ANX-PR/CL/001-01

LEARNING GUIDE

SUBJECT

93001300 - Energy System: Market, Technologies And Perspectives

DEGREE PROGRAMME

09BP - Master Universitario En Energia Solar Fotovoltaica

ACADEMIC YEAR & SEMESTER

2024/25 - Semester 1

Index

Learning guide

1. Description

1.1. Subject details

Name of the subject	93001300 - Energy System: Market, Technologies And Perspectives
No of credits	4 ECTS
Type	Core
Academic year ot the programme	First year
Semester of tuition	Semester 1
Tuition period	September-January
Tuition languages	English
Degree programme	09BP - Master Universitario en Energia Solar Fotovoltaica
Centre	09 - Escuela Tecnica Superior De Ingenieros De Telecomunicacion
Academic year	2024-25

2. Faculty

2.1. Faculty members with subject teaching role

Name and surname	Office/Room	Email	Tutoring hours *
Clara Sanchez Perez	IES-103	clara.sanchez.perez@upm.es	Sin horario. Set an appointment by email
Alejandro Datas Medina	IES-202	a.datas@upm.es	Sin horario. Set an appointment by email

Ignacio Rey-Stolle Prado (Subject coordinator)	IES-107	ignacio.reystolle@upm.es	Sin horario. Set an appointment by email
Carlos Del Cañizo Nadal	IES-107	carlos.canizo@upm.es	Sin horario. Set an appointment by email

* The tutoring schedule is indicative and subject to possible changes. Please check tutoring times with the faculty member in charge.

2.3. External faculty

Name and surname	Email	Institution
Cristóbal José Gallego Castillo	cristobaljose.gallego@upm.es	E.T.S.I. AERONÁUTICA Y DEL ESPACIO (UPM)

3. Skills and learning outcomes *

3.1. Skills to be learned

CB10 - Que los estudiantes posean las habilidades de aprendizaje que les permitan continuar estudiando de un modo que habrá de ser en gran medida autodirigido o autónomo.

CB6 - Poseer y comprender conocimientos que aporten una base u oportunidad de ser originales en el desarrollo y/o aplicación de ideas, a menudo en un contexto de investigación

CB7 - Que los estudiantes sepan aplicar los conocimientos adquiridos y su capacidad de resolución de problemas en entornos nuevos o poco conocidos dentro de contextos más amplios (o multidisciplinares) relacionados con su área de estudio

CB8 - Que los estudiantes sean capaces de integrar conocimientos y enfrentarse a la complejidad de formular juicios a partir de una información que, siendo incompleta o limitada, incluya reflexiones sobre las responsabilidades sociales y éticas vinculadas a la aplicación de sus conocimientos y juicios

CB9 - Que los estudiantes sepan comunicar sus conclusiones y los conocimientos y razones últimas que las sustentan a públicos especializados y no especializados de un modo claro y sin ambigüedades

CE1 - Comprender, analizar y juzgar la relevancia de cualquier contribuciÃ³n en este campo, en relaciÃ³n con su entorno social, energÃ©tico y cientÃfico-tÃ©cnico.

CE6 - Aplicar metodologÃas de diseÃ±o e implementaciÃ³n de tÃ©cnicas de aprendizaje y clasificaciÃ³n automÃ¡ticos para una gestiÃ³n inteligente del conocimiento

CG5 - GestiÃ³n de la informaciÃ³n: buscar y gestionar recursos bibliogrÃ¡ficos adecuados con eficiencia, aprender a continuar los estudios de manera ampliamente autÃ³noma como base para la futura actividad de investigaciÃ³n e innovaciÃ³n

CG8 - Aplicar metodologÃas, procedimientos, herramientas y normas del estado del arte para la creaciÃ³n de nuevos componentes tecnolÃ³gicos; Construir nuevas hipÃ³tesis y modelos, evaluarlos y aplicarlos a la resoluciÃ³n de problemas

