



INTERNATIONAL  
CAMPUS OF  
EXCELLENCE

COORDINATION PROCESS OF  
LEARNING ACTIVITIES  
PR/CL/001



E.T.S. de Ingenieros de Minas y  
Energia

# ANX-PR/CL/001-01

## LEARNING GUIDE

### SUBJECT

**63000155 - Reservoir simulation**

### DEGREE PROGRAMME

06AF - Master Universitario En Ingenieria De Minas

### ACADEMIC YEAR & SEMESTER

2018/19 - Semester 2

## Index

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### Learning guide

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

## 1. Description

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### 1.1. Subject details

<b>Name of the subject</b>	63000155 - Reservoir simulation
<b>No of credits</b>	3 ECTS
<b>Type</b>	Optional
<b>Academic year of the programme</b>	Second year
<b>Semester of tuition</b>	Semester 4
<b>Tuition period</b>	February-June
<b>Tuition languages</b>	English
<b>Degree programme</b>	06AF - Master universitario en ingeniería de minas
<b>Centre</b>	06 - Escuela Técnica Superior de Ingenieros de Minas y Energía
<b>Academic year</b>	2018-19

## 2. Faculty

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### 2.1. Faculty members with subject teaching role

<b>Name and surname</b>	<b>Office/Room</b>	<b>Email</b>	<b>Tutoring hours *</b>
Ramon Rodriguez Pons-Esparver (Subject coordinator)	604	ramon.rodripons@upm.es	Tu - 11:00 - 14:00 W - 11:00 - 14:00

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

## 3. Skills and learning outcomes \*

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### 3.1. Skills to be learned

CE01 - Capacidad para abordar y resolver problemas matemáticos avanzados de ingeniería, desde el planteamiento del problema hasta el desarrollo de la formulación y su implementación en un programa de ordenador. En particular, capacidad para formular, programar y aplicar modelos analíticos y numéricos avanzados de cálculo, proyectos, planificación y gestión, así como capacidad para la interpretación de los resultados obtenidos, en el contexto de la ingeniería de minas.

CG18 - Conocimientos adecuados de los aspectos científicos y tecnológicos de métodos matemáticos, analíticos y numéricos de la ingeniería, mecánica de fluidos, mecánica de medios continuos, cálculo de estructuras, carboquímica, petroquímica y geotecnia

### 3.2. Learning outcomes

RA110 - Aplicar la simulación numérica, a través de herramientas informáticas empleadas por la industria, a distintos casos reales de producción y almacenamiento

RA105 - Comprender los procesos básicos asociados a un yacimiento de hidrocarburos y a un almacenamiento de CO<sub>2</sub>

RA107 - Comprender los modelos fundamentales de simulación en yacimientos de hidrocarburos

RA106 - Conocer los parámetros fundamentales para su caracterización

RA108 - Plantear y desarrollar las ecuaciones diferenciales de flujo de hidrocarburos en medio poroso

RA109 - Aplicar el método de diferencias finitas a la simulación del flujo en yacimientos de hidrocarburos

\* 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

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### 4.1. Brief description of the subject

This subject allows an approach to the reservoir simulation and gas storage. For that purpose, after knowing the fundamentals and the mathematic formulation of the main involved processes that appear in the reservoir simulation, numerical techniques are applied for the resolution of two phase and three phase flow problems in a porous media. For this task, commercial software is used, as it is done in the oil & gas industry.

### 4.2. Syllabus

1. Introduction to reservoir simulation and to NG and CO<sub>2</sub> storage
2. Fluid flow equations in a porous media
3. Numerical discretization and solution of the fluid flow equations (1, 2 & 3 phases)
4. Real applications to two-phase and three-phase reservoir and CO<sub>2</sub> & NG storage problems

