

http://www.peteng-master.tuc.gr

Prof. Nikos Pasadakis July 2017





Designed to provide students with a scientific background in hydrocarbon exploration and skills in the practical aspects of petroleum engineering.

The MSc program operates under the aegis of:





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THE GROUP | CORPORATE RESPONSIBILITY | HEALTH, SAFETY & ENVIRONMENT | INVESTOR RELATIONS | MEDIA CENTER |



WHO WE ARE

Founded in 1998, HELLENIC PETROLEUM is one of the leading energy groups in South East Europe, with activities spanning across the energy value chain and presence in 7 countries. Its shares are primarily listed on the Athens Exchange (ATHEX: ELPE) with a secondary listing on the London Stock exchange (LSE: HLPD/98LQ).

HELLENIC PETROLEUM's key shareholders are Paneuropean Oil and Industrial Holdings S.A. (42.6%) and the Hellenic Republic Asset Development Fund (35.5%), with the remaining held by institutional (15.3%) and private (6.6%) investors.









MSc Course description:

•The School of Mineral Resources Engineering of the TUC runs the Postgraduate Program in Petroleum Engineering since 2014

•It is aiming to provide a scientific background and applied knowledge in oil and natural gas exploration & production

•The program's duration is 12 months, with course work on a full- time basis, accounting for a total of 48 ECTs and a diploma thesis, corresponding to 12 ECTs





Students admission:

- •The successful candidates should hold a University degree in Engineering or a Science discipline relevant to the program's subject
- •The maximum annual enrollment is 20 students
- •Program language: The program lectures and course work are given in English and fluency in oral and written English is required
- •Program fees: The fees of the program are 3,000€
- •Especially, the fees for students coming from Greece, Cyprus, Serbia, Bulgaria, Montenegro and FYROM are covered by scholarships, provided by "Hellenic Petroleum"





BOX-06

Petroleum Geology (39 hours, 5 ECTs).

- •Basic geology (earth structure, rocks, sedimentary basins, mapping)
- Sedimentology and depositional environment
- Structural geology
- •Basin analysis
- Play assessment









Petroleum Chemistry and Geochemistry (39 hours, 5 ECTs)

- •Hydrocarbons chemistry
- •Origin of oil and gas
- •Organic matter, carbon cycle
- •Generation of petroleum, source rocks, migration and reservoir geochemistry
- •Biomarkers
- •Chemical analysis
- •Petroleum and the environment





Hydrocarbons Chemistry and Technology Research Unit

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ACTIVITIES

- Instrumental analysis and characterization of fossil fuels (petroleum, natural gas, coal, etc)
- Chemometric applications on analytical data. Development of corellations between chemical compositon and physicochemical properties of hydrocarbon mixtures. Prediction of properties.
- Organic Geochemical applications in fossil fuels positioning, production and exploitation.
- Identification and characterization of organic pollutants in the environment produced during production and use of fossil fuels, Fingerprinting.

SPECIALTY EQUIPMENT & INFRASTRUCTURE

- Gas Chromatograph-Mass Spectrometer (GC-MS) Fisson MD-800
- Gas Chromatographs (GC), HP5890 and Perkin-Elmer-8700
- Liquid Chromatograph (HPLC) Waters
- Infrared Spectrometer (FT-IR) Perkin-Elmer Spectrum 1000
- Solid phase microextraction device (SPME)
- Solid phase extraction unit (SPE)
- Purge & Trap device for sample injection in GC n GC-MS,
- Pyrolysis gas chromatography unit (Py-GC)
- Thermal desorption device for sample injection GC n GC-MS
- Rock-Eval II pyrolysis system for the characterization of organic matter in rocks and soils



RESEARCH AND DEVELOPMENT PROJECTS

- "Evaluation of possible source rock in Greece using organic geochemistry methods" Basic Research 2007, Financed by ELKE TUC, 2007
- "Simulation of Epsilon oil reservoir using specialized software" PEP Eastern Macedonia 2000-2006, Financed by GSRT, KAVALA OIL, 2006- present.
- "Evaluation of biogas from neogene formations in Central Crete", PEPER Crete 2000-2006, Financed by GSRT, Municipality of Arkalohori, 2006- present.
- "Evaluation and monitoring of oil spills in the subsurface using modern geophysical methods", Financed by GSRT "Competitiveness", GEOTEK, 2004-present
- "Pilot study of lubricant oil extraction", Financed by ELKE TUC, 2004-2007
- "Characterization of oil spills in the Aspropirgos refinery (Athens)", Financed by Hellenic Petroleum, 2003-2006
- "Development of low cost adsorbent for gas cleaning using activated Greek lignites", Financed by IGME, 2002-2006.
- "Geochemical study of Greek lignites. Origin determination using characteristic biomarkers", Financed by IGME, 1998









