MSc in Petroleum Engineering
Heriot-Watt University

1. About the program

The MSc program in Petroleum Engineering is a higher education program jointly developed by *Instituto do Petróleo e Gás* – Association for Research and Advanced Training - (ISPG) and Heriot-Watt University (HWU).

Petroleum Engineering is an interdisciplinary field that applies engineering principles and quantitative methods in exploring subsurface oil and gas reserves. This MSc course offers qualified graduates a learning experience strongly based on field research and development projects that respond to the oil and gas industry needs.

The program of the MSc Course takes place at the *Faculdade de Ciências* of the *Universidade de Lisboa* campus, in Lisbon, with English as the teaching language. The teachers/tutors are from HWU and from the scientific and industrial associates of ISPG:

- Universidade de Lisboa: Faculdade de Ciências e Instituto Superior Técnico.
- Universidade Nova de Lisboa.
- Universidade de Coimbra.
- Universidade de Aveiro.
- Universidade do Porto.
- Universidade do Minho.
- Galp.

The graduates of this program will be awarded with the degree of MSc in Petroleum Engineering by Heriot-Watt University.

The sixth edition of the program will begin on January 2019 and is integrated in the network of Approved Learning Partners (ALPs) of Heriot-Watt University/Institute of Petroleum Engineering, which is recognized internationally as one of the leading centres of excellence in petroleum engineering and petroleum geosciences teaching, training and research with strong links to this industry worldwide.

The program is carefully monitored to ensure that the academic standards and quality of the education is fully compliant with the Heriot-Watt University standards.

2. Program content

The MSc program consists of eight academic courses and two projects, in accordance with the lecture program of MSc in Petroleum Engineering at Heriot-Watt University:

Petroleum Geoscience

Concerns the origin, structure and internal geometry of reservoirs and the creation, migration and entrapment of hydrocarbons. Geological models form the basis for reserve estimation and development planning.

i. Introduction to the Earth.
ii. The petroleum play.
iii. Sedimentology.
iv. Structural Geology.
v. Geophysics.
vi. Correlation.
vii. Mapping.
viii. Geological statics.
ix. Volumetrics.

Formation Evaluation

Understanding the concept of formation evaluation and well logging. Understanding the physical principles of the tools used in logging. Characterizing the formation based on interpretation of well logs.

i. Introduction to openhole logging.
ii. Rock and fluid properties.
iii. Summary of procedures used in interpretation.
iv. Log measurements and tools.
v. Interpretation of porosity.
vi. Lithology and porosity in complex formations.
vii. Saturation determination.
viii. Interpretation charts.

Reservoir Engineering

Understanding the rock and fluid properties of an hydrocarbon reservoir. Describing the nature of the fluid flow and pressure distribution in a reservoir. Understanding the effects of production/ injection on recovery of reserves.

i. Introduction to reservoir engineering.
ii. Reservoir pressures and temperatures.
iii. Reservoir fluids composition.
iv. Phase behaviour of hydrocarbon systems.
v. Behaviour of gases.
vi. Properties of reservoir liquids.
vii. Fundamental properties of reservoir rocks.
viii. Rock properties measurement.
ix. Permeability – its variations.
x. Fluid flow in porous media.
xi. Drive mechanisms.
xii. Vapour liquid equilibrium.

xiii. Equilibrium ratio prediction and calculation.
xiv. PVT analysis.
xv. Material balance equation.
xvi. Material balance equation application.
xvii. Water influx.
xviii. Immiscible displacement.

Drilling Engineering

Involves a range of engineering disciplines in the design and safe construction of exploration and development wells. These wells are required either as sources of information or to drain oil and gas reservoirs.

i. Overview.
ii. Rig components.
iii. Drillstring.
iv. Drilling bits.
v. Formation pressures.
vi. Well control.
vii. Casing.
viii. Cementing.
ix. Drilling fluids.
x. Hydraulics.
xi. Directional drilling.
xii. Directional surveying.
xiii. Measurement while drilling.
xiv. Subsea drilling.

