University of Tripoli
Faculty of Engineering

PETROLEUM ENGINEERING DEPARTMENT
Graduate programs

Brief history

Oil production first started in Libya in 1961. However, the establishment of the first Petroleum Engineering (PE) Department was not achieved until the academic year 1969/1970, exactly in September 1969. At that time, the PE Department was at the Faculty of Engineering. This event was a beginning of the first plan toward Libyanization of the oil industry in the country through preparing and graduating engineers specialized in all branches of petroleum industry against the monopoly of the foreign companies.

Later on, in 1972 a specialized faculty was founded as the "Faculty of Petroleum and Mining Engineering" it was composed of six engineering departments: -

1. Petroleum Engineering,
2. Chemical Engineering,
3. Mining Engineering,
4. Metallurgical Engineering,
5. Geological Engineering
6. Geophysical Engineering.

However, experience showed that it was better to make the above-mentioned engineering branches belong to the main engineering faculty rather to be within an independent one, because it was found that many engineering courses, especially for the first three years, are offered by the main engineering faculty also. Therefore, to avoid duplication, these departments were annexed back to the Faculty of Engineering at the University of Tripoli in 1983.

In order, for the petroleum engineer, to bear the responsibility of his future career, he has to study at first for his Bachelor of Science (B. Sc.) degree the basic human and physical science courses, the basic general engineering courses, and the specialized hard core Petroleum Engineering courses. According to this, the curriculum was designed to cover a total of 151 credits within ten academic semesters. In addition to the specialization subjects, the student of the final year has to prepare graduation project related to one of the scientific or technical

problems in his field of specialization in order to test his ability in comprehension of what he has covered during his study and to train him in searching, designing, and problem solving.

The petroleum engineering graduate program started in the spring semester of 1992 with a total number of 5 students. This program, so far, is available for the Masters of Science (M. Sc.) enrollment only. As of the end of spring 2016, 35 students have been accepted in the program of which 12 students have graduated, 8 lift the program and 15 are still in the program.

Vision

1. Educate petroleum engineers with most recent knowledge and technical applications.
2. Provide the society with high professional engineers capable to perform their tasks in the most proper manners to meet the needs of oil industry, academic and research associations.

Mission

1. Provide graduated engineers with high quality of education and training through an effective teaching, research and modern computer applications.

2. Develop the ability of graduated engineers to conduct research and tackle real problems experienced in oil industry.

3. Emphasis on the rule of university to work as scientific technological research centre with full interaction with society and oil industry.

4. Prepare graduate engineers to continue for further education leads to PhD Programs.

Programs

The graduate program in the Petroleum Engineering Department offers M.Sc. degree in the petroleum engineering.

Program

PROGRAM	*Master of Science in Petroleum Engineering*
DEGREE	*M.Sc.*
OBJECTIVES	To develop the capabilities and knowledge of the engineers (B.Sc holders) by offering M. Sc. Degree in Petroleum Engineering

Code	Title	Credits	Hours	ECTS
Faculty Requirements (3 credits)				
GE604	Advanced Engineering Mathematics	3	4	8
GE609	Numerical Methods in Engineering	3	4	8
Department Requirements (12 credits)				
PE610	Advanced Reservoir Engineering **	3	4	8
PE620	Advanced Drilling Engineering **	3	4	8
PE630	Advanced Production Engineering **	3	4	8
PE640	Advanced Gas Engineering **	3	4	8
Elective courses (10 credits)				
PE602	Oil Field Technology	3	4	8
PE611	Advanced Formation Evaluation	3	4	8
PE617	Advanced Transient Pressure Analysis	3	4	8
PE618	Advanced Topics in EOR	3	4	8
PE619	Reservoir Simulation	3	4	8
PE621	Advanced Topics in Well Completion	3	4	8
PE622	Horizontal Wells Technology	3	4	8
PE623	Advanced Topics in Formation Damage	3	4	8
PE697	Special Topics	3	4	8
PE698	Graduate Seminar **	1	2	10
Thesis (6 Credits)				
PE699	M. Sc. Thesis	6	*0*	*50*
Total		**31**	**0**	**124**

*** Mandatory Courses* *ECTS: European Credit Transfer and Accumulation System*

Description of the Graduate Courses

- *Faculty General Courses*

GE604 Advanced Engineering Mathematics (3 *Credits* – 4 Hours)

Review of ordinary differential equations; linear differential equation of the first order; linear differential equations with constant coefficients; particular solutions by variations of parameters. Power series solutions; method of Frobenius; Legendre's equation; Fourier-Legendre Series; Bessel's equation; modified Bessel equation. Fourier methods; Fourier series; Sturm-Liouville theory; Fourier integral; Fourier transformation. Partial differential equations; heat conduction equation; separation of variables; waves and vibrations in strings; wave equation; D'Alembert's solution; longitudinal vibrations in an elastic rod; two dimensional stress systems; solution of Navier's equations by the application of Fourier transforms; Laplace equation.

