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PLAN DE ESTUDIOS DEL MASTER PROPIO EN INGENIERÍA DE PETRÓLEO Y GAS (mip)

(Syllabus Oil & Gas Engineering Master's Degree)

ESCUELA DE MINAS Y ENERGÍA

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POLITÉCNICA

mip 2024-2025

ESCUELA TÉCNICA SUPERIOR DE INGENIEROS DE MINAS Y ENERGÍA DE MADRID

The Master's Degree is made up of the following courses:

1. **PETROLEUM GEOLOGY**
2. **GEOPHYSICS**
3. **DRILLING ENGINEERING**
4. **RESERVOIR ENGINEERING**
5. **PRODUCTION AND COMPLETION ENGINEERING**
6. **SURFACE FACILITIES ENGINEERING**
7. **SHALE OIL AND GAS: RESERVOIRS AND COMPLETIONS**
8. **GAS AND CO2 STORAGE**
9. **LIQUEFIED NATURAL GAS (LNG)**
10. **HEALTH, SAFETY AND ENVIRONMENT**
11. **PETROLEUM ECONOMICS**
12. **PETROPHYSICS Lab**
13. **FIELD TRIP**
14. **FINAL WORK**

Our students so far come from these countries

Our School of Mines and Energy of the Universidad Politécnica de Madrid (UPM)

COURSE PG1	PETROLEUM GEOLOGY
SECTION PG1.1	SEDIMENTARY ROCKS AND SEQUENCE STRATIGRAPHY.

Lecturers:

	**José Eugenio Ortiz.** Ph.D. in Mining engineering-U.P.M. Professor at the Madrid School of Mines. Member and responsible of the Biomolecular Stratigraphy Laboratory. Expert in Stratigraphy, Palaeoclimatology, Palaeontology and Organic Geochemistry. He was Director of the Geological Engineering Department of the Madrid School of Mines and Secretary of the Geological Society of Spain.
	**Pedro Cámara Rupelo.** Geologist, (Graduated in the Complutense University of Madrid, 1974). He worked for different companies Geocisa, Eniepsa and PRN as a field geologist. In 1982 he joined REPSOL and worked as Exploration Manager in Algeria, Egypt; Subdirector of Exploration in Trinidad, Perú, Bolivia, Colombia, Azerbaijan, and Kazakjhstan. E & P Director in Brazil, Regional Exploration Director of Europe, Africa and Middle East; and country Manager in Norway. Once retired in 2013, his research on geology is focused on lectures and field trips in the Pyrenees and Cantabrian Basin. He is also an active member of different professional associations of petroleum geoscientists such as Geosen, SGE, AGGEP and AGB.

Objectives:

1. Learn the depositional environment for different sedimentary rocks.
2. Learn the compaction processes of sedimentary depositions.
3. Learn the cementation processes.
4. Reservoir rocks and sealing rocks.
5. Knowledge and methods to apply the sequence stratigraphy concepts

Syllabus:

1. Sedimentary Geology (J.E. Ortiz)

- 1.1. Erosion, transport and sediment: Sediment genesis.
- 1.2. Weathering.
- 1.3. Dissolution, Oxidation and Hydrolysis.
- 1.4. Transport.
- 1.5. Sediments and bedding.
- 1.6. Sedimentary rocks.

2. Sedimentary environment. (J.E. Ortiz)

- 2.1. Fluid characteristics.
- 2.2. Geographical aspects.
- 2.3. Climatic aspects
- 2.4. Types.

3.Introduction. (P. Cámara)

4. Sequence Stratigraphy. (P. Cámara)

- 4.1. Basic concepts.
- 4.2. Sequence stratigraphic units
- 4.3. System tracts.
- 4.4. Parasequences.
- 4.5. Carbonate sequence stratigraphy
- 4.6. Hierarchy in sequence stratigraphy.
- 4.7. Chronostratigraphy

Program:

This course lasts3 days.

Day 1: Sedimentary Geology. (J.E. Ortiz)
Day 2: Sedimentary Environment. (J.E. Ortiz)
Day 3: Sequence Stratigraphy. (P.Cámara)

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- Vail, P.R., Bowman, S. & Sangree J.B. (1989). The basics of sequence stratigraphy for seismic, well and outcrop data. Rice University. Department of geology and Geophysics. Houston. Texas 77251.
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- Catuneanu, O., Galloway W.E. et al. (2011). Sequence stratigraphy: methodology and nomenclature. Newsletters on stratigraphy. V 44/3. pp 173-245.
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- Tlig S., Alouani R. et al. (2013). A transition from carbonate shelf to pelagic basin environments of deposition: rifting and depositional systems in the Jurassic of northeastern Tunisia. AAPG Bulletin V. 97, nº 7 (July 2013). pp 1051-1070.
- Torres, T., Ortiz, J.E., Soler, V., Llamas, J.F., Fernández-Gianotti, J., Delgado, A., Reyes, E., Cobo, R., García de la Morena, M.A., Martínez, M.J., Calvo, J.P., Cortés, A. (2003). A Pleistocene lacustrine basin of the east domain of Guadix-Baza basin (Granada, Spain): sedimentology, chronostratigraphy and palaeoenvironment. Limnogeología en España: un tributo a Kerry Kelts, Consejo Superior de Investigaciones Científicas, Madrid. pp 151-185.
- Torres, T., Ortiz, J.E., Martín-Sánchez, D., Arribas, I., Moreno, L., Ballesteros, B., Blázquez, A., Domínguez, J.A., Rodríguez Estrella, T. (2003). The long Pleistocene record from the Pego-Oliva marshland (Alicante-Valencia, Spain). In: Martini, I. P.& Wanless, H. R. (eds), Sedimentary Coastal Zones from High to Low Latitudes: Similarities and Differences. Geological Society, London, Special Publications 388. pp 429-452.
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COURSE PG1	PETROLEUM GEOLOGY
SECTION PG1.2	STRUCTURAL GEOLOGY AND BASIN ANALYSIS

Lecturers:

	**Pedro Cámara Rupelo.** Geologist, (Graduate of Complutense University of Madrid, 1974). He worked for different companies Geocisa, Eniepsa and Hispanoil. In 1995 he joined REPSOL and worked like Exploration Manager in Algeria, Egypt; like Subdirector of Exploration in Trinidad, Perú, Bolivia, Colombia, Azerbaijan, and Kazakjhstan; like E & P Director in Brazil; like Regional Exploration Director of Europe, Africa and Middle East; and like country Manager in Norway. Once retired, 2013, his research on geology is focused on lectures and field trips in the Pyrenees and Cantabrian Basin. He is also an active member of different professional associations of petroleum geoscientists such as Geosen, AAPG, SGE, AGGEP and AGB.
	**José Eugenio Ortiz.** Ph.D. in Mining engineering-U.P.M. Professor at the Madrid School of Mines. Member and responsible of the Biomolecular Stratigraphy Laboratory. Expert in Stratigraphy, Palaeoclimatology, Palaeontology and Organic Geochemistry. He was Director of the Geological Engineering Department of the Madrid School of Mines and Secretary of the Geological Society of Spain.

Objectives:

To introduce the basic concepts of structural geology and the hydrocarbon trap.
1. To understand the Theory of Plate Tectonics.
2. To understand the factors required to produce the Hydrocarbon Trap.
3. To recognize the main Extensional Trapping Styles.
4. To recognize the main Strike-Slip Trapping Styles.
5. To recognize the Contractional Trapping Styles.
6. To introduce the basic concepts of structural geology.
7. To recognize the main sedimentary basin types
8. To analyse the basin geodynamics
9. To recognize the main petroleum systems associated to basin´s types

Syllabus:

1. The Theory of Plate Tectonics. (J.E. Ortiz)
- 1.1. Continental Drift.
- 1.2. Seafloor Spreading.
- 1.3. Plate Tectonic Theory and Types of Plate Margin.
- 1.4. Intra-cratonic Deformation and Crustal Stress

2. An Introduction to Rock Mechanics and Rock Failure Modes. (J.E. Ortiz)
- 2.1. Andersonian Principles.
- 2.2. Mohr Circles.
- 2.3. Coulomb-Navier Failure.
- 2.4. The Effect of Pore Pressure.
- 2.5. Neotectonics.

3. Contractional Tectonics. (J.E. Ortiz)
- 3.1. Thin-skinned Deformation (terminology, detachments, wedge theory, controls, evaporites).
- 3.2. Thick-skinned Deformation (basement involvement, pre-existing weaknesses).
- 3.3. Seismic Expression.
- 3.4. Field Examples

4. Basic tectonic concepts (P. Cámara)
- 4.1. Deformation. Stress, strain, ductile and brittle deformation
- 4.2. Faults
- 4.3. Folds
- 4.4. Tectonic regimes.

4.5. Maps. Geological cross-sections. Restorations.

5. Extensional Tectonics. (P. Cámara)

5.1. Extension regimes
5.2. Extensional Detachments.
5.3. Growth faults and Gravity sliding
5.4. Crustal profiles

6. Compressional Tectonics. (P. Cámara)

6.1. Compression regimes
6.2. Basement Involved and reverse faults.
6.3. Detachment tectonics
6.4. Inversion tectonics.
6.5. Thrust and folded belts
6.6. Crustal profiles

7. Strike & Slip Tectonic. (P. Cámara)

7.1. Basic Terminology.
7.2. Transcurrent & Transform faults.
7.3. Contractional Pop-Ups.
7.4. Extensional Pull-Aparts.

8. Salt Tectonics. (P. Cámara)

8.1. Evaporites and their deposition.
8.2. Salt structures.
8.3. Salt growth stages.
8.4. Salt Tectonic systems
8.5. Salt influence in petroleum systems
8.6. Salt tectonics and Energy transition

9. Basin Analysis. **(P. Cámara)**

9.1. Structure of the Earth
9.2. Subsidence and isostasy
9.3. The Wilson Cycle
9.4. Methods for basin´s study
9.5. Classification of Sedimentary basins

10. Basins & Tectonic plate margins (P. Cámara)

10.1. Basins on Divergent margins.
10.1.1. Continental Rift basins.
10.1.2. Passive and Rifted margins.
10.1.3. Ocean basins.
10.1.4. Intra-cratonic basins and Aulacogens.
10.1.5. Hydrocarbon occurrences in Divergent margins
10.2. Basins on Convergent Margins. Strike-slip basins
10.2.1. Trench basins.
10.2.2. Fore arc and Back Arc basins.
10.2.3. Foreland basins.
10.2.4. Hydrocarbon occurrences in convergent margins
10.2.4. Strike & Slip basins.

11. Traps. (P. Cámara)

12. Spanish basin examples (P. Cámara)

12.1. Western Mediterranean basin
12.2. Guadalquivir – Gulf of Cadiz Basin
12.3 North Basque-Cantabrian Basin

13. Basque-Cantabrian Tectonic Evolution. (P. Cámara)

Program:

This course lasts 5 days.

Day 1: (José Eugenio Ortiz)

- Plate Tectonics.
- Continental Drift.
- Seafloor Spreading.
- Theory and Types of Plate Margin.
- Intra-cratonic deformation and Crustal Stress

Day 2: (José Eugenio Ortiz)

- Rock Mechanics
- Rock Failure

Day 3: (Pedro Cámara)

- Basic tectonic concepts
- Extensional Tectonics
- Compressional tectonics
- Strike-Slip Tectonics.
- Salt tectonics

Day 4: (Pedro Cámara)

- Basin analysis
- Basins on Divergent Margins
- Basins on Convergent Margins and Strike-slip basins

Day 5: (Pedro Cámara)

- Trapping Geometries.
- Spanish basin examples
- Basque-Cantabrian basin tectonic evolution.

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- Bürgmann R., Arrowsmith R. and Dumitru T. (1994) "Rise and fall of the southern Santa Cruz Mountains, California, from fission tracks, geomorphology and geodesy". Journal of geophysical Research, Vol 99, NO.B10. pp 181-202.
- Guan S., Stockmeyer JM., Shaw JH., Plesch A. & Zhang Jian. Structural inversion, imbricate wedging and out-of-sequence thrusting in the southern Junggar fold-and-thrust belt, northern Tian Shan, China. AAPG Bulletin, V. 100, nº 9 (September 2016). Pp 1443-1468.
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COURSE PG1	PETROLEUM GEOLOGY
SECTION PG1.3	BASIN ANALYSIS AND PETROLEUM SYSTEMS

Lecturer

Jorge Navarro Comet, Senior petroleum geoscientist with 30+ year's worldwide experience on different petroleum basins. He holds a BSc in Geology from the Complutense University (Madrid, Spain). Currently working as independent geologist. He worked until end 2020 as Geology Manager in CEPSA, where he was responsible for coordination, management and supervision of the petroleum geology studies and works in regions where CEPSA was active: South America, North Africa, Middle East, South East Asia and Spain. Active member of the CEPSA geosciences quality assurance committee which validated geological works, hydrocarbon prospects, volumetrics and risks, geological modelling, exploration and development well proposals. Before joining CEPSA in 1997, he was working for REPSOL as exploration and development geologist in Syria and offshore Spain. He has been a lecturer on petroleum geology in a number of Spanish Universities, also leading geological field trips. Author of several papers and oral presentations on petroleum exploration and production history. He is an active member of different professional associations of geoscientists such as EAGE, AAPG and SGE. Now, president of the Asociación de Geólogos y Geofísicos Españoles del Petróleo (AGGEP) and of the EAGE Madrid Local Chapter.

Objectives:

This course aims to improve participants' understanding of the basic concepts and techniques of Basin Analysis and Petroleum Systems and their applications to petroleum exploration, via lectures, some practical exercises and presenting case histories from around the world. It will cover:

1. Concept and application of the Petroleum System exploration approach
2. The geological elements and processes are essential for the development of a petroleum accumulation
3. Different concepts for Basin Modeling and Petroleum System analysis
4. Relevant geological data required for constructing computer-based Basin and Petroleum System Models to be used in petroleum exploration

Syllabus:

1. Petroleum Systems
1.1. Revision of petroleum exploration historical approach
1.2. Petroleum System concept: geological elements and processes
1.3. Source rock. Sedimentary environments, types, quality, parameters distribution over geological time and geography
1.4. Reservoir. Types, properties and characterization: porosity, permeability, geometry, continuity, fluid saturation)
1.5. Generation and migration through space and time. Processes, mechanisms, kinetics, maturity indicators and evaluation techniques
1.6. Seal. Types (lateral/top seal), assessment and properties. Leakage mechanisms and seal failure examples. Fault seal analysis
1.7. Trap. Types and geometries: structural, stratigraphic, hydrodynamic and other complex traps
1.8. Petroleum System event chart: geological elements, processes, timing and critical moment
1.9. Petroleum System: Algeria case history
1.10. Exercise: construction and analysis of a Petroleum System event chart
1.11. Play fairway and exploration risk analysis: quantification and Common Risk Segment mapping

2. Basin and Petroleum System Modeling
2.1. Petroleum System and Basin modeling principles, input data required and source of the information
2.2. Basin and Petroleum System modeling work flow. Backstripping and forward modeling.
2.3. Burial history. Construction of burial and chronostratigraphic charts. Subsidence, depositional history (thickness, age, lithology) and tectonic history (uplifts, erosion, unconformities)
2.4. Thermal history reconstruction: geothermal gradient, heat flow, thermal conductivity and paleothermometers
2.5. Subsurface pressure distribution: lithostatic and hydrostatic pressure
2.6. Model simulation (1D, 2D & 3D) and calibration
2.7. Basin and Petroleum System modeling: Peru case history

Program:

This course lasts 3 days.

Day 1 (Jorge Navarro)

- Petroleum Systems.

Day 2 (Jorge Navarro)

- Petroleum Systems.
- Basin and Petroleum System Modeling.

Day3 (Jorge Navarro)

- Basin and Petroleum System Modeling

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- Allen, P.A. and Allen, J.R., 2013. Basin Analysis: Principles and Application to Petroleum Play Assessment, 3rd Edition. Wiley-Blackwell.
- Biteau, J.J. and Baudin, F., 2019. Petroleum Geology. History, Genesis, Exploration, Resources. EAGE Publications.
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- Galeazzi, S., Point O., Haddadi, N., Mather, J. and Druesne, D., 2010, Regional geology and petroleum systems of the Illizi–Berkine area of the Algerian Saharan Platform: An overview. Marine and Petroleum Geology, v. 27, pp. 143–178.
- Bora, D. and Dubey, S. 2015. New insight on petroleum system modeling of Ghadames basin, Libya. Journal of African Earth Sciences 112, pp. 111-128.

COURSE PG1	PETROLEUM GEOLOGY
SECTION PG1.4	PETROLEUM GENERATION AND MIGRATION. ROCK EVAL

Lecturers:

	**María Jesús García Martínez.** Ph.D. in Mining engineering. Associate professor of the Polytechnic University of Madrid. She has directed two doctoral theses about biodegradation and biofuels and she is the author of 16 papers published in JCR journals. She has participated in a total of 32 funded research projects, 5 of them in competitive public calls. She has 46 communications to congresses. Research and publication in the areas of environmental geochemistry, human health risk assessment, biofuels, remediation and life cycle assessment.
	**Yolanda Sánchez-Palencia González.** Ph.D. in Mining engineering. Assistant professor in the Madrid School of Mines and Energy, Polytechnical University of Madrid. Responsible of the Biomolecular Stratigraphy Laboratory in this School. This is a Quality Laboratory of the Community of Madrid. She has been working in Research Projects of the Spanish Ministry of Science and Education.

Objectives:

1. Learn how hydrocarbons are generated in the sedimentary source rock.
2. Learn how the maturation of organic matter progress during rocks compaction.
3. Evaluate TOC and reflectance vitrinita.
4. Lab analysis by the Rock Eval.

Syllabus:

1. Organic matter:
1.1. Organic matter sedimentation.
1.2. Types of organic matter.
1.3. Organic matter maturation: Diagenesis, Catagenesis and Metagenesis.

