.1 Basic concepts of Pinch technology 5.2 Stream networks 5.3 The significance of the Pinch 5.4 Design of energy recovery systems 5.5 Selection of Pinch temperature difference 5.6 Tabular method 5.7 Stream splitting 5.8 Process retrofit 5.9 Installation of heat pumps 5.10 Installation of heat engines 5.11 The grand composite curve
6 Energy in buildings	6.1 Steady state loads and comfort 6.2 Transient heating and air conditioning loads 6.3 Thermal performance monitoring 6.4 Lightning 6.5 Energy targets
7 CHP Plants	7.1 Introduction to CHP 7.2 The benefits of CHP 7.3 Problems asociated with CHP 7.4 Balance of energy demand 7.5 Types of prime movers 7.6 The economics of CHP generation 7.7 CHP in the industrial sector 7.8 CHP in the commercial sector 7.9 CHP in the domestic sector 7.10 Conclusions

Planning				
Methodologies / tests	Competencies / Results	Teaching hours (in-person & virtual)	Student?s personal work hours	Total hours
Guest lecture / keynote speech	A1 A6 B2 B3 B5 B13 B14 B16 B7 B6 C1 C3 C5 C6 C8 C9 C11	10	25.5	35.5
Problem solving	A1 A6 B2 B3 B5 B13 B14 B16 B7 B6 C1 C3 C5 C6 C8 C9 C11	17	56	73
Objective test	A1 A6 B3 B5 B13 B14 B16 B7 B6 C1 C3 C5 C6 C8 C9 C11	3	0	3
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
Guest lecture / keynote speech	Oral presentation that can be audiovisually aided and the introduction of questions with the aim of transmiting the knowledge and facilitating the learning
Problem solving	Oral presentation that can be audiovisually aided and the introduction of questions with the aim of transmiting the knowledge and facilitating the learning
Objective test	Proba escrita utilizada para a avaliación da aprendizaxe, cuxo trazo distintivo é a posibilidade de determinar se as respostas dadas son ou non correctas. Constitúe un instrumento de medida, elaborado rigorosamente, que permite avaliar coñecementos, capacidades, destrezas, rendemento, aptitudes, actitudes, intelixencia, etc. É de aplicación tanto para a avaliación diagnóstica, formativa como sumativa.

Personalized attention	
Methodologies	**Description**
Guest lecture / keynote speech Problem solving	Tutorials

Assessment			
Methodologies	**Competencies / Results**	**Description**	**Qualification**
Objective test	A1 A6 B3 B5 B13 B14 B16 B7 B6 C1 C3 C5 C6 C8 C9 C11	Proba escrita utilizada para a avaliación da aprendizaxe, cuxo trazo distintivo é a posibilidade de determinar se as respostas dadas son ou non correctas. Constitúe un instrumento de medida, elaborado rigorosamente, que permite avaliar coñecementos, capacidades, destrezas, rendemento, aptitudes, actitudes, intelixencia, etc. É de aplicación tanto para a avaliación diagnóstica, formativa como sumativa.	70
Problem solving	A1 A6 B2 B3 B5 B13 B14 B16 B7 B6 C1 C3 C5 C6 C8 C9 C11	Entrega de problemas resueltos	30

Assessment comments
Exam: therory (45 min) + exercises (180min) (use of textbook and solved exercises)

Sources of information	
Basic	- F. P. Incropera y D. P. DeWitt (1999). Fundamentos de Transferencia de Calor. Mexico: Prentice-Hall - T. D. Eastop y D. R. Croft (1990). Energy Efficiency for Engineers and Technologists. Londres: Longman Scientific & Technical - M. J. Moran y H. N. Shappiro (2004). Fundamentos de Termodinámica Técnica 2ª ed. Barcelona: Reverté
Complementary	

Recommendations
Subjects that it is recommended to have taken before
Subjects that are recommended to be taken simultaneously
Subjects that continue the syllabus
Final Year Dissertation /730497219
Other comments

?Para ayudar a conseguir un entorno inmediato sostenido y cumplir con el objetivo de la acción número 5: ?Docencia e investigación saludable y sustentable ambiental y social? del "Plan de Acción Green Campus Ferrol":
La entrega de los trabajos documentales que se realicen en esta materia:
? Se solicitarán en formato virtual y/o soporte informático
? Se realizará a través de Moodle, en formato digital sin necesidad de imprimirlos
? En caso de ser necesario realizarlos en papel:
- No se emplearán plásticos
- Se realizarán impresiones a doble cara.
- Se empleará papel reciclado.
- Se evitará la impresión de borradores.
? Se debe de hacer un uso sostenible de los recursos y la prevención de impactos negativos sobre el medio natural
? Se debe tener en cuenta la importancia de los principios éticos relacionados con los valores de la sostenibilidad en los comportamientos personales y profesionales
? Se incorpora perspectiva de género en la docencia de esta materia (se usará lenguaje no sexista, se utilizará bibliografía de autores de ambos sexos, se propiciará la intervención en clase de alumnos y alumnas?)
? Se trabajará para identificar y modificar prejuicios y actitudes sexistas, y se influirá en el entorno para modificarlos y fomentar valores de respeto e igualdad.
? Se deberán detectar situaciones de discriminación y se propondrán acciones y medidas para corregirlas.