

THE UNDERGRADUATE CURRICULUM OF PETROLEUM ENGINEERING
DEPARTMENT/COLLEGE OF ENGINEERING/ UNIVERSITY OF Al Kitab, 2021-2022

The undergraduate curriculum and the syllabus are included:

The Undergraduate Curriculum:

First Year				1 st Semester, Hours/Week				2 nd Semester, Hours/Week			
No.	Code	Subject	Credits	Theoretical	Tutorial	Practical	Total hours	Theoretical	Tutorial	Practical	Total hours
1	PE100	General Geology	8	3	-	2	5	3	-	2	5
2	GE101	MathematicsI	6	3	1	-	4	3	1	-	4
3	GE102	Computer ProgrammingI	6	2	-	2	4	2	-	2	4
4	GE103	Statics and Dynamics	4	2	1	-	3	2	1	-	3
5	GE104	Engineering Drawing and Descriptive Geometry	4	1	1	2	4	1	1	2	4
6	GE105	Analytical Chemistry	3	2	-	2	4	-	-	-	-
7	GE106	Physics	3	-	-	-	-	2	-	2	4
8	GE107	Human Rights and Democracy	2	1	-	-	1	1	-	-	1
9	GE108	English LanguageI	2	1	-	-	1	1	-	-	1
10	GE109	Arabic Language	No credits	1	-	-	1	1	-	-	1
Total			38	16	3	8	27	16	3	8	27
Total Hours / Week				27				27			

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Second Year				1 st Semester, Hours/Week				2 nd Semester, Hours/Week			
No.	Code	Subject	Credits	Theoretical	Tutorial	Practical	Total hours	Theoretical	Tutorial	Practical	Total hours
1	PE200	Structural and Petroleum Geology	6	2	-	2	4	2	-	2	4
2	GE201	MathematicsII	6	3	1	-	4	3	1	-	4
3	GE202	Fluid Mechanics	5	2	2	-	4	2	2	2	6
4	PE203	Fundamentals of Petroleum Engineering	4	2	1	-	3	2	1	-	3
5	GE204	Computer ProgrammingII	4	1	-	2	3	1	-	2	3
6	GE205	Thermodynamics	3	3	1	-	4	-	-	-	-
7	GE206	Strength of Materials	3	-	-	-	-	2	1	2	5
8	PE207	Petroleum Properties	2	1	1	2	4	-	-	-	-
9	GE208	English LanguageII	2	1	-	-	1	1	-	-	1
		Total	35	15	6	6	27	13	5	8	26
		Total Hours / Week		27				26			

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Third Year				1 st Semester, Hours/Week				2 nd Semester Hours/Week			
No.	Code	Subject	Credits	Theoretical	Tutorial	Practical	Total hours	Theoretical	Tutorial	Practical	Total hours
1	PE300	Petroleum Reservoir EngineeringI	8	3	1	2	6	3	1	2	6
2	PE301	Petroleum Drilling EngineeringI	8	3	1	2	6	3	1	2	6
3	PE302	Well Logging	6	3	1	-	4	3	1	-	4
4	GE303	Engineering Mathematics	6	3	1	-	4	3	1	-	4
5	PE304	Petroleum Production EngineeringI	4	2	1	-	3	2	1	-	3
6	PE305	Petroleum Engineering Economics	4	2	-	-	2	2	-	-	2
7	GE306	Engineering Statistics	2	2	1	-	3	-	-	-	-
8	PE307	Geophysics	2	-	-	-	-	2	1	-	3
9	GE308	English LanguageIII	2	1	-	-	1	1	-	-	1
10	GE309	Summer Internship	No credits	-	-	-	-	-	-	-	-
Total			42	19	6	4	29	19	6	4	29
Total Hours / Week				29				29			

