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

2023/24 - 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	2023-24

2. Faculty

2.1. Faculty members with subject teaching role

Name and surname	Office/Room	Email	Tutoring hours *
Alejandro Datas Medina	IES-202	a.datas@upm.es	Sin horario. Concertar cita por email
Ignacio Rey-Stolle Prado (Subject coordinator)	IES-107	ignacio.reystolle@upm.es	Sin horario. Concertar cita por email

Carlos Del Cañizo Nadal	IES-113-1	carlos.canizo@upm.es	Sin horario. Concertar cita por email
Clara Sanchez Perez	IES-103	clara.sanchez.perez@upm.es	Sin horario. Concertar cita por 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

The general goal of this course is to consolidate and expand the general knowledge around energy in a broad sense of students who will become experts in a particular energy field as is Photovoltaic Solar Energy. Graduate courses are necessarily specific so it is mandatory to raise your head, look around and understand the wide context. This general goal will be accomplished by means of achieving this set of specific goals:

- To think about the definition and concept of Energy
- To know the energetic evolution of humankind

- To understand the energetic situation of our contemporary world
- To analyze the role of fossil fuels in the world energy system
- To define and understand what Renewable Energies are
- To know the fundamentals and degree of development of the main Renewable Energies
- To understand how energy impacts different markets and sectors
- To develop a basic knowledge of the envisaged 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 gender 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	Classroom activities	Laboratory 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: On the concept of Energy** Group work Continuous assessment 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: World Energy System** Group work Continuous assessment 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			**Assingment 3. Electricity markets** Group work Continuous assessment Not Presential Duration: 04:00
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			**Assingment 4: Fossil fuels** Group work Continuous assessment 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			**Assingment 5: Energy and climate change** Group work Continuous assessment Not Presential Duration: 04:00

	Unit III.2 Energy and Climate Change Duration: 01:00 Lecture			
7	**Unit III.3 Energy and Gender** Duration: 01:00 Lecture **Unit III.4 Energy and Food** Duration: 01:00 Lecture **Unit III.5 Energy and Transport** Duration: 01:00 Lecture			**Assingment 6: Energy and transport** Group work Continuous assessment 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			**Assingment 7. Energy storage** Group work Continuous assessment Presential Duration: 04:00
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			**Assingment 8. Hydrogen** Group work Continuous assessment Not Presential Duration: 04:00
10	**Unit IV.4 Nuclear Fusion** Duration: 01:00 Lecture **Final Presentations** Duration: 02:00 Cooperative activities			**Final paper** Individual work Continuous assessment Not Presential Duration: 06:00
11	**Final Presentations** Duration: 03:00 Cooperative activities			**Final presentation** Individual presentation Continuous assessment Presential Duration: 01:00
12				
13				**Final exam** Written test Final examination Not Presential Duration: 02:00 **Oral Exam** Individual presentation Final examination Presential Duration: 00:30

14				**Assessmento of Class participation** Individual presentation Continuous assessment 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: On the concept of Energy	Group work	No Presential	04:00	5%	5 / 10	CB6 CB7 CB8 CB9 CB10 CG5 CG8 CG9 CT3 CT4 CE1 CE6
3	Assignment 2: World Energy System	Group work	No Presential	04:00	5%	5 / 10	CB6 CB7 CB8 CB9 CB10 CG5 CG8 CG9 CT3 CT4 CE1 CE6
4	Assingment 3. Electricity markets	Group work	No Presential	04:00	5%	5 / 10	CB6 CB7 CB8 CB9 CB10 CG5 CG8 CG9 CT3 CT4 CE1 CE6

5	Assingment 4: Fossil fuels	Group work	No Presential	04:00	5%	5 / 10	CB6 CB7 CB8 CB9 CB10 CG5 CG8 CG9 CT3 CT4 CE1 CE6
6	Assingment 5: Energy and climate change	Group work	No Presential	04:00	5%	5 / 10	CB6 CB7 CB8 CB9 CB10 CG5 CG8 CG9 CT3 CT4 CE1 CE6
7	Assingment 6: Energy and transport	Group work	No Presential	04:00	5%	5 / 10	CB6 CB7 CB8 CB9 CB10 CG5 CG8 CG9 CT3 CT4 CE1 CE6
8	Assingment 7. Energy storage	Group work	Face-to-face	04:00	5%	5 / 10	CB6 CB7 CB8 CB9 CB10 CG5 CG8 CG9 CT3 CT4 CE1 CE6

9	Assingment 8. Hydrogen	Group work	No Presential	04:00	5%	5 / 10	CB6 CB7 CB8 CB9 CB10 CG5 CG8 CG9 CT3 CT4 CE1 CE6
10	Final paper	Individual work	No Presential	06:00	25%	5 / 10	CB6 CB7 CB8 CB9 CB10 CG5 CG8 CG9 CT3 CT4 CE1 CE6
11	Final presentation	Individual presentation	Face-to-face	01:00	25%	5 / 10	CB6 CB7 CB8 CB9 CB10 CG5 CG8 CG9 CT3 CT4 CE1 CE6
14	Assessmento of Class participation	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
13	Final exam	Written test	No Presential	02:00	75%	5 / 10	CB6 CB7 CB8 CB9 CB10 CG5 CG8 CG9

							CT3 CT4 CE1 CE6
13	Oral Exam	Individual presentation	Face-to-face	00:30	25%	5 / 10	

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

Progressive evaluation

Assignments

40% of your final score will be linked o the results of the 8 assignments of the course (exercises, problems, comments on proposed readings, ...). What will be assessed is the depth, quality, and level amid your classmates.

Final paper and presentation

50% of your final score will be associated with an individual paper with a free topic to be completed and presented in the final session of the course. What will be assessed in this exercise will be depth, quality, and level amid your classmates of the written essay, For the presentation, we will assess the clarity, 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

Global Evaluation

The course can be successfully passed following the global evaluation which consists of a final exam that will be held in the exam period after the school period. This exam counts 100% of the evaluation, and it has two parts a written exam (75%) and an oral presentation (25%) of a topic belonging to the course syllabus.

Extra evaluation

In the case of failure to pass the progressive and global evaluations, the course can be passed in an extra (final) evaluation, typically taking place at the end of the second semester.

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