Geochemical study

<u>Methods</u>

Rock-Eval analysis Elemental analysis Core extraction Group type fractionation GC analysis of the saturate fraction GC-MS biomarker analysis

Geochemical study of Prinos basin



Hopanes m/z 191

Steranes m/z 217¹⁰

Petroleum Geochemistry as a tool in environmental protection

✓ Fingerprinting: determination of the origin of petro-chemical pollutants

 Monitoring the fate of hydrocarbons in polluted areas

Fingerprinting: determination of the origin of petro-chemical pollutants



Nikos Pasadakis, Evangelos, Gidarakos, Georgia Kanellopoulou, Nikos Spanoudakis: "Identifying Sources of Oil Spills in a Refinery by Gas Chromatography and Chemometrics. A case study", Environmental Forensics, 9 (2008) 33-39.

Monitoring the fate of hydrocarbons in polluted areas



Compositional changes in petroleum due to the biodegradation.

To improve remediation in petroleum polluted areas

Marta Ruiz, Nikos Pasadakis, Nicolas Kalogerakis: "Bioremediation and toxicity determination of natural seawater polluted with weathered crude oil by salt-tolerant consortia in a SBR", Marine Pollution Bulletin, 52 (2006) 1490-1493





Reservoir Engineering (39 hours, 5 ECTs)

- Introduction to reservoir engineering
- Fluid pressure regimes
- Phase behavior
- Reservoir fluid sampling
- •Porous media
- Rock-fluid interactions
- •Fluid flow in porous media
- •Stabilized flow- transient flow-gas flow equations
- •Well testing
- •Well performance
- Introduction to Well Test interpretation
- •Type curve analysis
- Pressure derivative analysis







PVT and Core Analysis Laboratory



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ACTIVITIES

- Phase equilibria and thermodynamic behaviour (PVT) studies of mixture of multiphase fluids at high pressures and temperatures.
- Compositional analysis and characterization of gas and liquid petroleum samples.
- 3. Reservoir Core analysis studies.
- 4. Measurements of Physical properties of Petroleum and its Fractions.
- 5. Catalytic processing of hydrocarbon mixtures.
- 6. Asphaltenes deposition studies.
- 7. Phase equilibria simulation of hydrocarbon mixtures
- 8. PVT properties simulation models based on EOS and ANN.
- High pressure experimental determination of gas hydrate equilibrium at three (V-L-H) and two (L-H) phase region of the phase envelope.
- Experimental determination of GH formation curve of a gas azeotrope mixture of Xe – HFC 134a.
- Experimental study of host formations containing gas hydrate at high pressures. As host formations both berea sandstone cores and clayish sediments have been studied. Permeability values as low as 0.3 µDarcy were measured.
- Compressibility study of clay sediments which contain gas hydrates at high pore pressures.
- CT-scan of pressurized natural sediment cores containing gas hydrates

SPECIALTY EQUIPMENT & INFRASTRUCTURE

- Equipment for evaluating phase equilibria and thermodynamic behaviour (PVT) of multiphasic mixtures at high pressures and temperatures, including a dual visual cell connected to a Hg pump, installed in a thermostatically controlled airbath
- Gas Chromatograph-Mass Spectrometer (GC-MS) Fisson MD-800
- Gas Chromatographs (GC), HP5890 and Perkin-Elmer-8700
- Liquid Chromatograph (HPLC) Waters
- Infrared Spectrometer (FT-IR) Perkin-Elmer Spectrum 1000
- Isco syringe pump model 500D, max working pressure 259bar
- A multi-port core holder, biaxial loading, model Temco DCHH-1.5 max working pressure 690bar.
- Autoclave reactor model Parr 4565M (volume 100ml, max working pressure 210bar at 350°C), equipped with magnetic stirrer.
- Gas booster model Haskel AGT 62/152H, max working pressure 1720bar.
- Solid phase microextraction device (SPME)
- Solid phase extraction unit (SPE)
- Purge & Trap device for sample injection in GC n GC-MS
- Pyrolysis gas chromatography unit (Py-GC)
- Thermal desorption device for sample injection GC n GC-MS
- Rock-Eval II pyrolysis system for the characterization of organic matter in rocks and soils