2. Van-Kevelen Diagram.

3. Petroleum Formation and Composition.
3.1. API gravity versus depth.
3.2. Crude Oil Fractions.
3.3. Inorganic

4. Rock Eval and Migration: (FIP)
4.1. Analysis: TOC and Pirolisis.
4.2. Reflectance of vitrinite.
4.3. Migration of hydrocarbons

Program:

This course lasts 4 days:

Day 1. (M.J. García / Y. Sánchez-Palencia)

- Organic matter.

Day 2. (M.J. García / Y. Sánchez-Palencia)

- Van-Kevelen Diagram.

Day 3. (M.J. García / Y. Sánchez-Palencia)

- Hydrocarbons formation and oil composition.

Day 4: (M.J. García / Y. Sánchez-Palencia)

- Rock Eval and migration

Bibliography:

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Scientific papers:

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- Y. Duan, C.Y. Wang, C.Y. Zheng, B.X. Wu, G.D. Zheng (2007). Geochemical study of crude oils from the Xifeng oilfield of the Ordos basin, China. Journal of Asian Earth Sciences 31 (2008) 341–356

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- Selley, R.C., 2014, Elements of Petroleum Geology. 3rd Edition. Academic Press.

COURSE PGPH2	GEOPHYSICS
SECTION PGPH2.1	ACQUISITION AND PROCESSING OF 2D/3D SEISMIC

Lecturers:

	**Alvaro Garcia-Hourcade.** Geological Engineering studies in University Complutense of Madrid (Spain). GOP Cycle (Geophysics major) postgraduate studies in French Petroleum Institut (IFP), Paris. 10,5 years' experience in the Oil & Gas industry (E&P). All of them in Cepsa. Currently leading G&G team focus on exploration in South America. Deep Ofßhore2D &,3D seismic interpretation in the eastem South American margin for the last 8 years. Onshore 2D & 3D seismic interpretation in Colombia during 2,5 years. Regional geology studies. Expert Petrel user for Geophysics modules.
	**Massimo Di Giulio Colimberti.** Geophysics engineer with experience in planning, design, acquisition, supervision in field and QC of 2D and 3D seismic survey (land and marine). Experience in seismic processing and supervision of PSTM and PSDM. Seismic modeling and ray tracing of geological structures. Checkshot and VSP design and supervision in field. Time to depth conversion of seismic data. Experience in the acquisition and interpretation of gravity, magnetic and electric surveys data. Interested in the application and implementation of state-of-the-art geophysical technology oriented to the imaging of geological structures, seismic acquisition, seismic attributes, depth conversion and geostatistics.

Objectives:

1. Become acquainted with the main geophysical methods used in exploration, their applications and their limitations.
2. Understand the basic concepts of seismic wave propagation, reflection, diffraction and refraction.
3. Understand in broad terms how 3D-seismic land and marine data are acquired.
4. Understand in broad terms how seismic data is processed.

Syllabus:

1. Introduction to Geophysics.
1.1. The Objective.
1.2. The Different Survey Methods.
  1.2.1. Gravity.
  1.2.2. Magnetic.
  1.2.3. Reflection Seismic.
1.3. The Importance of Seismic in Hydrocarbon Exploration.

2. Seismic Waves.
2.1. Waves Propagation.
2.2. Sinusoids.
2.3. Amplitude, Frequency and Phase.
2.4. Energy Decay.
2.5. Type of Elastic Waves.
2.6. Reflections and Refractions.
2.7. Reflection Coefficient.
2.8. Reflection Hyperbola.
2.9. Diffractions, Ground Roll, Multiples and Noise.

3.Data Acquisition.
3.1. Seismic Sources.
3.2. Seismic Receivers.
3.3. Seismic Spreads.
3.4. Key Parameters in 3D-Seismic Acquisition.
3.5. Logistics of Land Acquisition.
3.6. Logistics of Marine Acquisition.
3.7. Acquisition Time.
3.8. Acquisition Cost.

4. Data Processing
4.1. Processing Objective.
4.2. Main Processing Steps.
4.3. Interpretive Elements in Seismic Processing.
4.4. Processing Time.
4.5. Processing Cost.

Program:

This course last 4 days.

Day 1: Introduction to Geophysics. Seismic waves. (Alvaro Garcia-Hourcade)
Day 2 :Data acquisition. (Massimo de Giulio)
Day 3: Data Processing. (Massimo de Giulio)
Day 4: Exercises and control (Massimo de Giulio y Alvaro Garcia-Hourcade)

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Scientific papers:

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- Dragoset, B. A historical reflection on reflections. The Leading Edge. January 2005.
- Ibanez Poveda, Sergio, Mario Patino and John Mathewson. Depth Migration as a valuable tool for prospect derisking in the Colombian Foothills. Interpretation SEG. Special Section: Time or depth imaging of land data. Volume 5, Issue 4. November 2017.
- Mougenot, Denis. Marine, seabed and land seismic equipment for broadband acquisition: a review. Geophysical Prospecting. Volume 66, Nº 5. June 2018
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- Frehner, Brian. Marine, Monumental Geophysics: J. Clarence Karcher and the reflection Method. The Leading Edge. June 2021.

COURSE PGPH2	GEOPHYSICS
SECTION PGPH2.2	SEISMIC INTERPRETATION AND SUBSURFACE MAPPING

Lecturers:

	**Juan Klimowitz Picola.** Geologist-geophysicist with more than 30 years of experience in seismic interpretation. Co-director and founding partner of Gessal, since 1987, has been responsible for several exploration subsurface studies of natural resources, mining, hydrocarbon exploration, as well as of underground gas, CO2 or radioactive waste storage. Moreover, he is a specialist in computer applications applied to seismic interpretation. In addition, he has several papers published in specialist journals related to tectonics and stratigraphy.
	**Serafín Escalante García.** Geology graduated by Universidad Complutense de Madrid. He has 16 years' experience in different geological investigation: geological mapping, geophysical interpretation and geological modelling. He has been working for Gessal since 2003 and within this period he has worked as a technical support geologist for Repsol´s Argelia exploration team over three years. He is a specialist in geological and geophysical computer applications, with high experience in Petrel interpretation and modelling software.

Objectives:

Become acquainted with the main geophysical methods used in exploration, their applications and their limitations.

1. Understand how seismic data can be linked to geology by using well data.
2. Learn how seismic data can be converted from time to depth.
3. Get to know how 2D-seismic data is interpreted and how horizon maps are made.
4. Learn how 3D-seismic data is interpreted. How horizon maps are made, the principle of attribute extraction.

Syllabus:

1. 2D and 3D Seismic Interpretation
1.1. The Seismic Interpretation Objective.
1.2. Identification and Interpretation of Geologic Horizons.
1.3. Seismic stratigraphy & seismic structural expression
1.4. Problems and Pitfalls in Seismic Interpretation.
1.5. Seismic attributes

2. 2D and 3D Seismic Interpretation exercises
2.1 Introduction to interpretation software. Petrel
2.2. Fault/Horizon Interpretation in 2D and 3D software.
2.3. 2D and 3D Seismic Interpretation exercises.
2.4. How to Create a Horizon Map.

3. The Link between Seismic and Well Information.
3.1. Overview Well Calibration.
3.2. Well Shooting and VSP.
3.4. Sonic and Density Logs.
3.4. Synthetic Seismograms.
3.5 Exercises in Well tying

4. Time to Depth Conversion.
4.1. Overview Depth Conversion.
4.2. Velocity Information.
4.3. Depth Conversion Methods.
4.4. Exercises in Depth Conversion

Program:

This course lasts 4 days.

Day 1: Seismic Interpretation. (Juan Klimowitz)
Day 2: The Link between seismic and well Information. 2D Interpretation software Exercises (PETREL) (Juan Klimowitz)
Day 3: Time to Depth Conversion. 3D Interpretation software Exercises (PETREL). (Juan Klimowitz)
Day 4: 3D Interpretation software Exercises (PETREL). Overview and Introduction to geophysics tasks of Final Project. (Juan Klimowitz, Serafín Escalante)

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- McQuillin R., Bacon M., Barclay W.: An Introduction to Seismic Interpretation: Graham & Trotman Ltd. 1984.ISBN 0-86010-496-6.
- Sheriff R.E.: Encyclopaedic Dictionary of Exploration Geophysics, Third Edition: Society of Exploration Geophysicists (SEG), Tulsa Oklahoma. 1991. ISBN 1-56080-018-6.
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Scientific papers:

- Gong C, et al. Shelf-edge trajectories and stratal stacking patterns: their sequence and relation to styles of deep-water sedimentation and amount of deep-water sandstone. AAPG Bulletin Vol 99 nº 7 July. 2015.
- Harding R. Huuse M. Salt on the move: Multi stage evolution of salt diapirs in the Netherlands North Sea. Marine and Petroleum Geology 61. 2015
- Nigel E. et al. The dynamic behavior of shallow marine reservoirs: Insights from the Pliocene of offshore North Trinidad. Cross et al. AAPG Bulletin Vol 99 nº3 March 2015.
- Safronova P.A., Henriksen S., Andreassen K., Laberg J.S. and Vorren T.O. (2014). Evolution of shelf-margin clinoforms and deep-water fans during the middle Eocene in the Sørvestsnaget Basin, southwest Barents Sea. AAPG Bulletin Vol 98 Nº 3 March.
- Rossland A., Escalona A. and Rolfsen R. (2913). Permian–Holocene tectonostratigraphic evolution of the Mandal High, Central Graben, North Sea. AAPG Bulletin Vol 97 Nº6 June. 2013.
- Zhu H., Yang X., Liu K. and Zhou X. (2014). Seismic-based sediment provenance analysis in continental lacustrine rift basins: An example from the Bohai Bay Basin, China. AAPG Bulletin Vol 98 nº10 October. 2014.

COURSE PGPH2	GEOPHYSICS
SECTION PGPH2.3	GRAVITY AND MAGNETIC TECHNIQUES

Lecturers:

Cecile Rosine Barrere. PHD in Petroleum Engineering and Applied Geophysics of the NTNU University of Trondheim in Norway. Her PHD project focused on potential fields' interpretation and G&G data integration. She got her Master of Applied Geophysics in 2004 from Paris VI (Pierre et Marie Curie) University.
After 13 years working as a geoscientist (CGG Seismic R&D, Geological survey of Norway, Beicip-Franlab consulting company, Cepsa E&P) she moved to a role of upstream project development coordinator in January 2018. She continues to be potential field technical advisor for the geosciences department of CEPSA E&P. Since 2020, she is European project manager working on Horizon 2020 projects and supporting consortium proposal. writing in the field of geoscience and energy technologies.

Objectives:

1. Understand the basic concepts for gravity and magnetic prospecting techniques
2. Know when these economically competitive methods are worth implementing
3. Apprehend the principles of potential field anomaly interpretation
4. Learn about the application of these datasets in the O&G industry (basement geometry, depocenter detection, etc…)
5. Become acquainted with the interpretation methods

Syllabus:

1. Gravity data.
1.1. Introduction to gravity method concepts and data acquisition
1.2. Understanding the gravity maps

2. Magnetic data.
2.1. Magnetic method supporting concepts
2.2. Magnetic data acquisition and mapping

3. interpretation of potential field data
3. 1 Analysis of anomaly maps
3..2 Anomaly interpretation

Program:

This course last 2 - 3 days:
Day 1: Gravity & Magnetic techniques: data acquisition and interpretation. (Cecile Barrere)
Day 2: GEOSFT training, map production and 2D modeling. (Cecile Barrere)

Bibliography:

- LOWRIE, W. (2007). Fundamentals of Geophysics. Cambridge U.P.
- NETTLETON, L.L. (1976). Gravity and Magnetics in Oil Prospecting, McGraw Hill.
- REYNOLDS, J. M. (1998). An Introduction to Applied and Environmental Geophysics. Wiley & Sons.

Scientific papers:

- Bishop C. 2012. Interpretation and Modelling of the Pedirka Basin (central Australia) using Magnetics, Gravity, Well-log and Seismic data. 22nd International Geophysical Conference and Exhibition, 26-29 February 2012 - Brisbane, Australia
- Gadirov V.G. and Eppelbaum L.V. 2012. Detailed gravity, magnetics successful in exploring Azerbaijan onshore areas. Oil and Gas Journal 11/05/2012, volume 110, Issue 11
- Stander T.W.1989. A case history of petroleum exploration in the southern Forest City basin using gravity and magnetic surveys. Kansas Geological Survey Bulletin 226, 245-256

More learning materials:

- When Seismic is not enough - Exploit the Potential of Gravity and Magnetic Data. Duration: 1 h 26min
  https://www.youtube.com/watch?v=3tw8pH3NjZI
- Integrating Potential Field data with seismic data and structural geology. Duration: 31 min.
  https://www.youtube.com/watch?v=lM-ErOvJuwQ
- Seminar Gravity_and_magnetic_methods_in_petroleum_exploration ONGC (Oil and Natural Gas Corporation, India). 2013
  http://www.petrosociety.com/uploads/5/1/2/7/51278149/gravity_and_magnetic_methods_in_petroleum_exploration.pdf
- Exploring_for_oil_with_gravity_and_magnetics GEOSOFT 2008
  http://www.geosoft.com/media/uploads/resources/reports/the_new_frontier_exploring_for_oil_with_gravity_and_magnetics.pdf
- Gravity and magnetic methods in oil exploration. Geosoft.
  http://www.geosoft.com/gravity-and-magnetic-methods-oil-exploration

COURSE PGPH2	GEOPHYSICS
SECTION PGPH2.4	WELL LOGGING

Lecturers:

	**Manuel Gutiérrez Alonso.** Geologist working for Gessal, since 2006 as consultant in Repsol as Senior Petrophysicist in Regional Studies Group. Studies carried out in basin all around the world, both clastic and carbonatic environment. Also in No Conventional group involved in shale gas plays studies.
	Schlumberger.

Objectives:

1. Rock Recognition / Lithology.
2. Rock Properties calculation.
3. Fluids & contacts (OWC, GWC & GOC).
4. Logging equipment and Operations.

Syllabus:

1. Nomenclature and Types of Logs.

2. Acquisition and Recording of Wireline Log Data.

3. Course Outline and Objectives. Nature of a Hydrocarbon Accumulation; Porosity, Permeability, Wetness and the Matrix Concept; Invasion.

4. Wireline Open Hole Tools and Services. The Electric Logs and SP and their Interpretation; the Sonic Log and its Interpretation; the Radioactive Logs and their Interpretation; Qualitative Interpretation of Logs, Litho logy Determination and Gas Detection.

5. Quantitative Interpretation. Introduction and Objectives; Shale and Hydrocarbon Correction; Effective Porosity; Formation Factor; RwSw and Sxo determination; Estimation of the Depth of Mud Filtrate Invasion; Evaluation of Clean Sandstone Reservoir and Carbonate Reservoir.

Main Exercises and Tutorials:

- Exercise 1: Qualitative Interpretation.
- Exercise 2: Lithology and Porosity Identification.
- Exercise 3: Quantitative Interpretation: Rw, Sw and Sxo Determination.
- Exercise 4: Evaluation of a Clastic Gas Bearing Reservoir.
- Exercise 5: Evaluation of a Carbonate Reservoir.

Program:

This course lasts 6 - 7 days.

Day 1: Course by Schlumberger, Tools and Operations. (Manuel Gutiérrez Alonso)
Day 2: Tools and Operations. Production logs. (Manuel Gutiérrez Alonso)
Day 3: Wireline Open Hole Tools and Services. (Manuel Gutiérrez Alonso)
Day 4: Qualitative Interpretation of Logs. (Manuel Gutiérrez Alonso)
Day 5: Quantitative Interpretation of Logs. (Manuel Gutiérrez Alonso)
Day 6: Quantitative Interpretation of Log. Interpretation with software. (Manuel Gutiérrez Alonso)
Day 7: Quantitative Interpretation of Log. Interpretation with software. (Manuel Gutiérrez Alonso)

Bibliography:

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- E. R. (Ross) Crain: Crain´s petrophysical handbook. https://www.spec2000.net/01-index.htm
- Schlumberger: Log Interpretation Principles/ Applications. Schlumberger; several editions (downloadable from the SLB web page http://www.slb.com/resources/publications/books.aspx)
- Schlumberger: Log Interpretation Charts. Schlumberger; several editions (http://www.slb.com/resources/publications/books/log_charts.aspx)
- Serra, O. (2008) The well Logging Handbook. Editions Technip, Paris.

Scientific papers:

- Akbar , M. et al (1995). Classic interpretation Problems; evaluating carbonates. Schlumberger oilfield review, January
- Doveton, J. H. (2001). All models are wrong, but some models are useful: “solving” the Simandoux equation. From Session J of the International Association for Mathematical Geology Conference, Cancun, Mexico.

COURSE PGPH2	PETROLEUM GEOLOGY
SECTION PGPH2.5	PROSPECT AND PLAY ASSESSMENT: RISK ANALYSIS.

Lecturer:

Santiago Ledesma. PhD in Geological Sciences (Univ. Salamanca, 2001), Master in Oil & Gas Exploration and Production (Fundación Repsol-ISE, 2002); Exploration geologist (Gessal 2002); Exploration Manager (Petroleum Oil & Gas España, 2004); Upstream, Head of Geology in Naturgy Energy Group since 2007. He is a specialist in volumetric estimation and risk assessment for conventional and unconventional plays and prospects. He is also member of different professional associations such as the American Association of Petroleum Geologists (AAPG), Society of Exploration Geophysicists (SEG) and Asociación de Geologos y Geofisicos Españoles del Petróleo (AGGEP).

Objectives:

1. Learn to calculate oil & gas volumes
2. How petroleum volumes are assessed and classified by the E&P industry
3. Identifying the uncertainties, probabilities and risks intrinsic to the calculations
4. Learn about statistical tools used for prospects and plays evaluation
5. Establish the basis for the economic evaluation of E&P projects
6. LAB PRACTICE: Using a commercial program (REP), learn how to apply Monte-Carlo techniques to estimate volumes of oil and gas.

