ESCUELA TÉCNICA SUPERIOR DE INGENIERÍA
AGRONÓMICA Y DE MONTES
**GRADO DE INGENIERÍA FORESTAL**
2024/25 YEAR
**FORESTERÍA DE PRECISIÓN**

UNIVERSIDAD D CÓRDOBA

AM ETSIAM

## Course details

**Course name:** FORESTERÍA DE PRECISIÓN
**Code:** 642015
**Degree/Master:**    GRADO DE INGENIERÍA FORESTAL                    **Year:** 4
**Field:**
**Character:** OPTATIVA                         **Duration:** FIRST TERM
**ECTS Credits:** 4.0                          **Classroom hours:** 40
**Face-to-face classroom percentage:** 40.0%   **Study hours:** 60
**Online platform:** https://moodle.uco.es/

## Coordinating teacher

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## Brief description of the contents

La asignatura se desarrolla en 3 unidades didácticas i) Sistemas de información geográfica y teledetección, ii) tecnología LiDAR y iii) sistemas de soporte e información a la gestión forestal.


English version
The course develops over 3 learning units i) GIS and remote sensing, ii) LiDAR technology, and iii) Data Analytics and Decision Support Systems

## Prerequisites

### Prerequisites established in the study plan
Sin requisitos / Not required


### Recommendations
None specified

## Study programme

### 1. Theory contents

**Unidad I: Teledetección y SIG (Sistemas de Información Geográfica):**

La toma de datos mediante teledetección (e.j. satélites, imágenes aéreas, drones y otros sensores) proporcionan información cuantitativa sobre el estado, estructura y función del bosque. La tecnología SIG ayuda a procesar y analizar estos datos para tomar decisiones informadas sobre la gestión y la planificación forestal. Esta unidad incluye los siguientes aspectos teóricos:

- Sinergias de la teledetección y la modelización ecofisiológica para estimar la producción y la salud de las plantas.

o Variables biofísicas y ecofisiológicas

o Determinación de variables biofísicas mediante modelos de transferencia radiativa

- Aplicaciones de la teledetección para el seguimiento de la vegetación

**Unidad II: Tecnología LiDAR:**

LiDAR utiliza pulsos láser para medir distancias y crear modelos 3D precisos de los bosques. Esta tecnología es crucial para comprender la estructura de los bosques, identificar las especies arbóreas, calcular la biomasa y evaluar el terreno. Los datos LiDAR ayudan a optimizar las operaciones forestales, como las prácticas silvícolas.

- Detección y alcance de la luz (LiDAR).

o Fundamentos de las mediciones LiDAR

o Procesamiento de nubes de puntos

o Modelos 3D

- Aplicaciones LiDAR para inventarios forestales

**Unidad III: Análisis de datos y sistemas de apoyo a la toma de decisiones:**

La analítica de grandes datos y los sistemas de apoyo a la toma de decisiones integran diversas fuentes de datos, como la teledetección, los SIG y los datos de campo. Estas herramientas ayudan a los gestores forestales y a las partes interesadas a tomar decisiones informadas sobre la planificación, las operaciones y la conservación de los bosques.

**English version**

**Unit I: Remote Sensing and GIS (Geographic Information Systems):**

Remote sensing involves collecting data remotely using satellite, aerial imagery, drones, and other sensors. These data sources provide detailed information about forest cover, tree health, and more. GIS technology helps in processing and analyzing this data to make informed decisions about forest management and planning. This unit includes the following theoretical aspects:

- Synergies of Remote Sensing and Ecophysiological modelling for estimating plant production and health. - Biophysical and ecophysiological variables

- Radiative transfer models

- Remote sensing applications for vegetation monitoring

**Unit II: LiDAR Technology:**

LiDAR uses laser pulses to measure distances and create accurate 3D models of forests. This technology is crucial for understanding forest structure, identifying tree species, calculating biomass, and assessing the terrain. LiDAR data aids in optimizing forest operations like silvicultural practices.

- Light detection and ranging (LiDAR). - Fundaments of LiDAR measurements

- Processing point clouds
- 3D models

- LiDAR applications for forest inventories

**Unit III: Data Analytics and Decision Support Systems:**
   Big data analytics and decision support systems integrate various data sources, including remote sensing, GIS, and field data. These tools help forest managers and stakeholders make informed decisions about forest planning, operations, and conservation.

### 2. Practical contents

- Unidad I: Seguimiento de la salud de los bosques:

Las tecnologías de precisión ayudan a controlar la salud de los árboles y a detectar los primeros signos de enfermedades, plagas y otras alteraciones. Esto permite intervenir a tiempo para evitar la propagación de los problemas y mantener la vitalidad general de los bosques. Aquí estudiaremos un caso práctico de diferentes masas forestales con decaimiento (detalles).