## 5. Schedule

### 5.1. Subject schedule\*

Week	Face-to-face classroom activities	Face-to-face laboratory activities	Other face-to-face activities	Assessment activities
1	<b>Introduction to reservoir simulation and to NG and CO2 storage</b> Duration: 01:00 Lecture	<b>Introduction to reservoir simulation and to NG and CO2 storage</b> Duration: 01:00 Problem-solving class		<b>Full participation (8 weeks)</b> Other assessment Continuous assessment Duration: 00:00
2	<b>Introduction to reservoir simulation and to NG and CO2 storage</b> Duration: 02:00 Lecture	<b>Introduction to reservoir simulation and to NG and CO2 storage</b> Duration: 02:00 Problem-solving class		<b>Full participation (8 weeks)</b> Other assessment Continuous assessment Duration: 00:00
3	<b>Fluid flow equations in a porous media</b> Duration: 02:00 Lecture	<b>Fluid flow equations in a porous media</b> Duration: 02:00 Problem-solving class		<b>Full participation (8 weeks)</b> Other assessment Continuous assessment Duration: 00:00
4	<b>Fluid flow equations in a porous media</b> Duration: 01:00 Lecture	<b>Fluid flow equations in a porous media</b> Duration: 03:00 Problem-solving class		<b>Full participation (8 weeks)</b> Other assessment Continuous assessment Duration: 00:00
5	<b>Numerical discretization and solution of the fluid flow equations (1, 2 &amp; 3 phases)</b> Duration: 02:00 Lecture	<b>Numerical discretization and solution of the fluid flow equations (1, 2 &amp; 3 phases)</b> Duration: 02:00 Problem-solving class		<b>Full participation (8 weeks)</b> Other assessment Continuous assessment Duration: 00:00
6	<b>Numerical discretization and solution of the fluid flow equations (1, 2 &amp; 3 phases)</b> Duration: 01:00 Lecture	<b>Real applications to two-phase and three-phase reservoir and CO2 &amp; NG storage problems</b> Duration: 03:00 Problem-solving class		<b>Full participation (8 weeks)</b> Other assessment Continuous assessment Duration: 00:00
7		<b>Real applications to two-phase and three-phase reservoir and CO2 &amp; NG storage problems</b> Duration: 04:00 Problem-solving class		<b>Full participation (8 weeks)</b> Other assessment Continuous assessment Duration: 00:00
8		<b>Real applications to two-phase and three-phase reservoir and CO2 &amp; NG storage problems</b> Duration: 02:00 Problem-solving class		<b>Full participation (8 weeks)</b> Other assessment Continuous assessment Duration: 00:00
9				
10				
11				
12				
13				

14				
15				<b>Final work presentation</b> Individual work Continuous assessment Duration: 02:00  <b>Final exam</b> Problem-solving test Final examination Duration: 02:00
16				
17				

The independent study hours are training activities during which students should spend time on individual study or individual assignments.

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 subject schedule is based on a previous theoretical planning of the subject plan and might go through experience some unexpected changes along throughout the academic year.

## 6. Activities and assessment criteria

### 6.1. Assessment activities

#### 6.1.1. Continuous assessment

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
1	Full participation (8 weeks)	Other assessment	Face-to-face	00:00	2.5%	/ 10	
2	Full participation (8 weeks)	Other assessment	Face-to-face	00:00	2.5%	/ 10	
3	Full participation (8 weeks)	Other assessment	Face-to-face	00:00	2.5%	/ 10	
4	Full participation (8 weeks)	Other assessment	Face-to-face	00:00	2.5%	/ 10	
5	Full participation (8 weeks)	Other assessment	Face-to-face	00:00	2.5%	/ 10	
6	Full participation (8 weeks)	Other assessment	Face-to-face	00:00	2.5%	/ 10	
7	Full participation (8 weeks)	Other assessment	Face-to-face	00:00	2.5%	/ 10	
8	Full participation (8 weeks)	Other assessment	Face-to-face	00:00	2.5%	/ 10	
15	Final work presentation	Individual work	Face-to-face	02:00	80%	4 / 10	CG18 CE01

#### 6.1.2. Final examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
15	Final exam	Problem-solving test	Face-to-face	02:00	100%	5 / 10	CG18 CE01

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

No se ha definido la evaluación extraordinaria.



## 6.2. Assessment criteria

Continuous assessment is recommended in this subject. In this way the student, following the steps proposed, will know both the theoretical and practical fundamentals and the simulation tools for the different analyzed problems.

This continuous assessment is carried out as follows: 20% corresponds to the student participation whether in the classroom or laboratory. The other 80% corresponds with the oral presentation and defense of the simulation work proposed in this course and developed with ECLIPSE software.

It is not recommendable the assessment only by final exam in both examinations, ordinary and extraordinary. In any case, it will consist in developing a simulation model with the informatics tools used along the course period.

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## 7. Teaching resources

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### 7.1. Teaching resources for the subject

Name	Type	Notes
Moodle platform	Web resource	In this platform are available all the contents of the course and also some links to further resources.
Course notes	Others	Reservoir Simulation. Department of Petroleum Engineering and Applied Geophysics. Norwegian University of Science and Technology. 2016

Principles of Applied Reservoir Simulation	Bibliography	FANCHI, J.R. Principles of Applied Reservoir Simulation. Gulf Publishing Company, 2006.
Reservoir Simulation	Bibliography	MATTAX, C.C and DALTON, R.L. Reservoir Simulation. SPE Monograph Series, Vol 13, 1990.

## 8. Other information

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### 8.1. Other information about the subject

The software lab practices and work will be developed in the computer room (M2). Reservoir dynamic software (ECLIPSE ) will be used thanks to the partnership of Schlumberger and CEPESA with our School.