Syllabus:

1. Introduction

2. Prospect Assessment

2.1. Uncertainty

a) Volume estimation methods

- Analogy Methods
- Volumetric Methods
  - Deterministic Approach
  - Probabilistic Approach
- Other Methods

b) Data source

2.Probability

- Probability Density Functions
- Normal Distribution, the Central Limit Theorem
- Normal Cumulative Probability Distribution, Percentiles
- Lognormal Distribution
- Lognormal Cumulative Probability Distribution

3. Play Assessment

3.1. Petroleum System

3.2. Basin / Play / Lead / Prospect

3.3. Play assessment tools

4. Classification of Resources & Reserves

4.1. Petroleum Resources Management System (PRMS)

4.2. Geologic-Success (Pg) VS Economic-Success (Pe)

4.3. Introduction to E&P economics

5. Computer LAB: Monte Carlo analysis

5.1. Introduction to Reserves Evaluation Programme (REP)

5. 2. Prospect/Field evaluation

- Input parameters
- Entering probability distributions
- Calculations
- Tools

5.3. Understanding the results

5.4. Consolidations

5.5. Other tools

Main Exercises and Tutorials:

Exercise 1. Unconventional Play Evaluation Exercise
Exercise 2. Conventional prospect Monte-Carlo assessment exercise
Exercise 3. Frontier prospect evaluation exercise

Program:

This course lasts 4 days.

Day 1: Introduction. Prospect Assessment. Play Assessment.
Day 2: Classification of Resources & Reserves. Computer LAB: Monte Carlo analysis.
Day 3: Computer lab. Exercise.
Day 4: Computer lab. Exercise 3. General review and exam preparation.

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- SPE Oil and Gas Reserves Committee (OGRC), 2011. Guidelines for Application of the Petroleum Resources Management System (PRMS). http://www.spe.org/industry/docs/PRMS_Guidelines_Nov2011.pdf
- Peter R. Rose (2012). Risk Analysis and Management of Petroleum Exploration Ventures. AAPG Methods in Exploration No. 12
- P.J. Lee Deceased (2008). Statistical Methods for Estimating Petroleum Resources. Oxford University Press, Inc.

Scientific papers:

- D.G.Quirk, M.J.Howe and S.G.Archer (2017). A combined deterministic-probabilistic method of estimating undiscovered hydrocarbon resources. Journal of Petroleum Geology.
- Ferruh Demirmen (2007, SPE paper 103434). Reserves Estimation: The Challenge for the Industry. http://large.stanford.edu/courses/2013/ph240/zaydullin2/docs/demirmen.pdf
- Paul F. Worthington (Petroleum Geoscience, Vol. 13 2007). A road map for improving the technical basis for the estimation of petroleum reserves.

COURSE DE3	DRILLING ENGINEERING
SECTION DE3.1	BASIC DRILLING TECHNIQUES

	**Lecturer 1: Fernando Steegmann.** Mining Engineering from the Polytechnic University of Madrid and a diploma in Business Administration (PDD) from IESE. Head of the Department of Drilling CAMPSA and in Hispanoil, being successively Operations Manager in Brazil, Equatorial Guinea and Algeria. He worked in the design of Gaviota gas field platform and Drillmar drilling rig. Drilling Director of Repsol Exploration, with responsibility for all operations performed in Spain and abroad. Then E&P Director and later Technical Director in the Corporate Office of Repsol YPF.).
	**Lecturer 2: Juan Herrera Herbert (UPM).** Backed by a PhD in Mining Engineering from the Technical University of Madrid, a MSc in Mining Engineering also from the Technical University of Madrid and a MSc in Civil Engineering of Mines from the University of Chile (Chile), has a proven track of more than 20 years of experience in Industry (engineering and Consulting) and in Higher Education. Coming from a position of Head of a Department in the Technical University of Madrid, he is now involved in the creation, launch and running of EIT Raw Materials' Learning and Education activities as Education Officer of the Southern Co-Location Center. As Professor at the Madrid School of Mines and Energy, he coordinates several subjects related with oil and gas production and technology.

Objectives:

This is an introduction to Drilling Engineering. The objectives are to introduce the concepts and equipment used in drilling; to examine the design requirements and techniques and to examine the optimization of the drilling activity.

Syllabus:

1. Introduction
2. Overview
3. Rig Components
4. Drill String
5. Bits
6. Formation Pressure
7. Well Control
8. MWD
9. Offshore Drilling

Program:

This course lasts 3 days.

Day 1: (Fernando Steegmann)

- Module Introduction
  - History
  - Drilling equipment and operations
  - Circulating System. Mud
  - Casing and bits
  - Directional Drilling
  - Wellsite drilling logs
  - BOP and wellhead
  - Onshore, offshore drilling

Day 2: (Juan Herrera)

- Overview of Drilling.
- Rig Components.
- Bits.
- Film: Rotary Rig.
- Exercises:
  - Bit Selection and Grading.
  - Start Equipment List/Rig Spec.

Day 3: (Juan Herrera)

- Casing Introduction.
- Exercises: Casing design and calculations.
  - Select Casing setting points.
  - Cementing.
  - LOT Evaluation.

Bibliography:

- "Drilling Data Handbook", Ed. Technip - IFP. Halliburton Table.
- "Field Data Handbook". Dowell Schlumberger.
- "IADC Drilling Manual".
- "Petróleo Moderno: Un manual básico para la Industria". Bill D. Berger, January
- 1999. Penn Well Publishing Co. ISBN 0-87814-755-1.
- "Fundamentals of Casing Design". H. Rabia. ISBN 0-86010-863-5.
- "Kicks and Blowout Control". Adams and Kuhlman.ISBN-87814-419-6.

COURSE DE3	DRILLING ENGINEERING
SECTION DE3.2	DRILLING FLUIDS AND HYDRAULICS

	**Lecturer 1: Juan Herrera Herbert (UPM).** Backed by a PhD in Mining Engineering from the Technical University of Madrid, a MSc in Mining Engineering also from the Technical University of Madrid and a MSc in Civil Engineering of Mines from the University of Chile (Chile), has a proven track of more than 20 years of experience in Industry (engineering and Consulting) and in Higher Education. Coming from a position of Head of a Department in the Technical University of Madrid, he is now involved in the creation, launch and running of EIT Raw Materials' Learning and Education activities as Education Officer of the Southern Co-Location Center. As Professor at the Madrid School of Mines and Energy, he coordinates several subjects related with oil and gas production and technology.
	**Enrique J. Rojas** is Senior Operations Geologist in CEPSA E&P where he is responsible for coordination and supervision of the Operations Geology in the Ourhoud field in Algeria. During the last years in CEPSA E&P, has developed his job in different operated and non-operated assets of the company (Colombia, Perú, Thailand, Kenya, Liberia, Surinam, Algeria, etc.). He holds a BSc in Geology from the Complutense University (Madrid, Spain) and a Master degree in Project Management from the EAE Business School (Madrid, Spain). Before joining CEPSA E&P on 2012, he was working on the field site as a Mudlogger, Data Engineer and Mudlogging Unit Manager. Since 2006 He has worked as a consultant Well Site and Operations Geologist and Well Log analyst in REPSOL, TOTAL, OMW, TPAO, etc... Enrique has been responsible of Training Junior personnel on Operations and Wellsite Geology in CEPSA E&P. He is a member of different professional associations of petroleum geoscientists such as EAGE and AGGEP.

Objectives:

1. Understand the hydraulics of the mud fluid system of a drilling rig.
2. Understand the functions of the mud fluid during drilling.
3. Chemistry of the mud fluid.
4. Basic concepts and techniques of Wellsite and Operations Geology (WOG)
5. Integration of the WOG into the Well design, the engineering process and the best well Geological evaluation and well data optimization.

Syllabus:

1. The mud fluid chemistry.
1.1. Water base muds.
1.2. Oil base muds.
1.3. Heavy muds, components and operations.

2. The mud fluid circuit in a drilling rig.
2.1. Pumps and containers.
2.2. Subsurface mud pathway.
2.3. Mud parameters and measurement. Daily Reporting
2.4. Mud system hydraulics.-
2.5. Power at the bottom of the hole.

3. Wellsite and Operations Geology
3.1. Basic concepts and applications.
3.2. Pre-drilling works and studies. Geological Well Data Pack and Well Prognosis.
3.3. Basic Geological concepts in Drilling Engineering. Elementary Calculations.
3.4. Well supervision and Geological control. Geological reporting (Master and Composite Logs).
3.5. Basis of Mudlogging services, equipment and Techniques.
3.6. Gas while Drilling and Drilling Parameters Surveillance. Basic exercises.
3.7. Conventional Coring. How and What for.
3.8. Basis of Logging while Drilling and Geosteering (Tools and Operations).
3.9. Basis of Wireline Logging (Tools and Operations).

Program:

This course lasts 2 days.

Day 1: (Juan Herrera)
The mud fluid chemistry.
The mud fluid circuit in a drilling rig. Hydraulics.

Day 2: (Enrique J. Rojas)
Basic concepts and techniques of Wellsite and Operations Geology (WOG)
Integration of the WOG into the Well design, the engineering process and the best well Geological evaluation and well data optimization.

Bibliography (J. Herrera):

1. "Drilling Data Handbook", Ed. Technip - IFP. Halliburton Table.
2. "Field Data Handbook". Dowell Schlumberger.
3. "IADC Drilling Manual".
4. "Petróleo Moderno: Un manual básico para la Industria". Bill D. Berger, January
5. 1999. PennWell Publishing Co. ISBN 0-87814-755-1.
6. "Fundamentals of Casing Design". H. Rabia. ISBN 0-86010-863-5.
7. "Kicks and Blowout Control". Adams and Kuhlman. ISBN-87814-419-6.

Bibliography (Enrique J. Rojas):

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- Schlumberger, 2011. Wireline Log Quality Control Reference Manual. Slb Oilfield Mkt Communications.
- Theys, P. , 1991. Log Data Acquisition and Quality Control. Editions Technip.
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On-Line Resources:

- American Association of Petroleum Geologists. AAPG Wki: https://wiki.aapg.org/Main_Page
- Geological Society OnLine bulletin, Geoscientist Online: https://www.geolsoc.org.uk/Geoscientist
- Crain´s Petrophysical Handbook: https://www.spec2000.net/index.htm

COURSE DE3	DRILLING ENGINEERING
SECTION DE3.3	CASING AND CEMENTING

Lecturer 1: Jesus Caceres Jimeno (CEPSA).

Mining Engineer (2002).
From 2002 to 2011: Drilling Engineer at ENAGAS involving Underground Gas Storages.
Since 2011: Senior drilling engineer at Cepsa in Exploratory/Development drilling campaigns in Colombia, Peru, Algeria and Kenya.
Since 2015: Teacher at UPM (University Polytechnic Madrid).

Objectives:

1. Understand the casing depth selection.
2. Understand the casing design.
3. Understand the cement selection and placement.

Syllabus:

1. Casing design.
1.1. Introduction
1.2. Functions and types of casings
1.3. Materials
1.4. Casing Design
1.5. Exercise

2. Cementing.
2.1. Introduction
2.2. Factors affecting primary cementing
2.3. Cementing operations
2.4. Cementing design
2.5. Cement integrity
2.6. Exercise
2.7. Cementing program example

Program:

This course lasts 2 days.

Day 1: (Jesús Cáceres)

- Types of casings and casing design.

Day 2: (Jesús Cáceres)

- Types of cements and cementing operations.

Bibliography:

- "Drilling Data Handbook", Ed. Technip - IFP. Halliburton Table.
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- "IADC Drilling Manual".
- "Petróleo Moderno: Un manual básico para la Industria". Bill D. Berger, January
- 1999. PennWell Publishing Co. ISBN 0-87814-755-1.
- "Fundamentals of Casing Design". H. Rabia. ISBN 0-86010-863-5.
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- Mud Removal. Simon Bittleston.
- Getting to the roof of gas migration. Art Bonett. 1996.
- Well Cementing. Nelson. 2012.

COURSE DE3	DRILLING ENGINEERING
SECTION DE3.4	DIRECTIONAL, HORIZONTAL AND MULTILATERAL DRILLING

Lecturer 1: Jesus Caceres Jimeno (CEPSA).

Mining Engineer (2002).

From 2002 to 2011: Drilling Engineer at ENAGAS involving Underground Gas Storages.

Since 2011: Senior drilling engineer at Cepsa in Exploratory/Development drilling campaigns in Colombia, Peru, Algeria and Kenya.

Since 2015: Teacher at UPM (University Polytechnic Madrid).

Objectives:

1. Understand the fundamentals of directional drilling
2. Understand how to plan a directional well
3. Understand the techniques used in directional, horizontal and multilateral drilling.
4. Know the tools used in directional, horizontal and multilateral drilling.

Syllabus:

1. Fundamentals of Directional drilling.
1.1.- Definitions and Principles of Directional Drilling
1.2.- Applications and type of deviated wells
1.3.- Directional Well Planning. Challenges drilling highly deviated wells.
1.4 – Horizontal and Multilateral wells.

2. Techniques and Tools used in Directional Drilling
2.1.- Directional tools.
2.2 – Measure while drilling tools
2.3 – Logging while drilling tools

Program:

This course lasts 1 days.

Day 1: (Jesús Cáceres)

- Fundamentals of Directional Drilling

Bibliography:

- "Drilling Data Handbook", Ed. Technip - IFP. Halliburton Table.
- "Field Data Handbook". Dowell Schlumberger.
- "IADC Drilling Manual".
- "Petróleo Moderno: Un manual básico para la Industria". Bill D. Berger, January
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- "Fundamentals of Casing Design". H. Rabia. ISBN 0-86010-863-5.
- "Kicks and Blowout Control". Adams and Kuhlman. ISBN-87814-419-6.
- Geomagnetic Referencing. Andrew Buchanan. 2013.
- Hydrocarbon Exploration and Production, Volume 55, 2nd Edition, Frank Jahn Mark Cook Mark Graham. 2008.

COURSE DE3	DRILLING ENGINEERING
SECTION DE3.5	WELL DESIGN, PLANNING AND ENGINEERING

	**Lecturer 1: Fernando Steegmann.** Mining Engineering from the Polytechnic University of Madrid and a diploma in Business Administration (PDD) from IESE. Head of the Department of Drilling CAMPSA and in Hispanoil, being successively Operations Manager in Brazil, Equatorial Guinea and Algeria. He worked in the design of Gaviota gas field platform and Drillmar drilling rig. Drilling Director of Repsol Exploration, with responsibility for all operations performed in Spain and abroad. Then E&P Director and later Technical Director in the Corporate Office of Repsol YPF.
	**Lecturer 2: Javier Moro Morán (REPSOL).** Mining Engineering from University of Oviedo. MBA by IESE. As a drilling engineer and drilling manager, he was responsible for drilling operations in Spain, Argelia, Egypt and Syria. Later, as a part of the E&P technical staff of Repsol YPF, he became the lead of all drilling groups and departments worldwide. Then he was promoted as business Director in Argentina and Spain, and Country manager for all business (upstream, midstream and downstream) in Brazil as executive President of Repsol Brazil SA.

Objectives:

1. Understand the steps required to design a well. Review the geological data.
2. Previous available data. Required analysis.
3. How to specify the drilling rig specifications.
4. Learn how to specify the Mud fluid requirements.

Syllabus:

1. Previous data to be collected.

1.1. Rig availability.
1.2. Others wells drilled in the area.
1.3. Bit selection.
1.4. Casing depths selection.

2. Drilling parameters.

2.1. Weight on bit.
2.2. rpm.
2.3. Hydraulics.
2.4. Well progress (depth vs. time).

Program:

This course lasts 3 days.

Day 1: (Fernando Steegmann)

- Analysis of previous available data.

Day 2: (Javier Moro)

- Well design.

Day 3: (Javier Moro & Fernando Steegmann)

- Well design.

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- "Fundamentals of Casing Design". H. Rabia. ISBN 0-86010-863-5.
- "Kicks and Blowout Control". Adams and Kuhlman. ISBN-87814-419-6.

COURSE RE4	RESERVOIR ENGINEERING
SECTION RE4.1	RESERVOIR GEOLOGY

José Eugenio Ortiz. Ph.D. in Mining engineering-U.P.M. Professor at the Madrid School of Mines. Member and responsible of the Biomolecular Stratigraphy Laboratory. Expert in Stratigraphy, Palaeoclimatology, Palaeontology and Organic Geochemistry. He was Director of the Geological Engineering Department of the Madrid School of Mines and Secretary of the Geological Society of Spain.

Objectives:

1. Become acquainted with the controls of deposition on the properties and geometries of reservoirs.
2. Get to know how to recognize reservoir flow units.
3. Learn how to define the flow unit geometry in the subsurface.
4. Learn how to draw maps of flow units.
5. Learn how to define properties of flow units.
6. Learn how to determine volumetric hydrocarbons in place.

Syllabus:

1. Sedimentology.
1.1. Texture and properties – clastics.
1.2. Fluvial reservoirs – geometries.
1.3. Shallow marine reservoirs – geometries.
1.4. Deep water reservoirs – geometries.

2. Correlation.
2.1. Introduction.
2.2. Stratigraphy.
2.3. Correlation panels and cross sections.
2.4. Stratigraphy and reservoir performance.
2.5. Architecture, drive mechanism and recovery.
2.6. Compartmentalization and reserves.

3. Mapping.
3.1. Introduction.
3.2. Data types.
3.3. Manual contouring.
3.4. Computer contouring.
3.5. Structural maps.
3.6. Determination of Gross Rock Volume.
3.7. Isopachs.
3.8. Grid manipulation.
3.9. Fault maps.

4. Geological statistics.
4.1. Introduction.
4.2. Measures of central tendency.
4.3. Measures of variability.
4.4. Distributions.
4.5. Sample sufficiency.
4.6. Measures of spatial correlation
.
5. Volumetrics.
5.1. Introduction.
5.2. Gross reservoir and Net Pay.
5.3. Deterministic HIP calculations.
5.4. Monte Carlo HIP calculations.
5.5. Reserves definitions and categories.
5.6. Handling Uncertainty.