PVT and Core Analysis

- Phase Equilibria and Thermodynamic Behaviour (PVT) Studies of Mixtures of Multiphasic Fluids at High Pressures and Temperatures
- Compositional Analysis and Characterisation of gas and liquid petroleum samples
- Reservoir core analysis studies
 - Porosity
 - Absolute and relative permeability
 - Capillary pressure
- PVT simulation models based on EOS and Artificial Neural Networks
- Hydrates study





Data Analysis and Modeling (39 hours, 5 ECTs)

•Use of statistical tools for modeling field- and production-related data
•Data mining, regression, classification, clustering
•Geostatistical methods (variogram, kriging, interpolation, simulation)





Geostatistics Research Unit



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ACTIVITIES

- Development of Spartan Spatial Random Field Models and applications in the analysis of spatial information
- Development and solution of physical-statistical models of mechanical properties for heterogeneous materials
- Calculations of macroscopic effects of heterogeneity on the elastic and transport properties of porous media
- Development and solution of diffusion models for sintering and grain growth
- 5. Analysis of tall structure wind Response from GPS measurements
- Investigations of time series models for the analysis and management of groundwater resources in the Messara valley of Crete.

SPECIALTY EQUIPMENT & INFRASTRUCTURE

- Personal Computers (Windows XP) and peripherals.
- Software for scientific programming, simulation, geostatistical analysis and visualization of the results.

RESEARCH AND DEVELOPMENT PROJECTS

- Principal Investigator: STREP: «INTAMAP: INTeroperability and Automated MAPping», in negotiation with EC.
- Coordinator: Pythagoras II: «Development and Application of Novel Geostatistical Methods in Environmental Pollutant Mapping». Duration: 2005-2006.
- Επιστημονικόs Υπεύθυνοs: Χρηματοδότηση ΕΛΚΕ της Βασικήs Έρευνας 2004: «Spartan Random Field Models for Geostatistical Applications». Duration: 2005-2006
- Scientific Coordinator: FP6 014135 Marie Curie TOK action: «Development of Spartan Spatial Random Field Models for Geostatistical Applications» (SPATSTAT, FP6). Duration: 2005-2008.
- Principal Investigator: NMP2-CT-2004-505885-1 STREP: «Super High Energy Milling in the Production of Hard Alloys, Ceramic and Composite Materials» (ACTIVATION FP6). Duration: 2004-2007.
- Principal Investigator: Pythagoras II: «Laboratory Studies and Modeling of the Transport Mechanisms of Gas Hydrates in Underwater Sediments, the Conditions of Formation and the Natural-Gas Emission Rates in the Environment». Duration: 2006-2007.
- Principal Investigator: Program of Scientific and Technological Collaboration between Greece and China: «Integrated Remediation System in Polluted Areas and Waste Disposal Areas using Novel Technological Approaches». Duration: 2004-2006.

RESEARCH RESULTS/PRODUCTS

- Development of the Novel Geostatistical Method of "Spartan Spatial Random Fields"
- New Methodology for the automatic detection of anisotropy in spatial data

SERVICES OFFERED TO THIRD PARTIES

- 1. Geostatistical Analysis of Spatial Data
- Statistical Analysis

Oil in Place Cumulative Distribution 100.0% O Multiple Variograms Realizations (High, Medium, 90.0% * Exponential1 (Best Fit) Reali -CDF (Best Fit Variogram) 80.0% CDF (H,M,L Realizations) 8 70.0% CDF (Multiple Variograms) bility Normal (Multiple Variogram 60.0% Normal (Best fit Variogram) Normal (H,M,L Realizations) 50.0% 40.0% 30.0% 20.0% 10.0% 39.00 41 00 42.00 40.00 Oil in Place (Mstb)









Drilling Engineering (39 hours, 5 ECTs)