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Fourth Year				1 st Semester Hours/Week				2 nd Semester Hours/Week			
No.	Code	Subject	Credits	Theoretical	Tutorial	Practical	Total hours	Theoretical	Tutorial	Practical	Total hours
1	PE400	Petroleum Reservoir EngineeringII	6	3	2	-	5	3	2	-	5
2	PE401	Petroleum Production EngineeringII	6	3	2	-	5	3	2	-	5
3	PE402	Petroleum Drilling EngineeringII	6	3	2	-	5	3	2	-	5
4	PE403	Numerical Methods and Reservoir Simulation	6	2	-	2	4	2	-	2	4
5	PE404	Secondary Oil Recovery	6	3	-	-	3	3	-	-	3
6	PE405	Engineering Project	4	1	-	2	3	1	-	2	3
7	PE406	Gas Technology	3	3	-	-	3	-	-	-	-
8	PE407	Operations Research	3	-	-	-	-	3	-	-	3
9	GE408	English LanguageIV	2	1	-	-	1	1	-	-	1
Total			42	19	6	4	29	19	6	4	29
Total Hours / Week				29				29			

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The Syllabus:

FIRST YEAR

PE100: General Geology / 1st Semester & 2nd Semester / 8 Credits

Earth in space; shape and surface relief of the earth; matter and minerals; igneous, sedimentary and metamorphic rocks; weathering and soils; processes of erosion, transportation and deposition; ground water; crustal deformation (structural features) and mountain building movements; earthquakes and the earth's interior; keys to the past; time in geology; historical geology; plate tectonics and continental drift.

GE101: MathematicsI / 1st Semester & 2nd Semester / 6 Credits

Types of functions (trigonometric; inverse trigonometric functions, logarithmic functions, exponential functions, transcendental functions, other types of functions, graph of functions); Differentiation (explicit and implicit; application of derivatives in graphing); Integrals (integrals as a summation of areas; definite integrals, applications of definite integrals, areas and volumes; techniques of integration); determinants and matrices, conical section; Introduction to polar coordinates.

GE102: Statics & Dynamics / 1st Semester & 2nd Semester / 4 Credits

Static & dynamic principles; resultant of forces; friction; center of gravity; moment of inertia; rectilinear motion; curvilinear motion; rotation; energy & work; mechanical vibration.

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GE103: Computer ProgrammingI / 1st Semester & 2nd Semester / 6 Credits

Computer fundamentals, computer components, computer safety and software licenses, operating systems, the basic tasks of Microsoft Excel, inserting objects in Microsoft Excel, create mathematical formulas in Microsoft Excel, additional tasks in Microsoft Excel, an introduction to Microsoft Word, Inserting objects into Microsoft Word, additional tasks for Microsoft Word, an introduction to Microsoft PowerPoint, inserting objects and adding animations in Microsoft PowerPoint.

GE104: Engineering Drawing and Descriptive Geometry / 1st Semester & 2nd Semester / 4 Credits

Engineering Drawing: Introduction, instruments & their use; applied geometry; dimensions & lettering; orthographic drawing & sketching; pictorial drawing & sketching auxiliary view; section; convection & assembly; projection in general; Representation of points, lines, and planes; types of planes; application of lines and planes; development of surfaces; determination of true lengths of straight lines by revolution and auxiliary planes; traces of planes; finding line of intersection of planes by traces and projections.

GE105: Analytical Chemistry / 1st Semester / 3 Credits

Theory: Review of basic concepts; stoichiometry; chemical reaction and heat; organic chemistry; fuels; various batteries and electronic cells; principles of corrosion; water for domestic uses; industrial water; atmospheric pollution.

GE106: Physics / 2nd Semester / 3 Credits

Units, Physical Quantities, and Vectors; Two-dimensional force systems; Two dimensional moments; Motion along a straight line; Displacement, Time, and average velocity, Newton's laws of motion, Harmonic motion; Fluid Principles Fluid, density, Pressure in a fluid, Depth, and Pascal's law, Absolute Pressure and Gauge Pressure, Archimedes's principle, the Continuity

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equation, Bernoulli's Equation; Temperature and Heat, Temperature and Thermal Equilibrium, The Zeroth Law of Thermodynamics, Thermometers and Temperature Scales; Gas Thermometers and Kelvin Scale, Thermal Expansion, Thermal Expansion of Water, Thermal Stress, Quantity of Heat, Specific Heat, Heat Transfer, Conduction, Convection, Radiation; Equilibrium and Elasticity, Conditions for Equilibrium, Center of Gravity, Stress, Strain, and Elastic Module, Tensile and Compressive Stress and Strain, Shear Stress and Strain. Electric Charge and Electric Field, Fundamental Electric Constants, Particles and waves, atomic structure, Electric field of a point charge, Electric-field calculations, Electromagnetic field.