CG9 - Comunicar juicios, y conocimientos a audiencias especializadas y no especializadas, de una manera razonada, clara y sin ambigÃ¿edades

CT3 - Uso de la lengua inglesa: comprender los contenidos de clases magistrales, conferencias y seminarios en lengua inglesa; redactar en inglÃ©s informes y artÃculos cientÃfico-tÃ©cnicos usando herramientas informÃ¡ticas; realizar exposiciones pÃºblicas en inglÃ©s de trabajos, resultados y conclusiones de investigaciÃ³n, por ejemplo, en las asignaturas del MÃ¡ster o en congresos de carÃ¡cter mayoritariamente internacional o en estancias en centros extranjeros, todo ello con la ayuda de medios informÃ¡ticos audiovisuales

CT4 - Liderazgo de equipos: realizar trabajos en equipo (como los de algunas de las actividades de evaluaciÃ³n de las asignaturas), integrarse en un grupo de investigaciÃ³n participando activamente en sus reuniones, colaborando con iniciativa propia en trabajos o proyectos de I+D+i; interaccionar con efectividad con los miembros del equipo de trabajo multidisciplinar

3.2. Learning outcomes

RA14 - RA4 - Capacidad para analizar los resultados

RA16 - RA27 - Capacidad crítica para analizar los diferentes modelos en términos de principios básicos de la física

RA19 - RA45 - Capacitar al alumno a hacer presentaciones en público

RA20 - RA46 - Adiestrar al alumno en el trabajo en equipo

RA27 - Conocer la evolución energética de la humanidad

RA30 - Conocer los impactos de la energía en diferentes mercados y sectores

RA26 - Conocer la definición y concepto de energía

RA21 - RA47 - Aprender a argumentar convincentemente

RA29 - Conocer el catálogo de energías renovables

RA15 - RA5 - Relacionar los principios básicos con los aspectos prácticos

RA28 - Entender el contexto energético del mundo actual

* The Learning Guides should reflect the Skills and Learning Outcomes in the same way as indicated in the Degree Verification Memory. For this reason, they have not been translated into English and appear in Spanish.

4. Brief description of the subject and syllabus

4.1. Brief description of the subject

This course aims to consolidate and expand the students' general knowledge about energy in a broad sense, particularly for those who will become experts in a specific energy field such as Photovoltaic Solar Energy. Graduate courses are necessarily specific, so it is important to look beyond your immediate focus and understand the wider context. This general goal will be accomplished by achieving the following specific objectives:

- To consider the definition and concept of energy.
- To understand the energetic evolution of humankind.
- To comprehend the current energy situation in our contemporary world.
- To analyze the role of fossil fuels in the global energy system.

- To define and understand Renewable Energies.
- To know the fundamentals and development stages of the main Renewable Energies.
- To understand how energy impacts various markets and sectors.
- To develop a basic knowledge of future energy technologies currently under basic research.

4.2. Syllabus

1. Energy basics
   1.1. Around the concept of energy and energetic machines
   1.2. Energy along human history
2. World energy structure
   2.1. World energy system
   2.2. Wold electricity system
   2.3. Fossil fuels
   2.4. Renewable energies
3. Markets and impacts
   3.1. Energy and ecology
   3.2. Energy and climate change
   3.3. Energy and social issues
   3.4. Energy and food
   3.5. Energy and transport
4. Emerging and future energy technologies
   4.1. Energy storage
   4.2. Hydrogen energy
   4.3. Clean coal technologies
   4.4. Nuclear fusion