- Unidades II y III: Inventario y planificación de recursos:

Un inventario preciso de los recursos es crucial para una gestión forestal sostenible. Las técnicas de precisión permiten estimar mejor el volumen de madera, la composición de las especies y el estado general del bosque. Esta información ayuda a tomar decisiones bien informadas sobre la tala, la reforestación y los esfuerzos de conservación.

English version

- Unit I: Forest Health Monitoring:

   Precision technologies help monitor the health of trees and detect early signs of diseases, pests, and other disturbances. This enables timely interventions to prevent the spread of problems and maintain overall forest vitality. Here we will take a case study (details).

- Units II and III: Resource Inventory and Planning:

 Accurate resource inventory is crucial for sustainable forest management. Precision techniques allow for better estimation of timber volume, species composition, and overall forest condition. This information aids in making well-informed decisions about logging, reforestation, and conservation efforts.

## Bibliography

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Molina-Valero, J. A., A. Martínez-Calvo, M. J. Ginzo Villamayor, M. A. Novo Pérez, J. G. Álvarez-González, F. Montes and C. Pérez-Cruzado (2022). "Operationalizing the use of TLS in forest inventories: The R package FORTLS." Environmental Modelling & Software **150**: 105337.

Jiang, X., M. Jiang, Y. Gou, Q. Li and Q. Zhou (2022). "Forestry Digital Twin With Machine Learning in Landsat 7 Data." Front Plant Sci **13**: 916900.

## Methodology

### Methodological adaptations for part-time students and students with disabilities and special educational needs

centro incluye las adaptaciones especiales necesarias

### Face-to-face activities

| Activity | Large group | Small group | Total |
|---|---|---|---|
| *Field trips* | 5 | - | 5 |
| *Oral communication activities* | 25 | - | 25 |
| *Projects based on the course contents* | - | 5 | 5 |
| *Reading comprehension, listening, visual, etc. activities* | 5 | - | 5 |
| ***Total hours:*** | ***35*** | ***5*** | ***40*** |

### Off-site activities

| Activity | Total |
|---|---|
| *Information processing activities* | 30 |
| *Information search activities* | 30 |

| Activity | Total |
|---|---|
| *Total hours* | *60* |

## Results of the training and learning process

### Knowledge, competencies and skills

| | |
|---|---|
| CB2 | The ability to solve problems with creativity, initiative, a methodology, and critical reasoning. |
| CB5 | The ability to carry out activities taking on a social, ethical and environmental commitment in accord with the reality of the human and natural environment. |
| CEC6 | The ability to know, understand and use the principles of Topography, Geographic Information Systems and Remote Sensing |
| CEC11 | The ability to know, understand and use the principles of: Forestry |
| CEC13 | The ability to know, understand and use the principles of: Forest Harvesting |
| CEEF8 | The ability to know, understand and use the principles of: Spatial Management and Planning |

## Assessment methods and instruments

| Intended learning outcomes | Attendance checklist | Group or individual globalizing projects | Means of practical execution |
|---|---|---|---|
| *CB2* | X | X | X |
| *CB5* | X | X | X |
| *CEC11* | X | X | X |
| *CEC13* | X | X | X |
| *CEC6* | X | X | X |
| *CEEF8* | X | X | X |
| *Total (100%)* | *30%* | *60%* | *10%* |
| *Minimum grade (\*)* | *5* | *5* | *5* |

(\*)Minimum mark (out of 10) needed for the assessment tool to be weighted in the course final mark. In any case, final mark must be 5,0 or higher to pass the course.

**General clarifications on instruments for evaluation:**

El 60% de la nota corresponde a la evaluación de un trabajo en grupo sobre un tema a elegir del contenido de la asignatura, y el 40% a la asistencia.

**Clarifications on the methodology for part-time students and students with disabilities and special educational needs:**

No se requieren necesidades educativas especiales

**Clarifications on the evaluation of the extraordinary call and extra-ordinary call for completion studies:**

Se aplican los mismos criterios de evaluación

**Qualifying criteria for obtaining honors:**

*Se usarán los criterios generales de la UCO. Se valorará la excelencia de los estudiantes*

## Sustainable development goals

Affordable and clean energy
Industry, innovation and infrastructure
Responsible consumption and production
Climate action

## Other Faculty

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*The methodological strategies and the evaluation system contemplated in this Teaching Guide will respond to the principles of equality and non-discrimination and must be adapted according to the needs presented by students with disabilities and special educational needs in the cases that are required. Students must be informed of the risks and measures that affect them, especially those that may have serious or very serious consequences (article 6 of the Safety, Health and Welfare Policy; BOUCO 23-02-23).*