- •Design and construction of vertical, deviated & horizontal wells
- Onshore and offshore explorations
- Pore pressure estimation
- •Drilling equipment and procedures
- Hydraulics
- Casing and cementing
- Well control









Drilling Engineering and Fluid Mechanics Research Unit

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ACTIVITIES

- Research and development of drilling fluids for oil and gas drilling and for shallow well drilling (water-wells, coring, wells for environmental purposes, geothermal wells)
- 2. Hydraulics of drilling fluids
- Rheology of water suspensions
- 4. Single and multi-phase flow of non-Newtonian fluids in annuli
- Cuttings transport and settling of solids through non-Newtonian fluids

SPECIALTY EQUIPMENT & INFRASTRUCTURE

- Flow system with horizontal annulus, 40mm by 70mm and 5m long, made of plexiglass equipped with cooling system
- Mass flow meter (Rheonik) for 0-650 kg/min flow rates, with temperature and density measurement
- Differential pressure sensor (Validyne) 0-0,125 psi και 0-6 psi.
- Water tank (750 l) with pvc piping (50mm)
- Centrifugal pump (10hp) giving 700-lpm at 4.4 bar, equipped with inverter for flow regulation
- 2 hp agitator for fluid preparation equipped with impellers
- Two filter presses, a low and a high temperature (LPLT & HPHT, API), for studying filtration characteristics of drilling fluids
- Couette viscometer with rotating outer cylinder, from Grace Instruments, 0.01-600 rpm, with thermal container to get to temperatures up to 80°C, 1 atm.
- Yield stress rheometer with a vane (Brookfield Instruments)

RESEARCH AND DEVELOPMENT PROJECTS

- AIFEO, Analysis of properties of drilling fluids, Study for minimization of permeability of cores by drilling fluids in oil-wells with addition of Greek lignite, Funding: Ministry of Education, Pythagoras II, Duration 2005-2006.
- Study for use of Greek lignite as additive for high temperature drilling fluids, Funding: IGME/EPAN, Duration 2002-2005 (completed).
- Incubator of Ideas of University students (UNISTEP), EC & Region of Crete, Innovative Actions, Duration 2003-2005.
- Network of Technology Supply RENTS', EC & Region of Crete, Innovative Actions, Duration 2003-2005.
- Regional Innovation Pole of Crete & UNISTEP+, EPAN & GSRT & Region of Crete, Duration 2007-2008.

RESEARCH RESULTS/PRODUCTS

Development of drilling fluid additive with lignites for use in high temperature wells

SERVICES OFFERED TO THIRD PARTIES

- 1. Measurements of rheology of slurries
- Studies of rheological and filtration properties of non-Newtonian fluids
- 3. Fluid flow in annuli, pressure drop measurements and predictions
- 4. Studies of cuttings transport
- 5. Innovation promotion / Development of Technology Parks







Production Engineering (39 hours, 5 ECTs)

- •Basic and advanced completion methods
- •Wellbore performance and nodal analysis
- Artificial and gas lift
- •Design of the surface facilities









Seismic Imaging and Well Logging (39 hours, 5 ECTs)

- Seismic reflection method for oil exploration and exploitation
- Seismic data acquisition techniques
- •Field surveys
- •2D, 3D, 4D, 3C surveys
- Seismic data processing techniques
- Wireline logging
- Logging while drilling





Applied Geophysics Laboratory

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ACTIVITIES

- 1. Magnetic, Gravity, Electromagnetic and Electrical mapping
- 2. Electrical sounding and tomography
- 3. Seismic refraction and reflection
- 4. Multichannel Analysis of Surface Waves (M.A.S.W.)
- 5. Seismic tomography
- 6. Ground Penetrating Radar (G.P.R.)
- 7. Geographical Information Systems (G.I.S.) in geophysics
- Classification of geophysical data
- Non Destructive Testing
- 10. Geotechnical parameters estimation using geophysical methods

SPECIALTY EQUIPMENT & INFRASTRUCTURE

Equipment:

- 24channel digital seismograph (GEOMETRICS ES 2401)
- 12 two-channel recorders DMT for seismic data
- SeisGun seismic source (Winchester, Betsy M3)
- Ground penetrating radar (GPR) with 5 antennas (PulseEkko 1000)
- Unit for electromagnetic profiling and mapping CM 031 (GF Instruments)
- VLF (WADI of ABEM)
- Unit for electrical tomography (Sting R1-Swift)
- Unit for electrical sounding and mapping (ABEM Terrameter + Booster)
- Proton magnetometer (GEOMETRICS)
- Differential magnetometer (GeoScan)
- Gravity meter Lacoste-Romberg, Model D –206

- Array of 12 hydrophones MP 25-250 SW (GeoSpace)
- Multichannel geophone cables
- Geophones
- 14 Hz, vertical and horizontal component geophones
- 4.5 Hz, vertical component geophones

Hardware:

- 2 work stations Suns (Unix-Solaris 2.5)
- 1 work station Sun-Blade (Unix-Solaris 2.8)
- 7 personal computers (Windows)
- 2 personal computers (Linux)
- 1 Laptop
- 2 laser printers
- 2 inkjet printers
- I plotter HP 750C
- 2 Scanners
- Software:
- Software for seismic data processing, PROMAX 2D and 3D(LANDMARK)
- Software for geophysical data processing, OASIS- montaj (GEOSOFT)
- Software for geophysical data processing, Neosys 1.3 (FORTNER)
- Software for inversion of electrical soundings, RESIX (INTERPREX)
- Software for processing G.P.R data, Pulse ekko, (SENSORS & SOFT-WARE)
- Software for electrical tomography data, 2D and 3D, (RES2DINV & RES3DINV, ADVANCED GEOPHYSICAL)
- Software-Geographical Information System ArcView GIS 3.2

RESEARCH AND DEVELOPMENT PROJECTS

- «Hybrid geophysical survey for imaging the saline water front at Stilos, Chania Perfecture, Greece». Funded by the Ministry of Education. Scientific Leader: Prof. A. Vafidis. (2005-2006)
- «Integrated geophysical methods for the detection of the saline water front at Stilos, Chania Perfecture, Greece. Funded by the General Secretariat of Research and Development, Greece». (2004 – 2005).
- «Monitoring of hydrocarbon pollution using modern geophysical methods». Funded by the General Secreteriat of Research and Development, Greece. Scientific Coordinator: Prof. A. Vafidis. 06/2004-11/2006.
- «Hybrid Geophysical technology for the Evaluation of Insidious contaminated Areas» European R&D project (HYGEIA/EVK4-2001-00046) Funded by E.U., 1/12/2001-31/11/2004.
- «Passive and active seismics in Western and Central Crete, Greece». Funded by the German Science Foundation. Scientific Leader: Prof. Hans-Peter Harjes. (1996 – 2006).









Reservoir Simulation (39 hours, 5 ECTs)

- Introduction to reservoir simulation
- •Types of reservoir simulation models
- •Black oil models
- •Compositional models
- thermal models
- •Reservoir simulation model set-up
- •Gridding in reservoir simulation
- •Block-to-block flow
- •Wells in reservoir simulatio
- •Numerical methods in reservoir simulation
- •Petrophysical input
- Pseudoization and upscaling
- History matching
- •Test cases







Special Topics in Petroleum Engineering (26 hours, 4 ECTs)

- Topics related to the physical behavior of reservoir rocks
- •Stress and strain
- Rock deformability
- Heterogeneity
- Fractures
- Fracture flow







Petroleum Economics and Law (26 hours, 4 ECTs)

- •Economic concepts involved in hydrocarbon exploration projects
- Project assessment
- Investments
- •Risk analysis
- Decision making







Available training Software:

•**Petroleum Experts** has granted to the TUC 10 licenses of its Integrated Production Modelling (IPM) suite, carrying an equivalent commercial value of 1,271,258.00 £.

•Schlumberger has granted to the TUC 5 licenses of its petroleum engineering software, carrying an equivalent commercial value of 4,676,806.40 \$

•Rock Flow Dynamics has granted to the TUC 60 licenses of its petroleum engineering software, carrying an equivalent commercial value of 9,000,000 \$







The Digital Oil Field IFM IVM ModelCatalogue IPM



Petroleum Experts (PETEX) is an engineering software company that develops sophisticated models that capture the physics, fluid thermodynamics and engineering complexity of oil and gas fields aiding the oil and gas companies to monitor, operate and efficiently produce their fields.



www.petex.com