5. Schedule

5.1. Subject schedule*

Week	Type 1 activities	Type 2 activities	Distant / On-line	Assessment activities
1	**Course Presentation** Duration: 01:00 Lecture **Unit I.1 Basic Concepts around Energy and Energetic Machines** Duration: 02:00 Lecture			**Assignment #1** Group work Progressive assessment and Global Examination Not Presential Duration: 04:00
2	**Unit I.2 Energy in Human History** Duration: 02:00 Lecture **Unit II.1 World Energy System** Duration: 01:00 Lecture			
3	**Unit II.1 World Energy System** Duration: 01:00 Lecture **Unit II.2 World Electricity System** Duration: 02:00 Lecture			**Assignment #2** Group work Progressive assessment and Global Examination Not Presential Duration: 04:00
4	**Unit II.3 Electricity Markets** Duration: 02:00 Lecture **Unit II.4 Fossil Fuels. Coal** Duration: 01:00 Lecture			
5	**Unit II.4 Fossil Fuels. Oil** Duration: 01:00 Lecture **Unit II.4 Fossil Fuels. Natural gas** Duration: 01:00 Lecture **Unit II.5 Renewable Energy Technologies** Duration: 01:00 Lecture			**Assignment #3** Group work Progressive assessment and Global Examination Not Presential Duration: 04:00
6	**Unit II.5 Renewable Energy Technologies** Duration: 01:00 Lecture **Unit III.1 Energy, Ecology and Demography** Duration: 01:00 Lecture			

	Unit III.2 Energy and Climate Change Duration: 01:00 Lecture			
7	**Unit III.3 Energy and Social Issues** Duration: 01:00 Lecture **Unit III.4 Energy and Food** Duration: 01:00 Lecture **Unit III.5 Energy and Transport** Duration: 01:00 Lecture			**Assignment #4** Group work Progressive assessment and Global Examination Not Presential Duration: 04:00
8	**Unit IV.1 Energy Storage** Duration: 02:00 Lecture **Unit IV.2 Hydrogen Energy Technologies** Duration: 01:00 Lecture			
9	**Unit IV.2 Hydrogen Energy Technologies** Duration: 01:00 Lecture **Unit IV.3 Clean Coal Technologies** Duration: 01:00 Lecture **Unit IV.4 Nuclear Fusion** Duration: 01:00 Lecture			**Assignment #5** Group work Progressive assessment and Global Examination Not Presential Duration: 04:00
10	**Unit IV.4 Nuclear Fusion** Duration: 01:00 Lecture **Final Presentations** Duration: 02:00 Cooperative activities			
11	**Final Presentations** Duration: 03:00 Cooperative activities			
12	**Final Presentations** Duration: 03:00 Cooperative activities			
13				**Final paper** Individual work Progressive assessment and Global Examination Not Presential Duration: 04:00 **Final Presentation** Individual presentation Progressive assessment and Global Examination Presential Duration: 04:00

14				**Assessment of student participation in class** Individual presentation Progressive assessment and Global Examination Presential Duration: 01:00
15				
16				
17				

Depending on the programme study plan, total values will be calculated according to the ECTS credit unit as 26/27 hours of student face-to-face contact and independent study time.

* The schedule is based on an a priori planning of the subject; it might be modified during the academic year, especially considering the COVID19 evolution.

6. Activities and assessment criteria

6.1. Assessment activities

6.1.1. Assessment

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
1	Assignment #1	Group work	No Presential	04:00	5%	5 / 10	CB6 CB7 CB8 CB9 CB10 CG5 CG8 CG9 CT3 CT4 CE1 CE6
3	Assignment #2	Group work	No Presential	04:00	5%	5 / 10	CB6 CB7 CB8 CB9 CB10 CG5 CG8 CG9 CT3 CT4 CE1 CE6
5	Assignment #3	Group work	No Presential	04:00	5%	5 / 10	CB6 CB7 CB8 CB9 CB10 CG5 CG8 CG9 CT3 CT4 CE1 CE6

7	Assignment #4	Group work	No Presential	04:00	5%	5 / 10	CB6 CB7 CB8 CB9 CB10 CG5 CG8 CG9 CT3 CT4 CE1 CE6
9	Assignment #5	Group work	No Presential	04:00	5%	5 / 10	CB6 CB7 CB8 CB9 CB10 CG5 CG8 CG9 CT3 CT4 CE1 CE6
13	Final paper	Individual work	No Presential	04:00	35%	5 / 10	CB6 CB7 CB8 CB9 CB10 CG5 CG8 CG9 CT3 CE1 CE6
13	Final Presentation	Individual presentation	Face-to-face	04:00	30%	5 / 10	CB6 CB7 CB8 CB9 CB10 CG5 CG9 CT3 CE1
14	Assessment of student participation in class	Individual presentation	Face-to-face	01:00	10%	5 / 10	CB8 CB9 CG9 CT3 CE1