GE609 Numerical Methods in Engineering (3 *Credits* – 4 Hours)

Interpolation; Linear interpolation, Lagrange and Aitkin's interpolating polynomials, Difference calculus, Newton forward and backward difference formula, curve fittings, least square approximations, Fitting nonlinear curves, Cubic spline, Chebyshev polynomials, Approximation with rational function ordinary differential equations, Analytical and computer-aided solutions, Boundary conditions, Taylor series method.

- *Department Courses*

- *Core courses*

PE610 Advanced Reservoir Engineering *(3 Credits – 4 Hours)*

General material balance equation (MBE) derivation, the MBE as an equation of a straight line, MBE for oil reservoirs, preparation of pressure, production and PVT data, effect of multi-zone production water influx models, radial influx models, Schilthius steady state model, Hurst transient model, Van Everdingen and Hurst model, Fetkovitch limited aquifer model, Allard and Chen bottom water drive model, Nabor and Barham linear water drive model are taught in the course. OILWAT software water coning in vertical and horizontal wells, calculating critical oil rate, calculating cone height and break-through time, after-break-through performance, water cut performance, fractional flow theory, importance of the viscous, gravity, and capillary forces, microscopic displacement mechanisms, capillary pressure and hysteresis effect of permeability variation, effect of natural fractures are also considered.

PE620 Advanced Drilling Engineering *(3 Credits – 4 Hours)*

Understanding the principles and techniques use for well planning including the design for proper mud weights, casing setting depth and hole sizes. This will be accomplished through the understanding of subsurface pore pressure and fracture gradients. The student will also learn how to optimize the weight on bit and rotary speeds as well as to control the bit and the drilling operation by the analysis of pf the

cost and penetration rate equations. Calculation of the frictional pressure losses as well as the cuttings slip velocity in the circulation system is determined for different drilling fluid types and for different flow regimes. Rotary drilling hydraulics theories will also be covered in detail which will be the basis to optimize the size of the bit nozzles and the equivalent circulation density as well as the mud lifting capacity. Techniques of well kick control will be discussed in theory and practice and they will be illustrated by design problems. Graphical design of surface, intermediate and production casing will be covered by a design problem. Technical software will be provided and practiced for each topic covered in the course.

PE630 Advanced Production Engineering *(3 Credits – 4 Hours)*

In which the student will be taught advanced topics and calculation procedures in production engineering related to the flow regimes inside the well and flow lines. Advanced topics related to artificial lifting are also considered in this course. Analysis of transient pressure tests in gas wells. Use of the production decline curve analysis. Finally the student will be aware of the most well known softwares available in the petroleum engineering.

PE640 Advanced Gas Engineering *(3 Credits – 4 Hours)*

Natural gas reservoirs material balance calculation for volumetric and water drive reservoirs, flow after flow and isochronal test analysis, vertical flow performance, gas-condensate reservoirs properties testing and sampling, estimation of gas initial in place (GIIP) by pressure depletion and by pressure maintenance, cycling operating problems, production performance, gas pipelines, horizontal flow equations, design of pipeline equipment and separation, metering, compression and processing of natural gas are the main subjects considered in the course.

- *Elective Courses:*

PE602 Oil Field Technology *(3 Credits – 4 Hours)*

In this course the student will learn about the types, applications, and design of two and three phase separators, oil treatment equipment, vapor recovery processes, gas treatment processes and equipment, gas flaring, produced water treatment and disposal, flow lines, gathering lines and transportation, oil, gas, and water metering, corrosion control.

PE611 Advanced Formation Evaluation *(3 Credits – 4 Hours)*

In which the student will be taught advanced topics in open hole logging, review of petrophysical parameters, rapid initial interpretation, log interpretation in complex lithology, computer processed interpretation, cased hole logging review of porosity tool principles, thermal decay time log, cement bond logging, production logs, effect of formation shales and clay, detailed study of shaly sand interpretation. Through-tubing production logging, logging devices, logging principles, single- / multi-phase fluid movement, tubing and casing leaks, primary cement evaluation, log interpretation current computer processing and interpretation, case studies and soft ware applications.

PE617 Advanced Transient Pressure Analysis *(3 Credits – 4 Hours)*

In this course the student is thought: step by step analysis of build-up tests in vertical oil wells. Analysis of transient pressure tests in horizontal wells. Analysis of transient pressure tests in hydraulically fractured wells. Analysis of transient pressure tests in gas wells. Analysis of transient pressure tests in horizontal wells. Finally the student will be aware of the most well known softwares available in the petroleum engineering.

PE618 Advanced Topics in EOR *(3 Credits – 4 Hours)*

Importance of EOR, mechanisms of improving the recovery. Displacement efficiency variables. Review of EOR methods. Water flooding injection and performance. Principles of phase behavior and miscibility. Types of miscible displacement, miscible slug, first contact miscibility, multiple contact miscibility (condensation and vaporization mechanisms). The minimum miscibility pressure and composition (MMP and MMC). $C0_2$ miscible and immiscible processes. Empirical correlations for defining the miscible limits. Miscibility performance prediction and miscibility project design. Introduction to other EOR processes. Thermal processes; types of steam injection, cyclic stimulation, forms of in-situ combustion, hot water injection. Chemical processes; micellar flooding, mobility control processes, polymer flooding, caustic flooding. Microbial flooding. Practical EOR aspects. NOC screening criteria of Libyan reservoirs.

