



POLITÉCNICA

INTERNATIONAL  
CAMPUS OF  
EXCELLENCE

COORDINATION PROCESS OF  
LEARNING ACTIVITIES  
PR/CL/001



E.T.S. de Ingeniería de Montes,  
Forestal y del Medio Natural

# ANX-PR/CL/001-01

## LEARNING GUIDE

### SUBJECT

**133000259 - Forest Resilience**

### DEGREE PROGRAMME

13AD - Master Universitario En Ingeniería De Montes

### ACADEMIC YEAR & SEMESTER

2024/25 - Semester 2

## Index

---

### Learning guide

1. Description.....	1
2. Faculty.....	1
3. Skills and learning outcomes .....	3
4. Brief description of the subject and syllabus.....	4
5. Schedule.....	6
6. Activities and assessment criteria.....	8
7. Teaching resources.....	11
8. Other information.....	13

## 1. Description

---

### 1.1. Subject details

<b>Name of the subject</b>	133000259 - Forest Resilience
<b>No of credits</b>	3 ECTS
<b>Type</b>	Optional
<b>Academic year of the programme</b>	First year
<b>Semester of tuition</b>	Semester 2
<b>Tuition period</b>	February-June
<b>Tuition languages</b>	English
<b>Degree programme</b>	13AD - Master Universitario en Ingeniería de Montes
<b>Centre</b>	13 - E.T.S. De Ingeniería De Montes, Forestal Y Del Medio Natural
<b>Academic year</b>	2024-25

## 2. Faculty

---

### 2.1. Faculty members with subject teaching role

<b>Name and surname</b>	<b>Office/Room</b>	<b>Email</b>	<b>Tutoring hours *</b>
M Pilar Pita Andreu (Subject coordinator)		pilar.pita@upm.es	M - 12:00 - 15:00 Tu - 12:00 - 15:00 Tutorials should be requested in advance by e-mail
Juan Antonio Martin Garcia		juan.martin.garcia@upm.es	W - 10:00 - 14:00 Tutorials should be requested in advance by e-mail

Ramon Perea Garcia-Calvo		ramon.perea@upm.es	Tu - 10:00 - 11:30 Th - 15:30 - 20:00 Tutorials should be requested in advance by e-mail
Rosa Ana Lopez Rodriguez		rosana.lopez@upm.es	Tu - 09:30 - 11:30 W - 09:30 - 11:30 Tutorials should be requested in advance by e-mail
Jesus Rodriguez Calcerrada		jesus.rcalcerrada@upm.es	Tu - 09:00 - 12:00 F - 09:00 - 12:00 Tutorials should be requested in advance by e-mail
Isabel Dorado Liñan		isabel.dorado@upm.es	Sin horario. Tutorials should be requested in advance by e-mail
Martin David Venturas		martin.venturas@upm.es	Tu - 11:00 - 13:00 W - 10:30 - 12:30 W - 15:30 - 16:30 Tutorials should be requested in advance by e-mail

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

## 2.2. Research assistants

Name and surname	Email	Faculty member in charge
Salomon Moreno, Roberto Luis	roberto.salomon@upm.es	Pita Andreu, M Pilar

## 3. Skills and learning outcomes \*

---

### 3.1. Skills to be learned

CB06 - 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

CB09 - 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

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.

CE 6.2 - Conocimientos y habilidades para la mejora ambiental del medio

CT04 - Capacidad crítica para el análisis, la síntesis y el aprendizaje mediante el intercambio de opiniones, presentando argumentos sólidos y estructurados

CT06 - Búsqueda bibliográfica, análisis de documentación y tratamiento de la información procedente de diversas fuentes y de su análisis y síntesis aplicándola a la resolución de problemas complejos

CT07 - Perfeccionar el conocimiento oral y escrito de la lengua inglesa

## 3.2. Learning outcomes

RA157 - Valorar la resiliencia de especies arbóreas a la herbivoría

RA134 - Capacidad para realizar búsquedas bibliográficas, consultar y utilizar con criterio bases de datos y otras fuentes de información, para llevar a cabo simulaciones con el objetivo de realizar investigaciones sobre temas complejos de su especialidad

RA155 - Valorar el efecto de las principales enfermedades y plagas que afectan a árboles forestales en el contexto del cambio global

RA156 - Analizar el efecto del incremento de CO<sub>2</sub> atmosférico y los fenómenos meteorológicos extremos en especies arbóreas

\* 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 offers a chance to gain a better understanding on how trees respond to several kinds of stress, both biotic (pathogens and pests, herbivory) and abiotic (mainly those related to climate change). Special attention will be given to ageing and regeneration, two key processes in forest dynamics and forest resilience.

The course will combine lectures given by specialists in their fields with laboratory practices, field trips and collaborative sessions, where recently published results on different topics will be discussed.