Production Technology

Concerns the productivity of oil and gas wells. It includes the design, installation and operation of down-hole and surface systems, to optimize the controlled recovery of pipeline quality crude oil and gas. Safety and the ability to respond to changing situations are important considerations.

i. Conventional completions.
ii. Advanced wells and completions.
iii. Reservoir and tubing performance.
iv. Selection and design of artificial lift.
v. Gas lift.
vi. Perforating.
vii. Formation damage.
viii. Matrix acidizing.
ix. Hydraulic Fracturing
x. Unstable formations and sand control.
xi. Field development concepts and fluid processing.

Reservoir Simulation

Developing an understanding of the role of simulation in reservoir engineering. Gaining insight into the value of simulation. Providing the appropriate numerical techniques to enhance hydrocarbon recovery.

i. Introduction and case studies.
ii. Basic concepts in reservoir engineering.

iii. Reservoir simulation model set-up.
iv. Gridding and well modelling.
v. The flow equations.
vi. Numerical methods in reservoir simulation.
vii. Permeability upscaling.
viii. Petrophysical input.

Well Testing Analysis

Understanding the rock and fluid properties of an hydrocarbon reservoir. Describing the nature of the fluid flow and pressure distribution in a reservoir. Understanding the effects of production/ injection on recovery of reserves.

i. Radial Flow.
ii. Pressure transient analysis in drawdown and buildup.
iii. Wellbore storage and type curve matching.
iv. Semi-infinite system late transient analysis.
v. Well in a bounded drainage area.
vi. Distributed pressure measurement.
vii. Exploration applications of distributed pressure measurement.
viii. Field development applications of distributed pressure measurement.
ix. Reservoir management.

Petroleum Economics

Understanding the economic concepts involved in project evaluation. Understanding the value of investments. Evaluating risks associated with economic decisions. Project Ranking.

i. Introduction
ii. Evaluation methods.
iii. Time value of money.
iv. Project parameters.
v. Government.
vi. Sources of uncertainty and risk.
vii. Risk management.

Projects

1. Field Development Project

Groups of 5-10 students are provided with real data from a field, similar to that which would be available to an Operator prior to a development decision. Analysis of this data results in an assessment of the reservoir and leads to the design of an appropriate production system. Through this exercise, students gain valuable insight into the use of imperfect and incomplete data, to the integration of the various taught components of the course and to problems of group interaction. It is also an opportunity to teach a range of transferable skills such as teamwork, presentation and negotiation. During the project students have access to state-of-the-art computer technology and industry standard software. Assessment is by means of a written report and by group presentation.

2. Individual Project

Students are required to carry out a detailed investigation of some topic related to petroleum geoscience or engineering. Projects are offered both by the Institute and by the industry, and normally include a wide range of experimental research, computer modelling and real oilfield problems. Assessment is by means of both thesis and oral presentation.

3. Requirements for Admission

Candidates must hold a Master degree in any field of engineering or other scientific area, preferably in one of the following courses: Mechanical Engineering, Chemical Engineering, Electrical Engineering, Civil Engineering, Geological Engineering, Geological and Mining Engineering, Physics Engineering, Geology, Geophysics or Physics.

The maximum number of students admitted each year is 20. Starting on January, the period of study lasts for 12 months.

At the final stage of the selection process, applicants must submit copies of the following documents:

i. Degree Certificate and Credits Transcription, both in English;
ii. 2 reference letters in English (usually academic, but can also be professional - 1 page maximum);
iii. Candidates whose first language is not English:
    a) Certificate stating that your highest level curriculum was taught in English, or
    b) English level certificate (minimum IELTS 6.5, Cambridge CAE grade B, TOEFL 87, Pearson Test of English 61);
iv. Application form.

Other documentation may be required.

4. Graduation and Certification

Heriot-Watt University sets and conducts all examinations, and assesses the program delivery. Students who complete successfully all the modules will be awarded the degree of MSc in Petroleum Engineering by Heriot-Watt University.

5. Career Opportunities

The HWU MSc in Petroleum Engineering is internationally recognized by oil and gas companies. Graduates of this degree will enhance their employability and career prospects in the global oil and gas industry. The degree is also a good starting point for a career in research and academia.