PE619 Reservoir Simulation *(3 Credits – 4 Hours)*

Introduction to reservoir simulation, purpose, benefits, historical development, basic engineering concepts in reservoir simulation. Darcy's law, concept of permeability, flow potential, real gas flow, fluid types, steady and un-steady flow, formulation of the reservoir simulation equations for single-phase flow and multiphase flow regimes. Setting up the finite-difference model, discretization process, finite differences, first and second derivatives, explicit and implicit formulations. Crank-Nicholson scheme, grid definitions, irregular grids, stability criteria. Van Newman analysis and matrix methods, numerical solutions of the simulator equations implicit pressure-explicit saturation (IMPES) method, implicit pressure-implicit saturation method, up-stream and down-stream permeabilities. Beside the above-mentioned aspects of reservoir simulation, the student will know something about the practical aspects of data preparation, sources of information, structure and formation data, fluid and rock properties data, production data, pressure data, choice of the model, girding, initialization, history matching, forecasting, and development of a two-dimensional single-phase model.

PE621 Advanced Topics in Well Completion *(3 Credits – 4 Hours)*

The student will have a good idea about how to determine the thickness of the perforated interval in the oil and gas wells in order to control the water and gas coning into the well using log and core analysis data. Practical techniques for determining the original and producing water and/or gas contacts. Understanding the theory and techniques used in designing perforation patterns for the optimization of well productivity taking into consideration the economical and the technical constraints. Sizing surface and subsurface production systems utilizing different vertical and

horizontal multiphase flow correlations. Selections of the suitable well completion type based on the existing reservoir drive mechanism and movement of the water/oil or gas/oil contacts. Sand production analysis and method of control and prevention will be covered through the design of gravel pack treatments. Technical software will be provided and practiced for each topic covered in the course.

PE622 Horizontal Wells Technology *(3 Credits – 4 Hours)*

Drilling profile considerations, drill string and bottom hole assembly design, surveying techniques and logging, well completions, cementing, ECP and control, stimulation, formation damage in horizontal wells, producing zone data acquisition, acidizing, fracturing, flow regimes and productivity calculations: pseudo-steady state calculations, effect of permeability anisotropy, effect of well eccentricity, effective wellbore radius, transient pressure tests: analysis of different flow regimes, factors complicating the analysis, design of a build up test.

PE623 Advanced Topics in Formation Damage *(3 Credits – 4 Hours)*

The principles of rock and fracture mechanics will be covered as the basis for understanding the theory and practice of hydraulic fracturing which will be used to design the hydraulic fracturing treatments. The course will focus on the origin, causes and mechanisms of formation damage. The magnitude of formation damage will be determined through the analysis and interpretation of well testing procedures and techniques. Practical methods utilizing the water compatibility results will be discussed in theory and practice for the selection of the non-damaging well completions or workover fluids. The course will also focus on the fundamentals and design of matrix and fracturing acid treatments for restoring the original permeability by creating new wormholes or by the removal of formation damage in the well bore region.Technical software will be provided and practiced for each topic covered in the course.

PE697 Special Topics *(3 Credits – 4 Hours)*

The topics are not listed in department programs and may vary from year to year according to interests of students and instructors.
M.S. students choose and study a topic under the guidance of the department coordinator. Typical contents include advanced fields of study according to recent scientific and technological developments in the related areas. Also, it could be studied from other related departments after getting the permission.

PE698 Graduate Seminar (1 Credits - 2 Hours)

This course help students to develop their research proposals, establishing and expanding their research skills and implementing their work through scholarly writing, which can be achieved through the seminar.
The seminar course must to be taken in the second semester of the registration and managed by an instructor who is responsible to prepare the final grade list of all the registered students.

Students must prepare and present their chosen topics through a scientific term paper, which can be shared and discussed with other students and department staff to gain their feedback.

PE699 M. Sc. Thesis

Each graduate student has to undertake and complete a research topic related to a specific problem in the Petroleum Engineering. The full academic supervision will be the responsibility of a faculty member with a minimum degree of Associate Professor. However, cooperation of experts from the industry can be requested if recommended by the supervisor.

- ***Learning Objectives (outcomes)***

Upon completion of the Master of Science Program in the Petroleum Engineering, graduates are expected to be able to:

1- Successfully apply state of art (advanced concepts and practical application) of Petroleum engineering
2- Conduct research and tackle technical problems experienced in oil industry in most efficient and contributive manners.
3- Continue further education and joining higher studies program leads to PhD degree.
4- Compete for better career opportunities.

الاعتماد			
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