Specific goals for this course are:

Offer up-to-date information on tree and forest responses to Global Change

Develop ecological indicators to assess the resilience of forest and agroforestry systems

Integrate resilience into sustainable forest management

Identify biotic threats to forests and management measures to increase resilience

## 4.2. Syllabus

1. Topic 1. CO<sub>2</sub> exchange between forest ecosystems and the atmosphere
  - 1.1. Tree Physiological responses to increased atmospheric CO<sub>2</sub>
  - 1.2. CO<sub>2</sub> effects on stress tolerance
2. Topic 2. Tree responses to climate change and extreme meteorological events
  - 2.1. Water deficit
  - 2.2. Global Warming and Heat Waves
  - 2.3. Long-term perspectives on forest resilience: the dendrochronological approach
3. Topic 3. The effects of ageing on tree responses to stress
4. Topic 4. Forest resilience to pathogens and pests in the context of global change
5. Topic 5. The impact of herbivory on forest trees
6. Topic 7. Forest Modelling
7. Topic 8. Forest dynamics. Main threats to natural regeneration

## 5. Schedule

### 5.1. Subject schedule\*

Week	Type 1 activities	Type 2 activities	Distant / On-line	Assessment activities
1	Lecture on the contents of Topic 1.1 Duration: 01:30 Lecture			Questions on the contents of the seminar Written test Progressive assessment Presential Duration: 00:30
2	Lecture on the contents of Topic 1.2 Duration: 02:00 Lecture			Questions on the contents of the seminar Written test Progressive assessment Presential Duration: 00:30
3	Lecture on the contents of Topic 2.1 Duration: 02:00 Lecture			Questions on the contents of the seminar Written test Progressive assessment Presential Duration: 00:30
4	Lecture on the contents of Topic 2.2 Duration: 01:30 Lecture			Questions on the contents of the seminar Written test Progressive assessment Presential Duration: 00:30
5	Lecture on the contents of Topic 2.3 Duration: 01:30 Lecture			Questions on the contents of the seminar Written test Progressive assessment Presential Duration: 00:30
6	Lecture on the contents of Topic 3 Duration: 01:30 Lecture			Questions on the contents of the seminar Written test Progressive assessment Presential Duration: 00:30
7		Lab practice Duration: 01:00 Laboratory assignments		Student's presentations and debate on the topic choosen Group presentation Progressive assessment Presential Duration: 01:00



8	<b>Lecture on the contents of Topic 4</b> Duration: 02:00 Lecture			<b>Questions on the contents of the seminar</b> Written test Progressive assessment Presential Duration: 00:30
9	<b>Field trip</b> Duration: 04:00 Additional activities			
10	<b>Lecture on the contents of Topic 5</b> Duration: 01:30 Lecture			<b>Questions on the contents of the seminar</b> Written test Progressive assessment Presential Duration: 00:30
11	<b>Lecture on the contents of Topic 6</b> Duration: 01:30 Lecture			<b>Questions on the contents of the seminar</b> Written test Progressive assessment Presential Duration: 00:30
12	<b>Lecture on the contents of Topic 7</b> Duration: 01:30 Lecture			<b>Questions on the contents of the seminar</b> Written test Progressive assessment Presential Duration: 00:30
13				
14	<b>Field Trip</b> Duration: 07:00 Additional activities			
15				<b>Student's presentations and debate on the topic choosen</b> Group presentation Progressive assessment Presential Duration: 01:30
16				
17				<b>Final Exam</b> Written test Global examination Presential Duration: 01:30

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	Questions on the contents of the seminar	Written test	Face-to-face	00:30	6%	2 / 10	CB06 CB09 CT07 CE 6.2
2	Questions on the contents of the seminar	Written test	Face-to-face	00:30	6%	2 / 10	CB06 CB09 CT07 CE 6.2
3	Questions on the contents of the seminar	Written test	Face-to-face	00:30	6%	2 / 10	CB06 CB09 CT07 CE 6.2
4	Questions on the contents of the seminar	Written test	Face-to-face	00:30	6%	2 / 10	CB06 CB09 CT07 CE 6.2
5	Questions on the contents of the seminar	Written test	Face-to-face	00:30	6%	2 / 10	CB06 CB09 CT07 CE 6.2
6	Questions on the contents of the seminar	Written test	Face-to-face	00:30	6%	2 / 10	CB06 CB09 CT07 CE 6.2
7	Student's presentations and debate on the topic chosen	Group presentation	Face-to-face	01:00	20%	5 / 10	CB06 CB10 CT04 CT07 CE 6.2
8	Questions on the contents of the seminar	Written test	Face-to-face	00:30	6%	2 / 10	CB06 CB09 CT07 CE 6.2