6. Reservoir Static Modelling.
6.1. Structural Framework.
6.2. Reservoir Correlation and Zonation.
6.3. Gridding Design.
6.4. Facies modelling / Petrophysical Property modelling.

Program:

This course last s3- 4 days.
Day 1: (José E. Ortiz)

- Sedimentology of reservoirs on deep waters and fluvial, and Correlation.

Day 2: (José E. Ortiz)

- Mapping and Geological statistics.

Day 3-4; (José E. Ortiz)

- Volumetrics and Reservoir Static Modelling
- Exercises about Sedimentology of reservoirs on deep waters and fluvial, Correlation, Mapping, and Geological statistics.

Bibliography:

- "Drilling Data Handbook", Ed. Technip - IFP. Halliburton Table.
- Abbotts, I.L., 1991, UK Oil and Gas Fields, 25years Commemorative Volume, Geological Society, 573p.
- Cosentino, L., 2001, Integrated reservoir Studies, Editions Technip, Paris, 310p.
- Dubrule, O., 1998, Geostatistics in Petroleum Geology, AAPG Continuing Education Course Note Series #38, Tulsa, Oklahoma.
- Jensen, J.L., Lake, L.W., Corbett, P.W.M., and Goggin, D.J., 2000, Statistics for Geoscientists and Engineers, Elsevier.
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COURSE RE4	RESERVOIR ENGINEERING
SECTION RE4.2	BASIC RESERVOIR ENGINEERING

	**Laura Valle Falcones (IPf).** Ph.D. in Mining Engineering-U.P.M. Master in Reservoir Geoscience and Engineering at IFP. Laboratory leader of Petrophysics Laboratory-UPM Technological Center. Research Scientist. Reservoir and gas storage characterization. Development of dynamic model for CO2 storage site. Technical expert evaluator of I+D+i projects.
	**Ana María García (ENAGAS).** Ph.D. in Mining Engineering-U.P.M. Master in Petroleum Engineering (ISE). Geoscience & Reservoir engineering coordinator at ENAGAS Underground Gas Storage Division. More than 18 year experience in activities related to the exploration, development & operation for Underground Gas Storage.

Objectives:

1. Understand Reservoir Rock Properties: Porosity, Permeability and Fluid-rock properties, Saturation, capillary pressure and relative permeability
2. Understand oil PVT analysis.
3. Understand Reservoir Pressure and Temperature Regimes and the techniques used for Distributed Pressure Measurements.
4. Understand the Phase Behavior of Reservoir Fluids.
5. Understand Gas reservoir behavior.
6. Understand Reservoir Performance Analysis Methods
7. Become acquainted with the Material Balance Technique.
8. Understand Reservoir Production Mechanisms.

Syllabus:

1. Reservoir Rock Properties.
1.1. Porosity.
1.2. Rock Compressibility
1.3. Absolute Permeability (Darcy's Law).

2. Reservoir description: Rock-Fluids Properties
2.1. Interfacial tension
2.2. Saruration
2.3. Capillary Pressure

3. Reservoir description: Rock-Fluids Properties
3.1 Wettability
3.2 Effective and relative Permeability

4. Oil PVT Analysis:
4.1. Definition of the Basic Parameters (Bo, Rs, Bg) and their Evolution with Pressure.
4.2. Oil Viscosity.
4.3. PVT analysis: Sampling Methods (Subsurface and Surface Recombined Samples).
4.4. Laboratory Experiments (Flash Expansion, Differential Liberation, Separator Tests).

5. Reservoir Pressure and Temperature.
5.1. Reservoir Fluid Pressure and Temperatures Regimes.
5.2. Techniques for Pressure Measurements: WFT.

6. Phase Behaviour of Reservoir Gas.
6.1. Pure Substances.
6.2. Multicomponent Hydrocarbon Mixtures.
6.3. Pressure-Temperature Phase Diagram Classification of Gas Reservoirs.

7. Gas and Gas-Condensate:
7.1. Ideal Gases.
7.2. Behavior of Real Gases: Equation of State.
7.3. Definition of the Basic Parameters (Z, Eg, CGR) and their evolution with Pressure.

7.4. Gas Viscosity.
7.5. Correlations.
7.6. Sampling Methods.
7.7. Laboratory Experiments (Retrograde Condensation).
7.8 Vapour Liquid Equilibrium Calculations: Equations of State.

8. Reservoir Performance Analysis Methods
8.1 Fluids Flow in porous media
8.2 Diffusivity Equation
8.3 Skin factor
8.4 Productivity Index

9. Material Balance.
9.1 Unsaturated oil Reservoir Material Balance
9.2 Gas Material Balance

10. Drive Mechanisms.
10.1 Depletion type reservoir
10.2 Water drive
10.3 Gravity drainage
10.4 Compaction drive

Tutorials:

Reservoir rock properties exercises
Reservoir Rock-Fluids properties exercises
Determination of the HWC from a RFT Survey.
Reservoir Performance Analysis exercises
MB exercises.

Program:

This course lasts 8 days

Days 1, 2 and 3: (Laura M Valle Falcones)

- Reservoir rock properties.
- Reservoir Rock-Fluids properties
- Oil PVT Analysis.

Day 4 and 5: (Ana Maria Garcia)

- Reservoir properties: pressure and Temperature.
- Phase behavior of hydrocarbon Systems gas reservoir

Days 6, 7 and 8: (Laura M Valle Falcones)

- Fluid Flow in porous media
- Material Balance
- Drive mechanisms

Bibliography:

- "Petrophysics". Djebbar Tiab&Erle C. Donaldson. Elsevier 2012.
- "A Geoscientist's guide to Petrophysics". B. zinszner, F-M. Pellerin. Editions Technip. IFP publications 2007
- "Applied Reservoir Engineering". C.R. Smith, G.W. Tracy, R.L. Farrar. OGCI and Petroskills publications. Tulsa, Oklahoma. 2012
- "The Practice of Reservoir Engineering". L. P. Dake, 1994. Developments in Petroleum Science, 36. Elsevier.
- "Reservoir Fluids: The Properties of Petroleum Fluids". W. D. McCain, 1990. Second Edition.PennWell.
- "Reservoir engineering handbook". 4th edition. Tarek Ahmed. Gulf Professional Publishing
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- "PVT and Phase Behaviour of Petroleum Reservoir Fluids". Ali Danesh, 1998. Developments in Petroleum Science, 47.Elsevier.
- "Waterflooding: The Reservoir Engineering Aspects of Waterflooding, Vol. 3". F.F. Craig Jr., Third Printing 1993. SPE Reprint Series.
- "Applied Petroleum Reservoir Engineering. Second Edition". B. C. Craft, M. F. Hawkins, 1991. Prentice-Hall.
- "Basics of Reservoir Engineering". R. Cosse, 1993. Editions Technip.
- "Petroleum Engineering Principles and Practices". J. S. Archer. And C. G. Wall, 1986. Graham &Trotman.
- "Petroleum Reservoir Engineering". Amyx, Bass & Whiting.McGraw-Hill BookCompan.

COURSE RE4	RESERVOIR ENGINEERING
SECTION RE4.3	WELL TESTING DESIGN AND ANALYSIS.

Magdy Rezk (CEPSA). Subject Matter Expert (SME) in Well Testing with 27 years of experience in the energy industry. Held former senior positions in major oil and gas companies such as Schlumberger, Shell and Repsol with a specialization in Well Engineering. Worked in more than 10 countries across 4 continents. Currently holding the position of Completion and Well Intervention Technical Authority at CEPSA in Madrid, Spain.

From 2015 to 2020, Magdy worked as lecturer in the CSF Repsol, teaching the Well Testing, Well Completion and Well Intervention Courses.

Magdy hold B.Sc. of Petroleum Engineering from Suez Canal University, Master in Completion and Well Intervention from Shell Open University, as well as MBA from Rome Business School.

Objectives:

1. Become acquainted with Well Testing Data Acquisition and Interpretation Techniques.
2. Understand the basic theory of well testing.
3. Be able to design a well test.
4. Get to know the tools needed to implement a well test.
5. Understand a well test report.
6. Be able to recognize different well-reservoir models in a pressure derivative response.
7. Understand the differences between oil and gas well testing.
8. Be able to interpret a well test flow period in terms of reservoir properties and boundary conditions.

Syllabus:

1. Fundamentals:
1.1. What is Well Testing?
1.2. Well Testing objectives
1.3. Well Testing business
1.4. Digital transformation

2. Well Testing design:
2.1. Health, Safety and Environment (HSE)
2.2. Well Testing program
2.3. Surface equipment & downhole tools
2.4. Engineering

3. Well testing execution:
3.1. Readiness to test
3.2. Perform the well testing operations
3.3. Reporting and communication
3.4. Well site Handover

4. Post Well Testing Operations:
4.1. Data & sampling
4.2. Well Testing interpretation
4.3. Final report
4.4. Key Performance Indicator (KPI)

Exercises and Tutorials

1. Well Testing proposal
2. Piping and Instrumentation diagram P&ID and Bottom Hole Assembly (BHA)
3. Field reading sheet and charts
4. Kappa's Shaphir software

Program:

This course lasts 4 days

Days 1: (Magdy Rezk)

- Fundamentals (2:30 hrs)
- Exercise number 1 (1 hr)
- Questions & Answers (30 minutes)

Day 2: (Magdy Rezk)

- Well Testing design (2:30 hrs)
- Exercise number 2 (1 hr)
- Questions & Answers (30 minutes)

Day 3: (Magdy Rezk)

- Well testing execution (2:30 hrs)
- Exercise number 3 (1 hr)
- Questions & Answers (30 minutes)

Day 4: (Magdy Rezk)

- Post Well Testing Operations (2:30 hrs)
- Exercise number 4 (1 hr)
- Questions & Answers (30 minutes)

Bibliography:

- KAPPA DDA BOOK http://www.kappaeng.com/news/KAPPA_DDA_book/23
- Bourdet, D.: Well Test Analysis: The use of Advances Interpretation Models, Elsevier 2002
- Stewart, G.: Well Test Design & Analysis, PenWell 2011
- Chaudhry, A.: Gas Well Testing Handbook, Gulf Professional Pub.2004
- McAleese, S.: Operational Aspects of Oil & Gas Well Testing, Elsevier 2006
- John Lee: Well Testing, Prof. of Petroleum Engineering T&M university, SPE of AIME 1982
- Paul J. Nardone, Well Testing Project Management, onshore and offshore operations, Elsevier 2009

COURSE RE4	RESERVOIR ENGINEERING
SECTION RE 4.4	RESERVOIR DYNAMIC SIMULATION

	**Carlos Iglesias Delgado de Torres (Repsol).** Ph.D. in Mining engineering-U.P.M-E.T.S.I.M.&E. Operations Reservoir Engineer in Los Perales-Las Mesetas field (Santa Cruz, Argentina). Implementation Reservoir Engineer in Cañadón de la Escondida field (Santa Cruz, Argentina). Development Reservoir Engineer in Barrancas field (Mendoza, Argentina). Senior Reservoir Engineer for the Spanish Business Unit and UK North Sea. Subsurface Team Leader in Repsol for Libya Business Unit, PE Superintendent for Akakus Oil Operations as secondee. Reservoir Engineer Advisor in Technical E&P Repsol worldwide. Currently Excellence Center Subsurface Coordinator for Norway and Ad-hoc Projects
	**Ramón Rodríguez Pons-Esparver (UPM).** Ph.D. in Mining engineering-U.P.M. Professor at the Madrid School of Mines and Energy (UPM). He was Director of the Applied Mathematics and Numerical Methods Department (UPM) during seven years. Coordinator of the courses of Reservoir Simulation at the School of Mines and Energy. Director of the Oil & Gas Engineering Master degree (UPM).

Objectives:

1. To understand the role of numerical reservoir simulation in the context of reservoir economic development.
2. To understand the fluid flow equations in a porous media.
3. To understand the differences between compositional and black-oil model equations.
4. To understand the numerical discretization of fluid flow equations.
5. To grasp the general structure of an Eclipse Input Data File.
6. To be able to use Eclipse 100.

Syllabus:

Part I: Reservoir Simulation Overview.

1. Introduction to Reservoir Simulation.
1.1. Purpose and benefits of numerical reservoir simulation.
1.2. Relationship with other E&P matters.
1.3. Main steps in the construction of a Reservoir Simulation Model.
1.4. Types of Reservoir Simulation Models.
1.5. Software for Reservoir Simulation.

2. The Fluid Flow Equations in a Porous Media.
2.1. Continuity or Mass Conservation Equation.
2.2. Darcy's Law.
2.3. Black Oil and Compositional Model Equations.

3. Numerical Discretization of the Fluid Flow Equations.
3.1. Notions about Finite Differences.
3.2. Types of Numerical Schemes:
a) Explicit, implicit, Crank-Nicholson
b) IMPES
c) Streamlines.
3.3. Comments about numerical stability and accuracy
.

Part II: Tutorial on General Structure of an Eclipse Input Data File.
Case Study: Basic vertical cross-section model to estimate vertical sweep efficiency under Waterflooding for an Undersaturated oil reservoir.

Part III: Tutorial on Practical Use of Reservoir Simulation.
Case Study: 3D Full Field simulation model for a real reservoir.
- Data gathering.
- Geological model. Grid construction.
- Fluid and rock-fluid properties.
- Aquifer modelling.
- Initialization.

- Well description.
- History matching.
- Forecast simulations.

Exercises and Tutorials

Basic exercises about finite difference discretization.
Modify and run with Eclipse 100 a vertical cross-section model to estimate sweep efficiency under waterflooding for an undersaturated oil reservoir.
Analyze input data and results of a 3D full field simulation model with different Pre and Post-Process

Program

This course lasts 7 days.

Days 1 and 2: (C. Iglesias & R. Rodríguez)

- Reservoir simulation overview

Day 3: (C. Iglesias)

- General structure of an Eclipse input data file

Days 4, 5, 6 & 7 (C. Iglesias & R. Rodríguez)

- Tutorial on practical use of reservoir simulation

Software Applications

Eclipse 100.
Eclipse Office, Graf, Floviz.

Bibliography:

- Crichlow, H.B. Modern Reservoir Engineering – A Simulation Approach. Prentice-Hall. 1977.
- Crotti, M.A. Distribución de Fluidos. Actualización 2003
- Ertekin, T., Abou-Kassem, J.H. & King, J.R. Basic. Applied Reservoir Simulation. SPE Textbook Series N.3. 2001.
- Fanchi, J.R. Principles of Applied Reservoir Simulation. Gulf Publishing Company.2006.
- Kleppe, J. Notes of the Reservoir Simulation course. Norwegian University of Science and Technology. 2010.
- Peaceman, D.W. Fundamentals of Numerical Reservoir Simulation. Elsevier. 1977.

COURSE RE4	RESERVOIR ENGINEERING
SECTION RE 4.5	ENHANCED OIL RECOVERY TECHNIQUES

Jaime del Moral Lacarcel (CEPSA E&P). Mining Engineer (Polytechnic University of Madrid, 1999). Master Petroleum Eng. (ISE 2001). Worked for PWC as Consultant in Energy and Environment during 1999-2000, and joined Cepsa E&P in 2001, were he has worked as Reservoir Engineer and as Subsurface Team Leader for different oil and gas projects in Algeria, Colombia, Peru and Egypt. Currently is Reservoir Engineering Manager for Cepsa E&P.

Objectives:

1. Understand the main physical mechanisms affecting the petroleum recovery.
2. Understand the typical evolution of a field life, and the logic behind the different recovery processes applied through it.
3. Understand the EOR methods commonly used and their applicability.
4. Being able to perform an analysis of the possible types of recovery mechanisms (including EOR) that can be applied to a given field.
5. Being able to identify the main technical and non-technical aspects that should be considered for an EOR project.

Syllabus:

1.- Recovery Methods
1.1.- Recovery Factor, concept and calculation
1.2.- Primary, Secondary and Tertiary recovery techniques
1.3.- The EOR Project

2.- Enhanced Oil Recovery
2.1.- Miscible Injection.
2.2.- Thermal EOR.
2.3.- Chemical EOR.
2.4.- Other EOR Methods.

Program:

This course lasts 2 days plus one Seminar.

Exercises and tutorials:

Team Exercise (Seminar): Analyze your field case and propose the most adequate type/s of recovery technique (may include EOR)

1. Identify main technical aspects of your field case
2. Review and screen all known recovery and EOR techniques
3. Identify main uncertainties and risks for your field case
4. Propose a road map describing your proposal for reducing uncertainties, risk mitigation and field development

Bibliography:

- "Enhanced Oil Recovery ". Larry W. Lake, 2010, SPE.
- "Enhanced Oil Recovery Field Case Studies", James Sheng, 2013, GPP
- "Enhanced Oil Recovery: Field Planning and Development Strategies", Vladimir Alvarado & Eduardo Manrique, 2010, GPP
- "Enhanced Oil Recovery ". Don W. Green & G. Paul Willhite, 1998, SPE.

COURSE P5	PRODUCTION AND COMPLETION ENGINEERING
SECTION P5.1	PRODUCTION AND COMPLETION OPERATIONS

	**Isidro Solorzano Herrera (ExRepsol).** Technical Mining Engineer by the University of Cantabria, PhD by the Polytechnic University of Madrid and Master in Financial Economics by Business School of Bilbao. He´s developed his professional career at Repsol and its joint venture companies in the areas of production and development of oil and Gas field projects. Currently, Honorary Professor of the University of Cantabria.
	Halliburton course. Taught separately

Objectives:

1. Evaluate the bottom hole completion options.
2. Assess geometrical configurations for drilled wellbores for both production and injection applications.
3. Evaluate functional capability of completion strings for a variety of situations.
4. Describe the purpose of major completion equipment components.
5. Identify limitation of well completion schematic designs.
6. Well safety requirements and capabilities inherent in well design.
7. Describe the option for producing multiple reservoir units.
8. General completion schematic options for producing two, three or more zones simultaneously.
9. Define the equipment requirements in terms of packers, tubing hangers and Xmas trees for multiple completion strings.
10. Describe the options and their advantages and disadvantages for casing/liner perforation.
11. Describe how to select between over balance and under balanced casing/liner perforating.