6.1.2. Global examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
1	Assignment #1	Group work	No Presential	04:00	5%	5 / 10	CB6 CB7 CB8 CB9 CB10 CG5 CG8 CG9 CT3 CT4 CE1 CE6
3	Assignment #2	Group work	No Presential	04:00	5%	5 / 10	CB6 CB7 CB8 CB9 CB10 CG5 CG8 CG9 CT3 CT4 CE1 CE6
5	Assignment #3	Group work	No Presential	04:00	5%	5 / 10	CB6 CB7 CB8 CB9 CB10 CG5 CG8 CG9 CT3 CT4 CE1 CE6
7	Assignment #4	Group work	No Presential	04:00	5%	5 / 10	CB6 CB7 CB8 CB9 CB10 CG5 CG8 CG9 CT3 CT4 CE1 CE6

9	Assignment #5	Group work	No Presential	04:00	5%	5 / 10	CB6 CB7 CB8 CB9 CB10 CG5 CG8 CG9 CT3 CT4 CE1 CE6
13	Final paper	Individual work	No Presential	04:00	35%	5 / 10	CB6 CB7 CB8 CB9 CB10 CG5 CG8 CG9 CT3 CE1 CE6
13	Final Presentation	Individual presentation	Face-to-face	04:00	30%	5 / 10	CB6 CB7 CB8 CB9 CB10 CG5 CG9 CT3 CE1
14	Assessment of student participation in class	Individual presentation	Face-to-face	01:00	10%	5 / 10	CB8 CB9 CG9 CT3 CE1

6.1.3. Referred (re-sit) examination

Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills

Extraordinary exam	Written test	Face-to-face	02:00	100%	5 / 10	CB6 CB7 CB8 CB9 CB10 CG5 CG8 CG9 CT3 CT4 CE1 CE6

6.2. Assessment criteria

Ordinary evaluation

Assignments

25% of your final score will be linked to the results of the assignments (exercises, problems, comments on proposed readings, ...). What will be assessed is the depth, quality, and your level amid your classmates.

Final paper and presentation

65% of your final score will be associated with an individual paper with a free topic to be completed and presented to your classmates at the end of the course. For the written paper, what will be assessed will be depth, quality, and your level amid your classmates. For the presentation, we will assess the clarity, and quality of replies to questions, fitting to time and format.

Class participation

10% of your final score will be linked to your attitude and participation (quality and quantity) in class

Extra evaluation

In the case of failure to pass the ordinary evaluations, the course can be passed in an extra (final) evaluation, typically taking place at the end of the second semester (i.e., by the end of June).

7. Teaching resources

7.1. Teaching resources for the subject

Name	Type	Notes
Course web page	Web resource	 The course web page at UPM's Moodle server contains all material needed to follow the course. This includes: 1) Presentations for all units in PDF format 2) Assignments 3) Ancillary material (readings, reports, videos, ...)

8. Other information

8.1. Other information about the subject

This course is closely related to SUSTAINABLE DEVELOPMENT GOAL 7, *Ensure access to affordable, reliable, sustainable, and modern energy for all*.

Many of the specific targets of SDG 7 are explicitly covered in the syllabus. For instance, the current structure of the world energy system, the degree of penetration of renewable energies in the generation pool, energy efficiency, and the impacts of our energy model on ecology, climate, demography, and gender, are dealt with. Accordingly, there are also connections with other SDGs, for example, SDG 11: Sustainable cities and communities; and SDG 13: Climate Action. Finally, it should be mentioned that SDGs in general, and SDG 7 in particular, are discussed in one of the topics in the course