10	Questions on the contents of the seminar	Written test	Face-to-face	00:30	6%	2 / 10	CB06 CB09 CT07 CE 6.2
11	Questions on the contents of the seminar	Written test	Face-to-face	00:30	6%	2 / 10	CB06 CB09 CT07 CE 6.2
12	Questions on the contents of the seminar	Written test	Face-to-face	00:30	6%	2 / 10	CB06 CB09 CT07 CE 6.2
15	Student's presentations and debate on the topic chosen	Group presentation	Face-to-face	01:30	20%	5 / 10	CB09 CB10 CT06 CT07

### 6.1.2. Global examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
17	Final Exam	Written test	Face-to-face	01:30	100%	5 / 10	CB06 CB09 CB10 CT04 CT06 CT07 CE 6.2

### 6.1.3. Referred (re-sit) examination

Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
Written examination for students who failed the final exam	Written test	Face-to-face	01:30	100%	5 / 10	CB06 CB09 CT04 CE 6.2

## 6.2. Assessment criteria

Continuous assessment:

At the end of each seminar, the students will have to answer some short questions about the contents of the seminar, This evaluation activity will account for 60% of the mark obtained by continuous assessment.

The students will have to carry a debate and/or oral presentation about some topics related to the contents of the course. The following items will be considered to evaluate these activities: The soundness of the scientific evidences that support the argumentation. Oral expression. Clarity and originality in data presentation. This activity will have a weight of 20% in the mark obtained by continuous assessment.

The students will have to attend to a field trip to the beech forest at Montejo de la Sierra and discuss/answer some questions regarding the contents of the trip This activity will have a weight of 20% in the mark obtained by continuous assessment.

Final Exam (Ordinary):

Students who failed the continuous assessment or wish to improve the mark obtained by continuous assessment will take a written exam about the contents of the course (May-June).

Final Exam (Extraordinary):

Students who failed the continuous assessment and the final exam will take a written exam about the contents of the course in July.

## 7. Teaching resources

### 7.1. Teaching resources for the subject

Name	Type	Notes
Portable Infrared gas analyzer (LI-6400, Li-Cor INC, NE, USA) for gas exchange measurements	Equipment	
Chen et al (2015). Roles of Climate, Vegetation and Soil in Regulating the Spatial Variations in Ecosystem Carbon Dioxide Fluxes in the Northern Hemisphere. PLoS ONE 10(4): e0125265. doi:10.1371/journal.pone.0125265	Bibliography	
Choat et al. 2018. Triggers of tree mortality under drought. Nature 558 (7711), 531	Bibliography	
Gill, R. M. A. (1992). A review of damage by mammals in north temperate forests: Impact on trees and forests. Forestry: An International Journal of Forest Research, 65(4), 363-388.	Bibliography	
Jiang et al. (2020) The fate of carbon in a mature forest under carbon dioxide enrichment. Nature 580: 227-231	Bibliography	
Leakey et al. (2009). Elevated CO <sub>2</sub> effects on plant carbon, nitrogen, and water relations: six important lessons from FACE. Journal of Experimental Botany, Vol. 60, No. 10, pp. 2859-2876	Bibliography	

<p>Morellet, N., Gaillard, J. M., Hewison, A. M., Ballon, P., Boscardin, Y. V. E. S., et al. (2007). Indicators of ecological change: new tools for managing populations of large herbivores. <i>Journal of Applied Ecology</i>, 44(3), 634-643.</p>	<p>Bibliography</p>	
<p>Keeling et al (2017). Atmospheric evidence for a global secular increase in carbon isotopic discrimination of land photosynthesis. <i>Proceedings of the National Academy of Sciences</i>. 114. 201619240. 10.1073/pnas.1619240114.</p>	<p>Bibliography</p>	
<p>Teskey R, et al 2015. Responses of tree species to heat waves and extreme heat events. <i>Plant, Cell and Environment</i> 38, 1699?1712</p>	<p>Bibliography</p>	
<p>Schuldt B, et al 2020. A first assessment of the impact of the extreme 2018 summer drought on Central European forests. <i>Basic and Applied Ecology</i> 45, 86-103</p>	<p>Bibliography</p>	
<p>Zhao DF, et al (2017) Environmental conditions regulate the impact of plants on cloud formation. <i>Nature Communications</i>. 8:14067   DOI: 10.1038/ncomms14067</p>	<p>Bibliography</p>	

## 8. Other information

---

### 8.1. Other information about the subject

Different seminars will be given by experts on the subject and illustrated with updated results from our Research Group and other authors, published in recognized scientific journals.

This course is connected with the Sustainable Development Goals established by UN, more specifically with Goal 13 'Climate action' and Goal 15 'Life on Land' through the analysis of CO<sub>2</sub> effects on plants and the resilience of forest species to both biotic and abiotic stress