Syllabus:

1 Wellbore completion concepts
1.1 Introduction
1.2 Bottom hole completion
1.3 Selection of flow conduit
1.4 Completion string facilities
1.5 Completion string components
1.6 Well completion designs

2 Multiple zone completion concepts
2.1 Introduction
2.2 Co-mingled Flow
2.3 Segregated - Multiple Zone Depletion
2.4 Alternate Zone Well Completion Strategy
2.5 Selection of Development Strategy
2.6 Multiple completion equipment

3 Perforating.
3.1 Shaped charge design and performance.
3.2 Perforation Pattern and Well Inflow Performance.
3.3 Perforation Charge Performance.
3.4. Perforation Gun Types.
3.5. Perforating Techniques.
3.6. Impact on Well Productivity.

Program:

This course lasts 3 days.

Days 1&2: (Isidro Solorzano)

- Well completion, perforating and surface & subsurface operations

Day 3: (Separate Halliburton course)

- Wellcat software

Bibliography:

- "Production Operations" Vol. 1 and 2 (4th Edition). T. Allan and A. Roberts. Oil and Gas Consultants International, Tulsa, USA. ISBN: 0-930972-19-8.
- "Petroleum Production Systems". M. Economides, A. Hill and C. Ehlig-Economides. Prentice Hall, 1994. ISBN: 0-13-658-683-X.
- "Well Performance" (2nd Edition). M. Golan and C. Whitson. Tapir, Norway. ISBN: 0-13-946609-6.
- "Surface Production Operations" Vol. 1 and 2. K. Arnold and M. Stewart. Gulf Publishing. ISBN: 0-87201-173-9.
- "Production Optimization Using Nodal Analysis". H. Beggs. Oil and Gas Consultants International. ISBN: 0-930972-14-7.
- "Hydrocarbon Exploration and Production". F. Jahn, M. Cook and M. Graham. Elsevier, No 46, Development in Petroleum Science. ISBN: 0-444-82883-4.

COURSE P5	PRODUCTION AND COMPLETION ENGINEERING
SECTION P5.2	WELL DYNAMIC BEHAVIOUR

Isidro Solorzano Herrera (ExRepsol). Technical Mining Engineer by the University of Cantabria, PhD by the Polytechnic University of Madrid and Master in Financial Economics by Business School of Bilbao. He´s developed his professional career at Repsol and its joint venture companies in the areas of production and development of oil and Gas field projects. Currently, Honorary Professor of the University of Cantabria.

Objectives:

1. Learn the concept of systems analysis.
2. List four segments in the production system where pressure losses occur.
3. Define inflow performance curve, outflow performance curve and the solution node.
4. Learn how systems analysis is used to estimate production rates.
5. List the three components of pressure loss for fluid flow in pipes.
6. Learn the fundamentals of Multiphase Flow.
7. Learn how to estimate pressure drop in tubing using graphical techniques.
8. Understand the purpose of a choke.
9. Understand critical and subcritical flow.

Syllabus:

1. Introduction.

2. Systems Analysis of the Production System.
2.1. Importance of Hydrocarbon Phase Behavior.
2.2. Reservoir Inflow Performance Review.

3. Tubing (Outflow) Performance.
3.1. "Gradient" or Pressure Traverse Curves.
3.2. Flow Maps and Correlations.
3.3. Temperature Modelling.

4. Surface Pressure Losses.
4.1. Completions Inflow Performance.
4.2. Computerized Well Performance Prediction Programs.

Program:

This course lasts 2 days.

Days 1&2: (Isidro Solorzano)

- Systems analysis of the production system, tubing performance and surface pressure losses

Bibliography:

- "Petroleum Production Systems". M. Economides, A. Hill and C. Ehlig-Economides. Prentice Hall, 1994. ISBN: 0-13-658-683-X.
- "Well Performance" (2nd Edition). M. Golan and C. Whitson. Tapir, Norway. ISBN: 0-13-946609-6.
- "Surface Production Operations" Vol. 1 and 2. K. Arnold and M. Stewart. Gulf Publishing. ISBN: 0-87201-173-9.
- "Production Optimization Using Nodal Analysis". H. Beggs. Oil and Gas Consultants International. ISBN: 0-930972-14-7.

COURSE P5	PRODUCTION AND COMPLETION ENGINEERING
SECTION P5.3	WORKOVER AND WELL STIMULATION

	**Sergio Jiménez Gil (Repsol).** Mining Engineer at the UPM, ETSIM and Energy of Madrid. Since 2007 working as Completion and Well Testing Engineer, involved on workover, completion and well testing operations in Repsol.
	**Susana Gómez (Repsol)** is a Chemical Engineer by Universidad Rey Juan Carlos of Madrid, with 10 years' experience in the Oil and Gas Industry in the Upstream Division. She joined Repsol in 2006 and since then has been developing her career as a Flow Assurance specialist within the Production and Facilities Engineering discipline. She has participated in worldwide projects (North of Africa, Gulf of Mexico, artic conditions, pre-salt...) involving assets on production and under development with complex fluid characterization, solid deposition and fluid-dynamic behaviour.

Objectives:

1. Recognize the different types of workover or well interventions.
2. To have a well understanding of the completion equipment subject of being intervene.
3. Identify the different elements of the most common workover technics, such us coiled tubing or slick line techniques.
4. Understand the importance of the near wellbore area in terms of formation damage and poor well performance.
5. Identify the major sources of formation damage e.g. during drilling and completion formation, production etc. as well as the appropriate remedial actions.
6. Provide guidelines for minimizing formation damage during workover operations.
7. Indicate how the presence of formation damage can be identified in a production or injection well.
8. Describe the role of and mechanism by which matrix stimulation improves well production performance.
9. Describe the well stimulation design methodology.
10. Identify well stimulation candidates.
11. Prepare a treatment design i.e. select the acid formulation, acid volume and acid pump rate.

Syllabus:

1. Completion: Description and design

1.1. Introduction
1.2. Well Completion Equipment
1.3. Well Completion Design

2. Well Interventions

2.1. Wireline Operations
2.2. Coiled Tubing Operations
2.3. Snubbing Unit Operations

3. Flow Assurance and Well Stimulation

Seminar to be confirmed

Program:

This course lasts 2 days plus a seminar to be confirmed.

Days 1&2: (Sergio Jiménez Gil)

- Workovers and Well Stimulation.

Seminar: Susana Gómez Álvarez

Bibliography:

- "Production Operations" Vol. 1 and 2 (4th Edition). T. Allan and A. Roberts. Oil and Gas Consultants International, Tulsa, USA.ISBN: 0-930972-19-8.
- "Well Performance" (2nd Edition). M. Golan and C. Whitson. Tapir, Norway. ISBN: 0-13-946609-6.
- Schlumberger "Oil Field Glossary": http://www.glossary.oilfield.slb.com/en/Terms
- Society of Petroleum Engineers – PetroWiki: http://petrowiki.org/PetroWiki
- "Petroleum Engineering Handbook", Vol. 2 and 4 (2007) Editor-in-Chief: Larry W. Lake. ISBN:978-1-55563-126-0

COURSE P5	PRODUCTION AND COMPLETION ENGINEERING
SECTION P5.4	ARTIFICIAL LIFT METHODS

Sergio Jiménez Gil (Repsol). Mining Engineer at the UPM, ETSIM and Energy of Madrid. Since 2007 working as Completion and Well Testing Engineer, involved on workover, completion and well testing operations in Repsol.

Objectives:

1. Explain the importance of Artificial Lift (AL) for world oil production.
2. List the different types of AL and explain their operating principle.
3. Discuss AL selection criteria.

Syllabus:

1. Introduction to Artificial Lift.

1.1. The need for Artificial Lift.
1.2. Types of Artificial Lift.
1.3. Other Artifitial Lift Systems.

2. Sucker-Rod pumps

2.1. Definition
2.2. Applications Considerations
2.3. Advantages and Disadvantages
2.4. Components

3. Progressing Cavity pumps

3.1. Definition
3.2. Applications Considerations
3.3. Advantages and Disadvantages
3.4. Components

4. Electrical Submersible pumps

4.1. Definition
4.2. Applications Considerations
4.3. Advantages and Disadvantages
4.4. Components

5. Gas lift

5.1. Definition
5.2. Applications Considerations
5.3. Advantages and Disadvantages
5.4. Components

6. Selection of Artificial Lift Systems

Program:

This course lasts 3 days:
Days 1&2: (Sergio Jiménez Gil)

Bibliography:

- "Production Operations" Vol. 1 and 2 (4th Edition). T. Allan and A. Roberts. Oil and Gas Consultants International, Tulsa, USA.ISBN: 0-930972-19-8.
- "Petroleum Production Systems". M. Economides, A. Hill and C. Ehlig -Economides. Prentice Hall, 1994. ISBN: 0-13-658-683-X.
- "Well Performance" (2nd Edition). M. Golan and C. Whitson. Tapir, Norway. ISBN: 0-13-946609-6.

COURSE SF6	SURFACE FACILITIES ENGINEERING
SECTION SF6.1	OIL AND GAS SURFACE PROCESSING

Isidro Solorzano Herrera (ExRepsol). Technical Mining Engineer by the University of Cantabria, PhD by the Polytechnic University of Madrid and Master in Financial Economics by Business School of Bilbao. He´s developed his professional career at Repsol and its joint venture companies in the areas of production and development of oil and Gas field projects. Currently, Honorary Professor of the University of Cantabria.

Objectives:

1. Provide a general overview of crude oil/ gas processing, the elements and equipment in an integrated surface facility plant and the impact in field development.
2. Understand the technical factors for the design and operation of a surface facility: fluid characteristics, quantities, specifications, location, data quality, etc.
3. Review the fluid behaviour aspects relevant for the design and operation of a "surface facility".
4. Provide a general understanding of process operations: separation, dehydration, gas treatment, gas processing, water treatment, fluid transportation, etc.
5. Provide a basic understanding on how process equipment work and how they are designed and rated.

Syllabus:

1. Introduction:
The Xmas tree. The gathering network. The processing plant. Product specifications. Production handling basic concept and schemes. The transport system. Impact on field development.

2. Field development:
2.1. Hydrocarbon composition: Chemical components. Contaminants, water cut.
2.2. Natural gas properties: Composition. Specifications. Density and Specific Gravity. Compressibility. Viscosity. Heating value. Liquid content.
2.3. Liquid hydrocarbon properties: Density and specific gravity. Characterization factor.
2.4. Phase behavior: Pure component. Mixtures. Fluid phase diagrams. Reservoir applications. Separator applications.
2.5. Phase equilibrium: Concepts. Ideal equilibrium constant. Simplified methods. Phase calculation. Dew point. Bubble point.
2.6. Gas-Water Behaviour: Water content in natural gas. Correlations. Hydrates. Hydrate inhibition. Corrosion.

3. Production philosophy
3.1 Separation objectives, oil and gas fields.
3.2 Basic process scheme.
3.3 Operational production problems: foaming, solids, emulsion, surging, etc.
3.4 Separators sizing basics: gas and liquid capacity.
3.5 Test separator

4. Separation and oil treatment:
4.1. Liquid stabilization: Vapour pressure. Process schemes. Separation stages. Selection criteria.
4.2. Separators: Production separators. Test separators. Scrubbers. Slug catchers. Filters. KO drums.
4.3. Process vessels: Operating principle. Process design and sizing. Mechanical design.
4.4. Crude Oil dehydration: Operating principle. Sizing considerations. Electrostatic equipment. Desalters.

5. Natural gas treatment and processing:
5.1. Natural gas treatment: general aspects. Gas dehydration. Glycol process. Adsorption processes. Acid gas problems. Gas sweetening. Amine processes. Physical solvent process. Solid bed process. Membranes. Mercury.
5.2. Natural gas processing: Dew pointing. NGL extraction. NGL stabilization. Process schemes. Oil absorption. Mechanical refrigeration. J-T expansion. Turbo expansion.

6. Water Treatment:
6.1. Water Specifications.
6.2. Basic Principles: mineral scale, scale inhibition, corrosion and oxygen.
6.3. Process Schemes.
6.4. Process equipment.
6.5 Corrugated plates, flocculation/coagulation, flotation, hydrocyclones, coalescer units, centrifuges.
6.6. Disposal of produced water.
6.7 Water injection treatment

7. Oil & Gas transportation:
7.1. Fluid flow: Terms & definitions. Basic concepts. Single phase. Multiphase flow.

7.2. Liquid pumping: General concepts. Centrifugal pumps. Rotary pumps. Reciprocating pumps. Drivers.
7.3. Gas compression: Thermodynamic of compressors. The process. Reciprocating compressors. Centrifugal compressors. Screw compressors.

8. Measurement and control:
8.1. Flow measurement: General concepts. Measurement classification. Custody transfer. Production allocation. Process control. Measurement types. Orifices. Turbines. Coriolis based. Ultrasonic. Multiplephase.
8.2. Process control: flow control. Level control. Temperature control. Pressure control. Control valves.

Program:

This course lasts 3 days:

Day 1: (Isidro Solorzano Herrera)

- Introduction and Sections 2, 3 and 4.

Day 2: (Isidro Solorzano Herrera)

- Sections 5 and 6

Day 3: (Isidro Solorzano Herrera)

- Sections 7 and 8

There will be two days dedicated to the Aspen Software

Bibliography:

- "Surface Production Operations Volume I and II from K. Arnolds and M. Stewart". Second Edition
- "Gas Conditioning & Processing Volume I, II, III".JMC Campbell. Campbell Petroleum Series, Norman, Oklahoma. Library of Congress Catalogue Card 76-15.
- "Oil Field Processing Volume One: Natural Gas & Volume Two: Crude Oil". Manning F & Thompson R. PennWell Books, Tulsa Oklahoma. ISBN 0-87814-342.

COURSE SF6	SURFACE FACILITIES ENGINEERING
SECTION SF6.2	OFFSHORE PLATFORMS

Manuel Moreu (SEAPLACE). Naval Architect and PhD Spanish School of Naval Architects and Ocean Engineers of Madrid Polytechnic School of Engineers and Master of Science in Ocean Engineering of Massachsetts Institute of Technology (MIT). Along more than forty years' experience, he has combined professional tasks, management duties at several sectors, like Offshore and new technologies, and teaching activities. He has been Member of the Board of Gamesa Corporación Tecnológica, S.A. of Metalships and Docks, Rodman Polyships, Neuvisa and of Iberdrola Renovables, S.A. and is Member of the Board of Iberdrola and Tubacex and counselor of the Executive Delegated Committee and Remuneration Committee of Iberdrola. President of Seaplace, S.L., H.I. Ingeniería y Proyectos S.L. and Howard Ingeniería y Desarrollo S.L.

Objectives:

Review the offshore oil and gas technology:
1. Introduction to the Offshore Installations.
2. The fixed production units.
3. Mobile Offshore Drilling Units.
4. Floating Production.
5. The Hybrid solution.
6. The subsea production.
7. Export.
8. Support fleet.
9. Planning and costing.

Syllabus:

1. The start of the offshore.
1.1. Origin of offshore development.
1.2. Environmental conditions.
1.3. Water depth.

2. The Jacket.
2.1. Considerations for Design.
2.2. Jacket, piling, MSF and topsides.
2.3. The installation.
2.4. Drilling.
2.5. Production.

3. MODU - Mobile Offshore Drilling Units.
3.1. Considerations for Design.
3.2. The drilling riser.
3.3. The motion compensation.
3.4. The mooring system.
3.5. The D. P.

4. Subsea wellheads.

5. Floating production.
5.1. From a MOU.
5.2. From a FPSO. The storage.
5.3. The production risers.

6. Export.
6.1. Shuttle.
6.2. Single point mooring.
6.3. Pipeline.

7. Offshore development.
7.1. Planning.
7.2. Project definition and specifications.
7.3. Project management and costs.

Program:

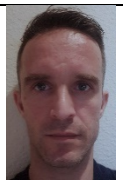
This course lasts 2 days:

Days 1 & 2: (Manuel Moreu)

Bibliography:

- IMO MODU CODE
- Harris Deepwater Floating Drilling Operations.
- ETA Offshore Seminars. The technology of offshore drilling, completion and production.
- Developments in offshore. J.B. Herbich et al. Elsevier. ISBN: 978-0-88415-380-1

COURSE SF6	SURFACE FACILITIES ENGINEERING
SECTION SF6.3	PROJECT PLANNING

	**Emilia Arias Gallego (Técnicas Reunidas).** Bachelor in Chemical Sciences from the Complutense University of Madrid. Almost 30 years of experience in developing Oil & Gas projects. Holds the position of FEEDs, Technology and Energy Transition in Tecnicas Reunidas. Besides her functions, she led an LNG project in USA, various projects of Up-stream in Argelia and Refining in Russia. Currently, she coordinates technology development projects collaborating with TR divisions in charge of these developments and with external companies. Gives support in new technologies to the company, in agreements with licensors, and during the execution of projects, etc. Promotes projects related to the Energy Transition in TR, search for new clients, gives support to the Business Development Department, collaborates in the preparation of offers and provides technical support in the execution of these projects. She is also in charge of the preparation of FEED project offers, the support during the execution, either from the technological or execution point of view, and the dialogue with clients and possible engineering subcontractors
	**JOAQUÍN PÉREZ VEIGA (Técnicas Reunidas)**. Industrial Engineer from the Politecnica University of Madrid, Bachelor in Economics from UNED University of Madrid and MBA from Instituto de Empresa of Madrid. Almost 30 years of experience in planning Oil & Gas & Petrochemical projects. Holds the position of Planning and Production Control Area Manager at Técnicas Reunidas, being responsible to coordinate all planning function in the company.
	**JAVIER BRENES (ALTRAN & REE)**. Mechanical Engineer at University of Las Palmas & Master in Energy Engineering at Universidad Politécnica de Madrid. Project Manager & Planner. **ALTRAN** & **REE (Red Eléctrica Española).** 2019-2022. Madrid-Spain. (Investment project portfolio from 2018 to 2023. Energetic Sector)
	**PABLO GÓMEZ (APP Project Management Services® Project Management, Planning & Control Services)** Degree in Geomatics Engineering and Topography UPM, and Geographic and Computerized Information Systems - GIS UPM . As PMO Services Manager at APP Project Management Services (APP PMS) is responsible for coordinating the studies of feasibility, managing offers and tenders, controlling deliveries and the quality of the proposals, auditing and optimizing linear planning, advanced planning and schedule quality control, risk analysis, risk mitigation strategies and forensic analysis of the APP's project portfolio according to APP's own advanced methodologies of Project Management.
	**GRIMILDA MARTÍNEZ SOLANO (APP Project Management Services® Project Management, Planning & Control Services)**. Senior Project Planning & Controls Engineer, Planning Leader, Scheduler and Control Project Engineer with more than 15 years of international experience in engineering, construction and procurement business including lump sum Planning and Controlling projects in P6, MSP and Excel. Served public administrations (Mexico, Spain, etc) and companies in different sectors. Highly large experience in railway projects worked in Spanish, French and English languages. Versatile experience across all stages of the project life cycle. Some key responsibilities are generation of planning and controlling schedules in different planning tools in BID's, FEED's and EPC projects, WBS development, S-curves, resources and manpower curves, preparation and monitoring of progress reports, as well as coordination of schedulers team.

