



POLITÉCNICA

INTERNATIONAL
CAMPUS OF
EXCELLENCE

COORDINATION PROCESS OF
LEARNING ACTIVITIES
PR/CL/001



E.T.S. de Ingenieros de
Telecomunicacion

ANX-PR/CL/001-01

LEARNING GUIDE

SUBJECT

93001300 - Energy System: Market, Technologies And Perspectiv

DEGREE PROGRAMME

09BP - Master Universitario En Energia Solar Fotovoltaica

ACADEMIC YEAR & SEMESTER

2025/26 - Semester 1

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1. Description

1.1. Subject details

Name of the subject	93001300 - Energy System: Market, Technologies And Perspectiv
No of credits	4 ECTS
Type	Core
Academic year of 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 - E.T.S. De Ingenieros De Telecomunicacion
Academic year	2025-26

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. 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
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* 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 contribución en este campo, en relación con su entorno social, energético y científico-técnico.

CE6 - Aplicar metodologías de diseño e implementación de técnicas de aprendizaje y clasificación automáticas para una gestión inteligente del conocimiento

CG5 - Gestión de la información: buscar y gestionar recursos bibliográficos adecuados con eficiencia, aprender a continuar los estudios de manera ampliamente autónoma como base para la futura actividad de investigación e innovación

CG8 - Aplicar metodologías, procedimientos, herramientas y normas del estado del arte para la creación de nuevos componentes tecnológicos; Construir nuevas hipótesis y modelos, evaluarlos y aplicarlos a la resolución de problemas

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

CT3 - Uso de la lengua inglesa: comprender los contenidos de clases magistrales, conferencias y seminarios en lengua inglesa; redactar en inglés informes y artículos científico-técnicos usando herramientas informáticas; realizar exposiciones públicas en inglés de trabajos, resultados y conclusiones de investigación, por ejemplo, en las asignaturas del Máster o en congresos de carácter mayoritariamente internacional o en estancias en centros extranjeros, todo ello con la ayuda de medios informáticos audiovisuales

CT4 - Liderazgo de equipos: realizar trabajos en equipo (como los de algunas de las actividades de evaluación de las asignaturas), integrarse en un grupo de investigación 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. World 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			

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

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.

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	10%	5 / 10	CG5 CG8 CG9 CB8 CB9 CE6 CB6 CB10 CE1 CB7 CT3 CT4
3	Assignment #2	Group work	No Presential	04:00	10%	5 / 10	CG5 CG8 CG9 CB8 CB9 CE6 CB6 CB10 CE1 CB7 CT3 CT4
5	Assignment #3	Group work	No Presential	04:00	10%	5 / 10	CG5 CG8 CG9 CB8 CB9 CE6 CB6 CB10 CE1 CB7 CT3 CT4

7	Assignment #4	Group work	No Presential	04:00	10%	5 / 10	CG5 CG8 CG9 CB8 CB9 CE6 CB6 CB10 CE1 CB7 CT3 CT4
13	Final paper	Individual work	No Presential	04:00	25%	5 / 10	CG5 CG8 CG9 CB8 CB9 CE6 CB6 CB10 CE1 CB7 CT3
13	Final Presentation	Individual presentation	Face-to-face	04:00	25%	5 / 10	CG5 CG9 CB8 CB9 CB6 CB10 CE1 CB7 CT3
14	Assessment of student participation in class	Individual presentation	Face-to-face	01:00	10%	5 / 10	CG9 CB8 CB9 CE1 CT3

6.1.2. Global examination

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

3	Assignment #2	Group work	No Presential	04:00	10%	5 / 10	CG5 CG8 CG9 CB8 CB9 CE6 CB6 CB10 CE1 CB7 CT3 CT4
5	Assignment #3	Group work	No Presential	04:00	10%	5 / 10	CG5 CG8 CG9 CB8 CB9 CE6 CB6 CB10 CE1 CB7 CT3 CT4
7	Assignment #4	Group work	No Presential	04:00	10%	5 / 10	CG5 CG8 CG9 CB8 CB9 CE6 CB6 CB10 CE1 CB7 CT3 CT4
13	Final paper	Individual work	No Presential	04:00	25%	5 / 10	CG5 CG8 CG9 CB8 CB9 CE6 CB6 CB10 CE1 CB7 CT3

13	Final Presentation	Individual presentation	Face-to-face	04:00	25%	5 / 10	CG5 CG9 CB8 CB9 CB6 CB10 CE1 CB7 CT3
14	Assessment of student participation in class	Individual presentation	Face-to-face	01:00	10%	5 / 10	CG9 CB8 CB9 CE1 CT3

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	CG5 CG8 CG9 CB8 CB9 CE6 CB6 CB10 CE1 CB7 CT3 CT4

6.2. Assessment criteria

Ordinary evaluation

Assignments

40% 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 how it generally compares to the work of your peers.

Final paper and presentation

50% of your final score will be based on an individual paper on a topic of your choice, which you will complete and present to your classmates at the end of the course. The written paper will be evaluated on its depth, quality, and how it compares to the work of your peers. 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	<p>
</p> <p>The course web page at UPM's Moodle server contains all material needed to follow the course. This includes:
</p> <ol style="list-style-type: none">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