Objectives

1. Discuss main elements related to managing a surface facility project: methodology, cost, schedule, etc.
2. Planning, execution and controlling of an Oil and Gas project
3. Use of IT tools for developing a project
4. Provide a general overview of the main IT tools for planning, risks and costs used in projects

Syllabus

1. Project Management
- 1.1. Definitions
- 1.2. Project Management Stages.
- 1.3. Project Cost Management: Plan Cost Management, Estimate Cost, Determine Budget; Control Cost.
- 1.4. Project Risk Management: Factors, Plan Risk Management, Risk Identification, Risk Analysis.
- 1.5. Contract types

2. Planning
- 2.1. Definitions & objectives
- 2.2. Basic concepts
- 2.3. Schedule levels

2.4. Schedule representations
2.5. Schedule preparation sequence
2.6. Progress and progress curves
2.7. Planning follow up
2.8. Key success factors

3. Oil & Gas Production Project Schedule (all phases development)
3.1. Objective and Target
3.2. Project Schedule
3.2.1. Basis
3.2.2. Preparation
3.2.3. Resources
3.2.4. Analysis
3.2.5. Criticality
3.2.6. Control
3.3. Project Integrations
3.4. Management Tool

4. Plan, Program and Control of projects
4.1. Objectives of the project
4.2. WBS
4.3. Activities definition
4.4. Activities duration
4.5. Precedence network development
4.6. IT tools
4.6.1. MS Project
4.6.2. Primavera P6
4.6.3. MindManager

5. 4D Planning
5.1. BIM for scheduling
5.2. AEC technology
5.3. Synchro 4D Software

6. Project Risks
6.1. Introduction
6.2. Risks analysis processes
6.3. Oracle Primavera Risks Analysis

7. Project Costs
7.1. Introduction
7.2. Presto

Program

This course lasts 6 days.

Day 1: Emilia Arias
Day 2: Joaquín Pérez Veiga
Day 3: Javier Brenes
Day 4: Javier Brenes
Day 5: Grimilda Martínez
Day 6: Pablo Gómez

Bibliography:

- A guide to the PROJECT MANAGEMENT BODY OF KNOWLEDGE (PMBOOK GUIDE) Fifth Edition
- Craig, Juana Clark. Project Management Lite: Just Enough to Get the Job Done...Nothing More. CreateSpace Independent Publishing Platform.
- Kerzner, Harold. Project Management (Kindle Location 12269). Wiley.
- Taylor, Peter. The lazy project manager (p. 20). Infinite Ideas (Trade).
- Thompson, Denise. The Human Factor in Project Management (Best Practices in Portfolio, Program, and Project Management) (p. 98). CRC Press.
- Kerzner, Harold. Project Management Case Studies. Wiley.
- Lewis, Richard. When Cultures Collide: Leading Across Cultures (p. xi). John Murray Press. Kindle Edition.
- Jack R. Meredith, Samuel J. Mantel, Jr. Project Management, a managerial approach. Sixth Edition. John Wiley & Sons, Inc.
- Manual de Risk Analisys. Lorenzo Sánchez Pacheco y Rafael Guadalupe
- Manual de Primavera 6.8. Mª José Fresneda Garrido, Raúl García-Caro del Real y Rafael Guadalupe
- "Integrated Learning of Production Engineering Software Applications in a Shipbuilding Context.", Souto Iglesias, Antonio; Martínez Barrios, Israel; Tomán, Mirko; Fernández Coracho; Guadalupe García, Rafael. "International Journal of Engineering Education" Pág:1400-1409, Volume 29 Number 6, ISSN 0949-149X
- Métodos de Planificación y Control de Obras, del diagrama de barras al BIM. Aldo Mattos y Fernando Valderrama, Ed. Reverté

COURSE SG7	SHALE OIL AND GAS: RESERVOIRS AND COMPLETIONS
SECTION SG7.1	RESERVOIR CHARACTERIZATION AND RESERVES.

Lecturers:

	**Lecturer 1: Jesus Caceres Jimeno** (CEPSA). Mining Engineer (2002). From 2002 to 2011: Drilling Engineer at ENAGAS involving Underground Gas Storages. Since 2011: Senior drilling engineer at Cepsa in Exploratory/Development drilling campaigns in Colombia, Peru, Algeria and Kenya. Since 2015: Teacher at UPM (University Polytechnic Madrid).
	**José Eugenio Ortiz.** Ph.D. in Mining engineering-U.P.M. Professor at the Madrid School of Mines. Member and responsible of the Biomolecular Stratigraphy Laboratory. Expert in Stratigraphy, Palaeoclimatology, Palaeontology and Organic Geochemistry. He was Director of the Geological Engineering Department of the Madrid School of Mines and Secretary of the Geological Society of Spain.
	**Enrique J. Rojas** is Senior Operations Geologist in CEPSA E&P where he is responsible for coordination and supervision of the Operations Geology in Rhourde El Khrouf and Ourhoud fields in Algeria. During the last years in CEPSA E&P, has developed his job in different operated and non-operated assets of the company (Colombia, Perú, Thailand, Kenya, Liberia, Surinam, Algeria, etc.). He holds a BSc in Geology from the Complutense University (Madrid, Spain). Before joining CEPSA E&P on 2012, he was working on the field site as a Mudlogger, Data Engineer and Mudlogging Unit Manager. Since 2006 He has worked as a consultant Well Site and Operations Geologist and Well Log analyst in REPSOL, TOTAL, OMW, TPAO, etc... Enrique has been responsible of Training Junior personnel on Operations and Wellsite Geology in CEPSA E&P. He is a member of different professional associations of petroleum geoscientists such as EAGE and AGGEP.

Objectives:

1. Learn how to characterize a shale oil or gas reservoir. Understand the possibilities of the gas hydrate.
2. Understand the differences with conventional reservoir characterization.
3. Understand how to evaluate “reserves” of a shale oil or gas reservoir.
4. Learn drilling and completion operations and cost of shale oil and gas reservoirs.

Syllabus:

1. Introduction to unconventional oil and gas.
   1.1. Shale gas approach.
   1.2. Gas hydrates potential.
2. Gas hydrate.
   2.1. Petrophysical model
   2.2. Geochemical measurements
   2.3. Petrophysical measurements
   2.4. Log responses
3. Reserves calculation and field development history.
4. Examples.

Program:

This course lasts 3 days:

Day 1: (Jesús Cáceres / Lázaro Sánchez (Lab))

- Introduction to unconventional reservoirs.

Day 2: (José Eugenio Ortiz)

- Laboratory analysis. Reservoir characterization.

Day 3: (Enrique Rojas)

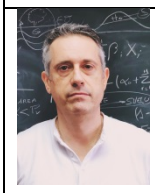
- Barnett gas shale resource development history.
- Reserves calculation overview. Examples.

Bibliography:

- Shale-Gas Reserves Estimation: Multiple Decline-Curve-Analysis Models. JPT. November 2012.
- Practical Aspects of Reserves Determinations for Shale-Gas Reservoirs. SPE 144357. June 2011.
- Gas Hydrate. Schlumberger 2010. Oilfield Review.
- Glorioso, J.C., Rattia, A., "Unconventional reservoirs: Basic Petrophysical Conceptes for Shale Gas". SPE 153004
- Passey, Q.R., et al., « From Oil-Prone Source Rock to Gas-Producing Shale Reservoir – Geologic and Petrophysical Characterization of Unconventional Shale-Gas Reservoirs". SPE 131350
- Sondergeld, C.H., et al., "Petrophysical Considerations in Evaluating and Producing Shale Gas Resources" SPE Unconventional Gas Conference, 23-25 Feb, Pittsburg Pennsylvania
- Milner, M., et al., "Imaging Texture and Porosity in Mudstones and Shales: Comparison of Secondary and Ion-Milled Backscatter SEM Methods". CSUC/SPE 138975
- Katsube, T.J., "Shale Permeability and Pore-Structure Evolution Characteristics" Geological Survey of Canada. Current Research 2000-E15

COURSE SG7	SHALE OIL AND GAS: RESERVOIRS AND COMPLETIONS
SECTION SG7.2	FRACKING AND ENVIRONMENT ISSUES

Lecturers:

	**Sonsoles Eguilior Díaz.** PhD. in Physics. Scientist working in the CIEMAT, with more than 15 years of experience, where she has worked in the areas of studies for safety and risk assessment and the development of transportation models and treatment of uncertainties.
	**Antonio Hurtado Bezos.** PhD in Mining Engineer and Mining Engineer. Research scientist of the Centre for Research on Energy, Environment and Technology (CIEMAT), has over 15 years of experience in risk management and assessment in both the industrial sector and scientific research in the area of the geological environment altered by human activity.

Objectives:

1. Learn the risks associated with hydraulic fracturing.
2. Learn the additives and their environmental impact.
3. Learn about the management of such risks.
4. Learn how pre-assessment of risks can help in project management

Syllabus:

1. Risk and hydraulic fracturing operations.
2. Environmental issues.
   - 2.1 Seismology
   - 2.2 Surface and subsurface hydrology
   - 2.3 Atmospheric emissions associated
   - 2.4 Noise and light emissions
   - 2.5 Radioactivity
   - 2.6 Surface footprint
   - 2.7 Conclusions
3. Shale Gas project Risk management.
   - 3.1 Risk Analysis
   - 3.2 Risk Assessment
4. Impacts
   - 4.1 Community: Human health and safety
   - 4.2 Environment

Program:

This course lasts 1 day (two half days):

Day 1/2: (Antonio Hurtado)

- Risk and environmental issues:

Day 1/2: (Sonsoles Eguilior)

- Risk management and impacts:

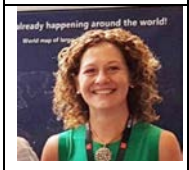
In addition to the presentation, the lecturers will supply scientific articles relating to the themes dealt with. The session last for 4 hours. Of these, the last hour will be taken up by an individual work to be assessed. It will consist in reading a scientific article connected with Shale Gas and in answering some questions.

Bibliography:

- ALL Consulting (2005), Technical summary of oil and gas produced water treatment technologies, ALL Consulting: Tulsa, Oklahoma. http://w.all-llc.com/publicdownloads/ALLConsulting-WaterTreatmentOptionsReport.pdf
- EPA (2011), Plan to study the potential impacts of hydraulic fracturing on drinking water resources, US Environmental Protection Agency: Washington DC.
- http://water.epa.gov/type/groundwater/uic/class2/hydraulicfracturing/upload/final-study-plan-hf_web_2.pdf
- https://cordis.europa.eu/project/id/636811/results (D3.1, D3.2, D4.1, D7.4)
- The Royal Society and The Royal Academy of Engineering (2012). Shale gas extraction in the U.K.: A review of hydraulic fracturing.

COURSE GS8	GAS AND CO2 STORAGE
SECTION GS8.1	GAS AND CO2 UNDERGROUND STORAGE

Lecturers:

	**José Eugenio Ortiz.** Ph.D. in Mining engineering-U.P.M. Professor at the Madrid School of Mines. Member and responsible of the Biomolecular Stratigraphy Laboratory. Expert in Stratigraphy, Palaeoclimatology, Palaeontology and Organic Geochemistry. He was Director of the Geological Engineering Department of the Madrid School of Mines and Secretary of the Geological Society of Spain.
	**Laura Valle Falcones (IPf).** Ph.D. in Mining Engineering-U.P.M. Master in Reservoir Geoscience and Engineering at IFP. Laboratory leader of Petrophysics Laboratory-UPM Technological Center. Research Scientist. Reservoir and gas storage characterization. Development of dynamic model for CO2 storage site. Technical expert evaluator of I+D+i projects.
	**Paula Fernández-Canteli Álvarez** (IGME-CSIC) Ph.D Mining Engineer. Geological storage project manager in the Geological Survey of Spain (IGME-CSIC). Responsible of the IGME team on ENOS, STRATEGY CCUS, Hystories, pilotSTRATEGY, CEEGS and GSEU-GeoEnergy European funded projects. Member of the CO2GeoNet Executive Committee from April 2019. IGME representative on GeoEnergy group of European Geological Survey (EGS) from 2019. Lead of CO2 storage team of PTECO2 (Spanish Technological platform of CO2) from 2022.

Objetives:

1. Learn how gas can be storage underground in depleted gas reservoirs or in aquifers.
2. Understand how a gas underground storage may be operated.
3. Understand how a CO2 gas may be storage in a deep aquifer.
4. Understand the necessary requirements to assure that CO2 is not linking from the subsurface structure.

Syllabus:

1. The Gas and CO2 underground storage. World Strategy.

2. CO2 underground storage.
2.1. Reservoir characterization and storage structure capacity.
2.2. CO2 phase behavior at reservoir conditions.
2.3. Monitoring.

3. The possible underground structures in Spain for CO2 storage.

Program:

This course lasts 2 days:

Day 1: (José Eugenio Ortiz)

- CO2 underground storage / Gas underground storage.

Day 2: (Laura Valle and Paula Fernández-Canteli)

- Characterization and storage structure capacity / Monitoring and possible underground structures in Spain for CO2 storage

Bibliography:

- http://www.ipcc.ch/pdf/special-reports/srccs/srccs_wholereport.pdf
- Ley 40/2010, de 29 de diciembre, de almacenamiento geológico de dióxido de carbono.

- Climate Change 2014: Mitigation of Climate Change. Intergovernmental panel on Climate Change. IPCC 6. What happens when CO2 is stored underground. Q&A from the IEAGHG Weyburn-Midale. CO2 Monitoring and Storage Project. Global CCS Institute. April 2014
- Rütters, H. et al, 2013. State-of-the-Art of Monitoring Methods to evaluate Storage Site Performance. CGS Europe report D3.3, Julio 2013, 109 p (www.cgseurope.net)
- Delprat-Jannaud, F. et al, 2013. State of the art review of CO2 Storage Site Selection and Characterization Methods. CGS Europe report D3.4, September 2013, 116 p (www.cgseurope.net)
- Korre, A. et al, 2013. Operational and safety risk regulations. CGS Europe report D3.5, December 2013, 121 p (www.cgseurope.net)

COURSE GS8	GAS AND CO2 STORAGE
SECTION GS8.2	GAS STORAGE SURFACE FACILITIES

Lecturer:

	**Ana María García (ENAGAS).** Ph.D. in Mining Engineering-U.P.M. Master in Petroleum Engineering (ISE). Geoscience & Reservoir engineering coordinator at ENAGAS Underground Gas Storage Division. More than 20 year experience in activities related to the exploration, development & operation for Underground Gas Storage.

Objectives:

1. Understand the equipment used in surface facilities to compress the gas.
2. Learn the monitoring to be used to control the gas in the reservoir.
3. Learn the need for a cushion gas to operate the gas storage.
4. Learn to calculate the operating gas volume.
5. Understand the hysteresis.
6. Energy Storage: H2

Syllabus:

Introduction

Gas chain
UGS in the word
UGS in Spain
UGS terminology
UGS types
UGS function

1. Surface facilities.
Process involved
1.1. Compressors.
1.2. Metering.
1.3. Treatment of the produced gas.

2. Wells completions.
2.1. Injection/production wells.
2.2. Monitoring.

Program:

This course lasts 2 days:

Day 1 & 2: (Ana Maria Garcia)

- Surface facilities & Well completions.

Bibliography:

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- Underground Gas Storage Facilities. Design & implementation. Orin Flaningan

COURSE GS8	GAS AND CO2 STORAGE
SECTION GS8.3	CO2 STORAGE SURFACE FACILITIES

Lecturers:

J. Carlos de Dios. Ph D. in Mining Engineering, Master in Bussiness Administration (MBAe). Expert on CO2 Geological Storage. Managing expertise of relevant Mining and Energy projects. Technical Director of Spanish CCUS Hub Carboncause

Objectives:

1. Understanding of surface facilities and equipment for CO_2 injection.
2. Learning on reservoir monitoring, leakage control and plume tracking.
3. Understanding of safe and efficient injections.
4. Learning of impurity impacts on CO_2 geological storage

Syllabus:

1. Reservoir characterization and CO_2 plume tracking
1.1. Innovative geophysical techniques for reservoir characterization and plume tracking
1.2. Low cost drilling

2. Well completions.
2.1. Injection/observation wells.
2.2. Monitoring

3. Surface facilities.
3.1. CO_2 injection facilities
3.2. Water conditioning
3.3. Microseismicity and hydrogeological monitoring networks

4 Hydraulic characterization of pair seal-reservoir
4.1. Laboratory works
4.2. Field tests

5. CO_2 transport conditions for the injection
2.1 Efficient and safe injection strategies

6.-Effects of impurities on CO_2 injection
5.1. Thermodynamic and geochemical impacts
5.2. Effects on efficiency and safety

Program:

This course lasts 1 day:

Day 1: (C de Dios)

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- de Dios C., Martínez C., Ramos A., Marín J., Delgado M.A, Salvador I. 2016. "Hontomín, Spain. Prepared for regular injection". 11th CO_2GeoNet Open Forum.
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- Piessens K, Berenblyum R., de Dios J.C., Hladik V., Koenen M., Welkenhuysen K. (2017) Developing, testing and demonstrating onshore storage of CO_2: First results from the ENOS field sites, European Geologist Journal nº 44 November 2017
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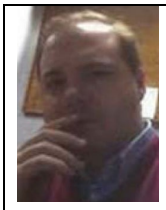
- de Dios, J.C.; Le Gallo, Y.; Marín J. (2019). Innovative CO_2 injection strategies in carbonates and advanced modeling for numerical investigation. Fluids 2019, 4 (1); 52, doi: https://doi.org/10.3390/fluids4010052
- de Dios, J.C.; Martínez, R. (2019) The permitting procedure for CO_2 geological storage for research purposes in a deep saline aquifer in Spain. International Journal of Greenhouse Gas Control 2019, Volume 91, 102822, https://doi.org/10.1016/j.ijggc.2019.102822

COURSE LNG9	LIQUEFIED NATURAL GAS (LNG)
SECTION LNG9.1	LIQUEFACTION PLANTS TECHNOLOGY

Lecturers:

	**Enrique Querol Aragón (UPM).** Ph.D. UPM. Mining Engineer in ETSIME - UPM. Responsible of transport, distribution and use of natural gas in www.minasyenergia.upm.es. Research and publications in the area of natural gas processes. Author of www.ptdu.org.es
	**Enrique Dameno García-Cuerva,** holds a degree in Industrial Engineering from University of Buenos Aires and a Master in Business Innovation from Deusto & INSEAD. He has 35 years' experience in companies such as BP Argentina, Occidental Petroleum, ASTRA CAPSA and Repsol. From 2005 to 2012 he worked at Repsol-Gas Natural LNG first in the Business Development & Technology area and later as LNG Sales Director. In 2013 he returned to Repsol as Gas/LNG Supply and Sales Long Term Director with responsibility for long-term deals worldwide. Among others deals, he successfully advised or conducted mid-term LNG sales in Korea, Thailand, and Japan; two long term LNG acquisitions sourced from USA and midterms gas supply deals in Spain. He has been part of GIIGNL and has written and presented papers at gas congresses. In 2016 he moved to Repsol Commercial Division as Commercial Digital Champion and Customer Experience Director, responsible for analytics & customer intelligence, new digital products (App Waylet) and digital marketing transversal initiatives. Since 2020 he works as digital consultant.

Objectives:

1. Understand the role of LNG (Liquefied Natural Gas) in the energy matrix
2. Get a comprehensive view of the LNG value chain including production, logistics, commercial and economic factors.
3. Learn the cryogenic concepts and associated technologies

Syllabus:

1. Introduction to LNG
1.1. Product definition
1.2. Basics of LNG production
1.3. Role of LNG. Why its importance?
1.4. LNG Value Chain
1.5. LNG units, quality and specifications
1.6. Industry figures
1.7. Project structures (financing, development, construction, operation, and commercialization)

2. Liquefaction plants technology
2.1. Natural gas treatment equipment
2.2. Liquefaction processes
2.3. Heat exchangers
2.4. Compressors and drivers
2.5. Cryogenic pumps
2.6. Tanks

3. Examples of liquefaction plants
3.1. Nigeria LNG
3.2. Qatargas and RasGas
3.3. Snhovit LNG
3.4. Atlantic LNG
3.5. Peru LNG
3.6. Yamal LNG
3.7. Sabine Pass
3.8. Snohvit LNG (Norway)
3.9. Atlantic LNG
3.10. Peru LNG.

Program:

This course lasts 2 days:

Day 1: (Enrique Dameno)

- Introduction to LNG (product, role, value chain, project structures and examples).

Day 2: (Enrique Querol)

- Technology of liquefaction plants.

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- Enrique Querol. Producción, transporte, distribución y uso. UPM. 2015. www.ptdu.org.es
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- Michael Tusiani, Gordon Shearer. LNG: A Nontechnical Guide. ASIN: 087814885X 2007
- LNG Glossary. GIIGNL International Group of Liquefied Natural Gas Importers. https://giignl.org/about-lng/glossary

COURSE LNG9	LIQUEFIED NATURAL GAS (LNG)
SECTION LNG9.2	REGASIFICATION PLANTS AND LNG TANKERS

Lecturers:

	**Pablo Quiroga López (Repsol).** Industrial Engineer by the Universidad Politecnica de Madrid and Master in Business Administration by the Universidad Pontificia de Comillas. He has more than 25 years of experience in energy project management and LNG regasification projects. He has been Business Development and Technical Manager in STREAM, a 50% Repsol and Gas Natural Fenosa Joint Venture. Currently he is LNG Technical Area Manager in Repsol's Gas and Power Division.
	**Jorge Zickermann de Lancastre.** Naval Architect and Marine Engineer by Instituto Superior Técnico, Lisbon, Portugal. Master in Maritime Law and Shipping Business by IME and U. P. Comillas, Madrid, Spain. He has extensive experience in ship building, ship design and fleet management being involved in the tendering and construction processes of more than 10 LNG carriers, and having being responsible for a fleet of up to 24 simultaneous LNG carriers. He has also participated in the design and commissioning of LNG terminals in Argentina, Canada, Mexico and Peru. He was until recently the Maritime Transport Director Naturgy.

Objectives:

1. Learn how to storage LNG.
2. Understand the need of the Cryogenic tanks and pumps.
3. Understand the process of LNG regasification.
4. Learn the LNG maritime transport.

Syllabus:

1. Introduction
1.1 Objectives of the Course
1.2 Safety
1.3 Regasification terminals in the world
1.4 Process flow chart

2. Terminal equipment and elements
2.1 Main equipment
2.2 Offsite and utilities

3. Terminal design and construction
3.1 Terminal design initial considerations
3.2 Design process and phases
3.3 Terminal construction

4. Operations in LNG Terminals
4.1 Terminal organization
4.2 Ships unloading
4.3 Vaporization and send-out
4.4 Truck loading
4.5 Energy balance
4.6 Working permits
4.7 Consumables

5. Wrap-up and conclusions
5.1 Safety

6. LNG Tankers
6.1 Actual technology.
6.2 Capacity.
6.3 Loading operations.
6.4 Unloading operations.

Program:

This course lasts 2 days:

Day 1: (Pablo Quiroga)

- Introduction, Terminal Organization and Maintenance. Safety

Day 2: (Jorge Zickermann)

- LNG Tankers. Loading and unloading.

Bibliography

- SEDIGAS. Manual de Plantas de Regasificación. 2009
- E. Álvarez Pelegry, J. Balbás Peláez. El Gas Natural – Del yacimiento al consumidor. Ed. Cie Inversiones Editoriales Dossat. 2003

COURSE LNG9	LIQUEFIED NATURAL GAS (LNG)
SECTION LNG9.3	LNG INTERNATIONAL MARKETS

Lecturers:

	**Ruben Mosquera Arias (Pavilion Energy).** BSc in Applied Physics (Universidad Autónoma, Madrid) and Master in Gas & Power (Instituto Superior de la Energia of Repsol, Madrid). Throughout the last 17 years he has held different positions in the energy industry. Started his career in Stream (Joint Venture of Repsol and Gas Natural) where he joined the LNG Supply area. Then he moved to Naturgy (formerly Gas Natural) where he first worked in the LNG Origination team and afterwards in the LNG Marketing area, as an LNG trader. In 2019 he joined Repsol LNG Trading team where he spent a couple of years building the LNG desk. In 2021 he started a new position as LNG trader in Pavilion Energy, a wholly-owned subsidiary of Temasek (a global investment company headquartered in Singapore).
	**Alfonso Vigre Maza.** Independent Energy consultant since May 2019 with more than 33 years of experience in energy matters. Head of NG and LNG Supply Portfolio Management in Naturgy where he was in charge of the management of long term LNG supply agreements as from January 2014 and long term NG and LNG supply agreements as from October 2016 until April 2019. Previously, his professional experience has been focused mostly on energy business: Manager Pipeline Gas Contracts, from 2012 to 2014 with responsibility of new contracts development and relations and negotiations with existing suppliers; New Contracts Manager with responsibility over the new purchase opportunities between 2010 and 2012, and previously in other positions regarding the management of supplies within the pipeline supply division in GNF as from 2005 and with pipeline and LNG supplies in Enagas and GNF between 1992 and 2005. He has been involved in most of the negotiations of existing long term supply contract both by pipe gas and LNG. He joined Enagas in 1985 where he work in different positions in the department of expropriations and lands acquisition until 1988 when he was appointed Enagas representative in Algeria where he worked and lived until 1992.

Objectives:

1. Understand the international LNG markets.
2. Understand the contracts main concerns.
3. Understand the GN and the LNG markets differences.
4. Understand the sellers/buyers balance.

Syllabus:

1. Contracts
1.1. GN versus LNG
1.2. Spot versus MP and LP

2.-Hubs in USA and in UE

3.-Sellers/Buyers balance
3.1. Actual
3.2. Medium and long term.

4. Spain market.

Program:

This course lasts 2 days:

Day 1: (Rubén Mosquera Arias)

- Contracts and Hubs

Day 2: (Alfonso Vigre)

- Sellers/buyers balance. Spain market.

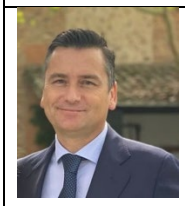
Bibliography

- SEDIGAS. Manual de Plantas de Regasificación. 2009
- SEDIGAS Annual Report
- ENAGAS : El Sistema Gasista Español / Informe 2013
- CEDIGAZ
- BP Statistical Review / BP Energy Outlook
- PLATTS LNG Daily
- PLATTS GAS Daily
- Argus Global LNG (monthly)
- PLATTS LNG Daily TERMINAL TRACKER

The last four publications are available by subscription. The first four can be unloaded from web free of charge.

COURSE LNG9	LIQUEFIED NATURAL GAS (LNG)
SECTION LNG9.4	LNG ECONOMICS

Lecturers:

	**Victor Tuñon Valladares (Gas Natural Fenosa).** He has spanned over 26 years with Gas Natural Fenosa and Repsol. He is now the Executive Director LNG & Gas Supply of Gas Natural Fenosa, having spent the previous years in the position of Global Gas Sales and General Manager of Gas Natural Comercializadora, Director Planning and Control, Gas for Repsol and the two previous years in the same role but with Gastream (LNG). Before this, he has been in the Gas and Power Vicepresidency (Repsol) and has been the General Manager of La Energía (Cogeneration Unit in Gas Natural Fenosa). He is a Mining Engineer (Madrid Polytechnic University) and MBA (IESE).
	**Alfonso Vigre Maza (Gas Natural Fenosa).** Independent Energy consultant since May 2019 with more than 33 years of experience in energy matters. Head of NG and LNG Supply Portfolio Management in Naturgy where he was in charge of the management of long term LNG supply agreements as from January 2014 and long term NG and LNG supply agreements as from October 2016 until April 2019. Previously, his professional experience has been focused mostly on energy business: Manager Pipeline Gas Contracts, from 2012 to 2014 with responsibility of new contracts development and relations and negotiations with existing suppliers; New Contracts Manager with responsibility over the new purchase opportunities between 2010 and 2012, and previously in other positions regarding the management of supplies within the pipeline supply division in GNF as from 2005 and with pipeline and LNG supplies in Enagas and GNF between 1992 and 2005. He has been involved in most of the negotiations of existing long term supply contract both by pipe gas and LNG. He joined Enagas in 1985 where he work in different positions in the department of expropriations and lands acquisition until 1988 when he was appointed Enagas representative in Algeria where he worked and lived until 1992.
	**Carlos Humphrey (Gas Natural Fenosa).** Mining Engineer (ETSIM-UPM) and end of career Award "Plantalamor". He also has Master in Science Degree in Petrochemestry by Institute FranÇais Du Pétrole (IFP). More than 25 years' experience in different companies of the Spanish energy industry. Started in REPSOL in 1995 and received a scholarship to study in IFP. In 1997 moved to Enagas and in 2004 to Stream (Join Ventura of REPSOL and Gas Natural) where he was appointed the LNG Supplier and Trading Director. Currently works for Natugy as LNG/Gas Long Term Contracts Director. He has negotiated and manages most of the LNG and pipegas contracts to the Spanish market for Naturgy (Nigeria LNG, Atlantic LNG, Libya LNG, Qatargas, Cheniere LNG, Yamal LNG, Statoil Sonatrach).

Objectives:

1. Understand the Spanish market.
2. Understand the GN price and the LNG price.
3. International contracts limitations and disputes. International arbitration.

Syllabus:

1. Spanish market
1.1. GN by pipeline
1.2. LNG terminals and regasification plants.
1.3. Spanish consumers.

2. International Contracts

3. Economics.

Program:

This course lasts 2 days:

Day 1: (Victor Tuñon, Alfonso Vigre)

- International contracts. Economics. Natural Gas and LNG supporting the power system. New gas sources: biogas and Hydrogen.

Day 2: (Carlos Humprey)

- Spanish market

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- SEDIGAS. Manual de Plantas de Regasificación. 2009
- SEDIGAS Annual Report
- ENAGAS : El Sistema Gasista Español / Informe 2013
- CEDIGAZ
- BP Statistical Review
- BP Energy Outlook
- PLATTS LNG Daily
- PLATTS GAS Daily
- Argus Global LNG (monthly)
- PLATTS LNG Daily TERMINAL TRACKER

The last four publications are available by subscription. The first four can be unloaded from web free of charge.

COURSE HSE10	HEALTH, SAFETY AND ENVIRONMENT
SECTION HSE10.1	SAFETY MANAGEMENT SYSTEM

Lecturers:

	**Ljiljana Medic Pejic (UPM).** Industrial Engineer Specialized in Energy at the Faculty of Mechanical Engineering at the Technical University of Belgrade). She obtained her PhD degree at the Technical University of Madrid (UPM) and the Oil & Gas Engineering Master degree (UPM). Professor at the Department of Energy and Fuels at the UPM. Head of Solids Safe Handling Laboratory Section of Laboratorio Oficial J.M. Madariaga (LOM). Researcher of over 10 R+D Projects in the last 5 year for national and foreign institutions and companies Member of national and international working groups for the elaboration of Rules and Standards in the field of Safety.
	**Emilia Arias Gallego (Técnicas Reunidas).** Bachelor in Chemical Sciences from the Complutense University of Madrid. Almost 30 years of experience in developing Oil & Gas projects. Holds the position of FEEDs, Technology and Energy Transition in Tecnicas Reunidas. Besides her functions, she led an LNG project in USA, various projects of Up-stream in Argelia and Refining in Russia. Currently, she coordinates technology development projects collaborating with TR divisions in charge of these developments and with external companies. Gives support in new technologies to the company, in agreements with licensors, and during the execution of projects, etc. Promotes projects related to the Energy Transition in TR, search for new clients, gives support to the Business Development Department, collaborates in the preparation of offers and provides technical support in the execution of these projects. She is also in charge of the preparation of FEED project offers, the support during the execution, either from the technological or execution point of view, and the dialogue with clients and possible engineering subcontractors

Objectives:

1. Understand the needs to manage the risks in operations.
2. Understand the needs to anticipate problems.
3. Understand the need to high management implication.

Syllabus:

1. Industrial Safety - Regulations and Risk Analysis
2. An introduction to equipment safety rules
3. Zone classification
4. Electrical installation in hazardous areas
5. Explosion risks - ATEX generation
6. ATEX in industrial plants
7. Equipment types of protection and their use
8. Minimizing explosion risk sources
9. Safety in the design of treatment facilities
   9.1. Safety Framework and variables
   9.2. Pressure Relieving Systems.
   9.3. Disposal systems.

Program:

This course lasts 3 days:

Day 1 & 2: (Ljiljana Medic)

Day 3: (Emilia Arias)

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- Chemical Engineering design. Fifth Edition. Coulson and Richardson. Ed. Elsevier

COURSE HSE10	HEALTH,SAFETY AND ENVIRONMENT
SECTION HSE10.2	ENVIRONMENTAL IMPACT ASSESSMENT IN E&P OPERATIONS

Lecturer:

María Jesús García Martínez. Ph.D. in Mining engineering. Associate professor of the Polytechnic University of Madrid. She has directed two doctoral theses about biodegradation and biofuels and she is the author of 16 papers published in JCR journals. She has participated in a total of 32 funded research projects, 5 of them in competitive public calls. She has 46 communications to congresses. Research and publication in the areas of environmental geochemistry, human health risk assessment, biofuels, remediation and life cycle assessment.

Objectives:

1. Understand the need to eliminate the environment impact in operations.
2. Understand the need to convince the public.
3. Understand the need of the high management involvement in the process.

Syllabus:

1 Environment impact associated with EP activities
2 Upstream Operations and challenges
3 Environment impact Identification. Methodology
4 Environment impact tolerability
5 Environment impact Management System

Program:

This course lasts 2 days:

Day 1: Environment impact assessment. Sections 1 to 4 (M.J. García)

Day 2: Management. Section 5 (M.J. García)

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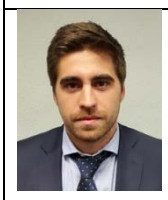
- E&P Forum/UNEP IE (1997) Environmental management in oil and gas exploration and production. http://www.ogp.org.uk/pubs/254.pdf
- Report 412 (2016) Guidelines for the management of Naturally Occurring Radioactive Material (NORM) in the oil & gas industry http://www.ogp.org.uk/pubs/412.pdf
- USEPA (2016) Integrated Risk Information System. http://www.epa.gov/iris

COURSE PE11	PETROLEUM ECONOMICS
SECTION PE11.1	BASIC PRINCIPLES OF ECONOMICS AND ACCOUNTING IN E&P

Lecturers:

	**José María Martínez-Val.** Ph.D. in Mining Engineering from Madrid School. Awarded Master degrees in Petroleum Engineering from Colorado School of Mines and Petroleum Economics & Management from IFP. A Professional Engineer (PE), board certified by the state of Texas. He is a guest lecturer at the Petroleum Engineering Master at the Danmarks Tekniske Universitet (DTU). He started working in the Oil and Gas industry in 2003 at Westport Resources Corporation in Denver, Colorado. He joined Repsol in 2004, and then moved to Mærsk Oil in 2012. Since 2018 he works for Total. He has help postings as petroleum engineer, reservoir engineer, project manager and subsurface development manager through his career. He has worked the entire E&P business cycle, from exploration, development and production in postings including Spain, USA, Mexico, Libya, Scotland, and Denmark..
	**Antonio Martín** holds an MSc in Mining Engineering from the Universidad Politecnica de Madrid. He has more than 23 years' experience in Asset/Country Management, Business Development and Strategic Analyst positions at international oil & gas upstream companies (Repsol, Cepsa, Cairn Energy). Background in exploration, well operations & field development (reservoir & production engineering) in Europe and North Africa. Expertise in Commercial / Business Development roles on international projects, including the search for new opportunities in A&D worldwide, as well as the techniques used in petroleum exploration, development, economic evaluation and contractual frameworks. Coordination of the evaluations, presentations at Committee and Board level, partnerships and stakeholders engagement plans implementations have been a key part of his roles in the last +12 years. Since June 2016, when he joined SGS Horizon, Antonio has been Head of Acquisitions and Divestments where he coordinates all Assets Evaluations, Reserves Certifications and advisory services for Companies and Governments related to portfolio management (A&D).
	**Jaime García González.** Mining Engineering at Universidad Politécnica de Madrid, Petroleum engineering program at the Colorado School of Mines and Master in International Financial Markets at Universidad Nacional de Educación a Distancia. In 2014, he joined Deloitte in the Energy and Utilities area, participating in projects with the main companies in the sector. At the end of 2015 he joined MIBGAS where he currently works in the areas of regulation, business development and market analysis.

Objectives:

1. Learn the basic principles of accounting in E&P operations.
2. Learn the basic principles and tools of economics in E&P operations.
3. Learn how to perform an economic evaluation of an E&P project.
4. Get to know and understand the fundamentals of decision analysis.
5. Learn how to deal with risk and construct decision trees analysis.
6. Understand risks/uncertainties management and strategic decisions.
7. Understand methods for Portfolio analysis and optimization.

Syllabus:

1. Tools for project valuation.

1.1. Measures of Project Value: NPV,IRR, Payback.
1.2. Using discounted cash flows: cost and cash flows projections as support to the project analysis
1.3. Project Risk Analysis: dealing with uncertainty, sensitivity analysis (scenario analysis, breakeven analysis, simulation), decision trees-valuing project flexibility.
1.4. Cost of Capital: estimating required rates of return for projects.

2. Main economic factors. Oil and gas prices.

3. Decision Analysis. Risks and Uncertainties in Portfolio Management.

3.1. Modeling and Structuring Decisions.
3.2. Decision Analysis Tools and Methodologies in the E&P Setting
3.3. Value of Information
3.4. Risk Sharing, Diversification and Portfolio Analysis
3.5. Modeling Risk Propensity in the E&P Sector
3.6. Managerial Perspectives on Risk

Program:

This course lasts 4 days:

- Day 1 Tools for project valuation (J.M. Martínez-Val)
- Day 2: Initial economic oil data (J.M. Martínez-Val)
- Day 3: Risk analysis, diversification and portfolio management (A. Martín)
- Day 4: Main economic factors: gas prices (J. García)

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COURSE PE11	PETROLEUM ECONOMICS
SECTION PE11.2	CONTRACT TYPES AND LICENSE APPLICATION

Lecturers:

	**Margarita Hernando.** Law Degree by UCM and an L.L.M. on Commercial Law by Bristol University. She has developed her career as an international energy lawyer with vast experience in oil and gas, drafting and negotiating related agreements, from upstream to downstream and including LNG and UGS, and ancillary issues on the corporate and financing side, including compliance, M&A, cross-border transactions, international bid rounds, and advising on business development. After serving as Upstream Legal Services Director at Repsol (16 years), she currently heads the Oil & Gas practice at Eversheds-Sutherland Nicea and acts as President of the Association of Oil and Gas Upstream and Hydrocarbons Underground Storage.
	**Oscar Aguado.** PhD. in Mining Engineering from Madrid School of Mines & Energy (UPM), graduated from HEC-Paris Business School, and awarded Masters in Petroleum Economics and Management from IFP-School, Managerial Energy Economics from OU at the US. Currently acts as Managing Director of Nebrija University and teacher at the Nebrija Business & Technology School, after more than 15 years at BBVA, of which the last 9 were as Head of Strategic Projects for the second largest Asset Manager in Spain, being responsible for the business plans in the 10 countries belonging to the geographical footprint. Prior to that he has being the Oil Companies analyst for the 2nd Spanish bank in different areas: Equity Research, M&A and Risk. He was also finance teacher at the University College of Financial Studies (CUNEF) at the Master in Financial Institutions and Markets, the Master in International Business and Global Management, and at the CUNEF Finance Summer School.

Objectives:

1. Distinguish between different contract types and different procedures to acquire exploration and production rights.
2. Become acquainted with the E&P license application.
3. Understand the main targets of the E&P companies.
4. Be acquainted with E&P contract features.

Syllabus:

1. Contract types

1.1. Each country sets its own rules for allowing the exploration and production of hydrocarbons; we will briefly examine how some jurisdictions are more welcoming than others, why history plays an important role as well as the impact of risk's perception. Main contract types will be described to learn to distinguish between them and main terms will be reviewed.

1.2. The different alternatives for acquiring hydrocarbons rights: farmouts, licensing rounds and direct negotiation will be compared

2. Economic performance of different petroleum fiscal system designs.

2.1. Introduction to petroleum fiscal systems. Government view vs. Contractor/Investor view.

2.2. Rent theory. Tax base spectrum. Regressive vs. progressive.

2.3. Design Elements: royalties, taxes, profits splits, cost recovery limits, uplifts, sliding scales-production based, "R" factor, IRR, windfall profit taxes, government participation.

2.4. Valuation Criteria and Analytical tools: the project economic limit, government take, effective royalty rate, savings index, progressiveness, payout (R).

Program:

This course lasts 1 day:

- Day 1: E&P Contract types and license application (M. Hernando) & Petroleum fiscal systems / Economic performance of different petroleum fiscal system designs (O. Aguado)

Bibliography:

- Host Government Contract Handbook (for international petroleum industry) by AIPN published by BARROWS COMPANY INC.
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- International Petroleum Fiscal Systems and Production Sharing Contracts. 2011 Daniel Johnston &Co., Inc
- Introduction to Oil Company Financial Analysis. 2005. David Johnston, Daniel Johnston. PennWell Corp.
- Dealing with Risk and Uncertainty in Exploration". Peter R. Rose. The American Association of Petroleum Geologists, 1987.
- S. Centeno. Estudio y diseño de un régimen fiscal que optimice la inversión en exploración y producción de hidrocarburos. 2015 Tesis Doctoral (UPM)
- Petroleum Exploration and Production Rights. World Bank Working Paper nº 179. 2010.

COURSE PE11	PETROLEUM ECONOMICS
SECTION PE11.3	ECONOMICS. VALUATION OF COMPLEX ASSETS

Lecturers:

Francisco Maldonado holds an MSc in Mining Engineering from the Universidad Politecnica de Madrid, a Master degree in Reservoir Management by the French Petroleum Institute (1994), and a Master degree in Business Administration by the University of Calgary (2018). He joined Repsol in 1994, and has been for the last 15 years in different managerial positions, mostly as Production manager and Subsurface Manager. He has spent most of his career in countries with O&G operations, which granted him valuable experience in Exploration, Appraisal, and Development projects, asset evaluation, project management and reserves management. He has been in Reserves Coordination roles for the last 15 years and has been working in unconventional assets in North America for the last six years.

Objectives:

1. Understand the main targets of the E&P companies.
2. Become acquainted with the main management indicators in an E&P company.
3. Learn how to perform an economic evaluation of an E&P project.
4. Get to know and understand the fundamentals of decision analysis.

Syllabus:

1. Economic evaluation.

1.1. Objectives of an economic evaluation.
1.2. "Economics" in the E&P asset lifecycle: purpose, key variables, and risks.
1.3. Phases of a project's economics. Evaluation network.
1.4. Measures of profitability. Characteristics.
1.5. Economic evaluation. Full cycle and half cycle.
1.6. Discounted net cash flow method. Building the cash flow.
1.7. Measures of profitability more commonly used: payback period, maximum financial exposure, profit to investment ratio, internal rate of return, net present value, discounted profit to investment ratio, etc. Characteristics. Pros and cons.
1.8. The discount rate. Factors to be considered.
1.9. Answering "what if" questions. Sensitivity analysis. Looking for the key uncertainties.
1.10. Sustainable development in the energy sector.

2. Decision analysis.

2.1. Concepts: uncertainty, exposure to uncertainty, risk, etc.
2.2. Basics of probability and statistics concepts.
2.3. The "shape" of oil patches uncertainty.
2.4. Expected value concept. Meaning and interpretation.
2.5. Decision trees. Chance node. Decision node.
2.6. Solving a decision tree.
2.7. Maximum tolerable dry hole risk.

3. Financial Statements.

3.1. Financial Statements in Oil and Gas companies
3.2. Reserves
3.3. Main parameters for companies evaluations
3.4. Ratio Analysis
3.5. Project Finance

4. Baytex vs. Peyto

4.1. Analyzing Financial Statements in Oil and Gas companies
4.2. Evaluating performance, solvency and strategy.
4.3. Liquidity and earnings management.

5. Petrozuata case:

5.1. Contractual review.
5.2. Fundamentals of Project Finance
5.3. Required return on capital: WACC
5.4. Target debt levels.

6. Real PSC Block

6.1. Business Development Case evaluation
6.2. Technical Review. Assumptions.
6.3. Economical Reviews. PSC review.

7. Evaluation exercise: how to valuate an oil block (Real PSC block).

7.1. Comments of the work realized.
7.2. Review calculation assumptions.
7.3. Simplified Valuations.
7.4. NPV.

8. Evaluation exercise: Project Finance (Petrozuata)

8.1. Comments of the work realized.
8.2. Review assumptions.
8.3. Empirical Analysis
8.4. Identification of key risks

Program:

This course lasts 3 days:

- Day 1: Economic oil data II and technical presentation of an oil real block (F. Maldonado)
- Day 2: Prospect & block valuation (F. Maldonado)
- Day 3: Evaluation exercise (F. Maldonado)

Bibliography:

- Megill, R. E. (1984). An Introduction to Risk Analysis, 2nd Edition. PennWell Publishing Co. Tulsa.
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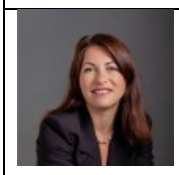
- Riis, T. (1999), Quantifying the Value of Information, Petroleum Engineer International, June 1999, pp.48-50.
- Schuyler, J. R. (1996), Decision Analysis in Projects. Project Management Institute, Sylva, North Carolina, 144 pp White, D. A. (1993), Geologic risking guide for prospects and plays, AAPG Bulletin, vol. 77, no. 12, pp. 2048-20

COURSE PE11	PETROLEUM ECONOMICS
SECTION PE11.4	BUSINESS STRUCTURE & STRATEGIC PLANNING

Lecturers:

	**Oscar Aguado.** PhD. in Mining Engineering from Madrid School of Mines & Energy (UPM), graduated from HEC-Paris Business School, and awarded Masters in Petroleum Economics and Management from IFP-School, Managerial Energy Economics from OU at the US. Currently acts as Managing Director of Nebrija University and teacher at the Nebrija Business & Technology School, after more than 15 years at BBVA, of which the last 9 were as Head of Strategic Projects for the second largest Asset Manager in Spain, being responsible for the business plans in the 10 countries belonging to the geographical footprint. Prior to that he has being the Oil Companies analyst for the 2nd Spanish bank in different areas: Equity Research, M&A and Risk. He was also finance teacher at the University College of Financial Studies (CUNEF) at the Master in Financial Institutions and Markets, the Master in International Business and Global Management, and at the CUNEF Finance Summer School.
	**Angelina Pershukova** holds an MSc in Petroleum Economics and Management from IFP School and the Russian Oil and Gas University, and a MBA in Oil & Gas Industry from Moscow Business School MIRBIS. She also has a degree in Linguistics from the Philological Faculty of Moscow State University, Russia. Currently, she serves as the Director of the Algeria and Spain Business Unit for Repsol, where she is responsible for oil and gas production in Algeria and decommissioning activities in Spain. She has over 18 years of international experience in the E&P business at Repsol. She began her career as a Business Development Analyst in Russia, where she was instrumental in identifying and evaluating new business opportunities, conducting market analysis, and supporting strategic decision-making processes, then moved to Spain as a Business Development Manager where she was responsible for driving growth initiatives in Russia and other countries, negotiating key partnerships, and managing stakeholder relationships finalizing the circle as the Country Manager for Russia, where she successfully managed the complex process of exiting the Russian market. In addition to her executive responsibilities, she is an Ambassador of the Engagement Program at Repsol E&P, promoting women's leadership inside and outside the company, committed to fostering an inclusive and empowering work environment.
	**Juan Ros.** MA in Business Administration and Accountancy from College of Financial Studies (CUNEF-UCM). Currently acts as Senior Equity Analyst for ODDO BHF covering stocks in the consumer, industrial and pharma sectors. Prior to that he was Head of Equity Research and Senior Equity Sales at Intermoney; Head of Iberian Small & Medium Caps and Senior Equity Analyst at BBVA; and Senior Strategy & Business Architecture Consultant at Accenture. Since 2007 he has been teaching finance in different postgrad programs including Universidad Europea de Madrid (UEM), Universidad de las Hesperides (U.h) and Universidad Francisco Marroquin (UFM)

Objectives:

1. Get to know and understand the factors of the price evolution.
2. Understand the consequences of the current crisis and learn how to deal with the future circumstances.
3. Be acquainted with the strategic planning of the upstream sector, taking into account several factors to understand better the performance of the execution.
4. Learn how to perform an economic evaluation of an E&P project taking your own strategy.

Syllabus:

1. Relevance of financial markets:
1.1. Repsol's Case.
1.2. Rating Agencies.
1.3. Multiples in petroleum companies.

2. Upstream, refining and natural gas.
2.1. Magnitudes.
2.2. Business structure upstream. Reserves, cycle live and prices
2.3. Demand
2.4. Business structure downstream. Refining complexity, capacity and margins
2.5. Business structure natural gas. LNG chain. Unconventional gas in Europe

3. Economy of the upstream projects.
3.1. Average Costs of petroleum.
3.2. Future projects profitability.
3.3. Crisis consequences.

4. Trading and commerce.

5. Contractual terms and consequences.

6. Reserves.
6.1. Definition.
6.2. Consequences in private companies.
6.3. Worldwide reserves technical and economical.

7. Value chain of oil companies.
7.1. Exploration - Production - Refining - Marketing - Chemistry.
7.2. Exploration - Liquefaction - Transport - Gasification - Distribution -Commercialization.
7.3. The case of electricity generation.
7.4. Sharing links between oil companies and gas companies.
7.5. Critics margins of the value chains.
7.6. The recent evolution of the chains.

8. Margin volatility, companies and oil prices.
8.1. Importance in the integration.
8.2. Importance of the crude oil costs.
8.3. Importance of the taxation.

9. The consequences of the recent crisis on businesses.
9.1. Stock aspects.
9.2. Investments aspects.
9.3. Production aspects.

10. Reflections on the future.
10.1. Strategies and Prices
10.2. A new age.

11. Upstream Strategic Planning.
11.1. Definition (general science).
11.2. Importance.
11.3. Cell.
11.4. Ambient.
11.5. Execution.
11.6. Period.
11.7. Management control.
11.8. Momentous and contentious planning decisions.
11.9. Future reflections.

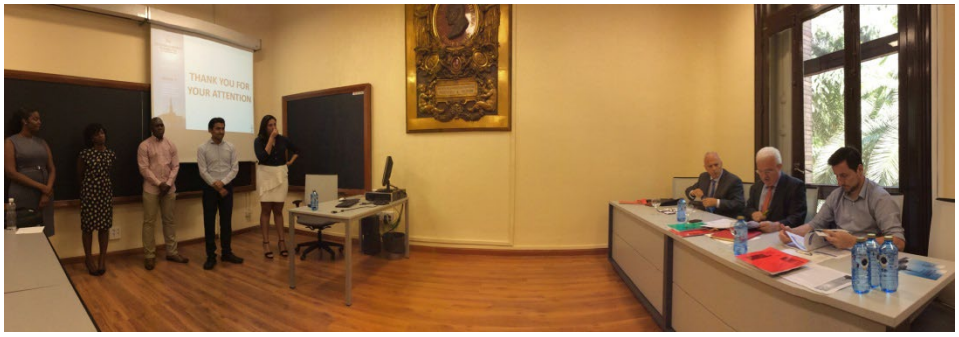
12. Business Development
12.1. M&A: Strategic Importance, Historical Context, Current Trends, Emerging Trends (Future Outlook)
12.2. Case Studies: Successful M&As, Challenges and Failures, Integration and Synergies

Program:

This course lasts 2 days:

- Day 1: Business Structure & Strategic Planning (O. Aguado)
- Day 2: Financial Markets (J. Ros) / Business Development (A. Pershukova)

COURSE 12	**PETROPHYSICS Lab** Petrophysics Lab course 
COURSE 13	**FIELD TRIP (FT)** One week field trip in order to know better sedimentary basins and petroleum systems  

	
COURSE 14	**FINAL WORK (FW)** A case study work group of modeling and simulation of an oil or gas field. Each group will write a Final Project Report that will be presented and defended before an academic and industrial board.  

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