GE107: Human Rights and Democracy & / 1st Semester & 2nd Semester / 2 Credits

GE108: English LanguageI / 1st Semester & 2nd Semester / 2 Credits

New Headway Plus/ Beginner

GE109: Arabic Language / 1st Semester & 2nd Semester / No Credits

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SECOND YEAR

PE200: Structural and Petroleum Geology / 1st Semester & 2nd Semester / 6 Credits

Mechanics of structural deformation; folds, faults, and joints; unconformities; sedimentary environments; origin of oil: generation, migration and accumulation of petroleum; source rocks; reservoir rocks, cap rocks, traps (types and discovering techniques); reservoir mechanics (pressure, temperature, reservoir energy); subsurface mapping; oil field waters, Iraq and Middle East oilfields.

GE201: MathematicsII / 1st Semester & 2nd Semester / 6 Credits

Polar coordinates (graphs in polar coordinates; arc length and areas in polar coordinates); Vectors in two and three space (Cross products; Vector valued functions; Motion along curves; differentiation and integration of vector valued functions); Infinite series (divergence and convergence of series, Taylor and Maclaurian series); Functions of more than one variable (Partial differentiation; Extreme values, gradients; Lagrange multiplier); Multiple integrals, change of order; change from Cartesian to polar coordinates; first order differential equations; introduction to second order differential equations.

GE202: Fluid Mechanics / 1st Semester & 2nd Semester / 5 Credits

Dimensions & units, process variables; physical state; overall mass balance; overall energy balance; overall momentum balance, concept of fluid behavior; Newtonian and non-Newtonian fluids, flow measurements; Pitot tube; Venturi meter, orifice meter; Rota meter; some design equations for the flow of incompressible fluids; friction losses in pipes and fittings; two-phase flow; fluid machinery.

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PE203: Fundamentals of Petroleum Engineering / 1st Semester & 2nd Semester / 4 Credits

Elements of petroleum engineering; origin of petroleum; reservoir rock properties and fluid distribution; volumetric calculations of oil in place: natural forces in oil and gas reservoirs; oil exploration; rotary drilling; rig components; casing, cementing and well completion; well logging; surface equipment; Iraqi oil fields.

GE204: Computer ProgrammingII / 1st Semester & 2nd Semester / 4 Credits

Matlab.

GE205: Thermodynamics / 1st Semester / 3 Credits

Temperature and heat: temperature, heat, specific heat, calorimetric, change of phase, thermal equilibrium. Thermal expansion: linear, areal, and volume expansion of solids, volume expansion of liquid and gases, Charles's law, Boyle's law, the ideal gas law, kinetic theory of gases, real gases, equations of state. Application of the concept of work to a thermodynamic system, heat added and removed first law of thermodynamics, some special cases of the first law (the gasoline engine, the ideal heat engine, and the Carnot cycle). The second law of thermodynamics: heat engine and the second law, refrigeration and the second law, reversibility, entropy, statistical interpretation of entropy. Binary system, multi-component system, bubble point, dew point, phase envelop, critical pressure-critical temperature.

GE206: Strength of Materials / 2nd Semester / 3 Credits

Stress; simple stress, shearing stress, bearing stress, thin wall cylinders, strain, stress diagram, Hook law, Poisson's ratio, thermal stress; torsion; torsion formula, flanged bolt; coupling helical springs; shear and bending moments diagrams; analytical and graphical deflection; buckling; special topics.

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PE207: Petroleum Properties / 1st Semester / 2 Credits

Crude Oils (chemical composition, classification, properties); density, specific gravity and coefficient of expansion; viscosity, molecular weight; vapor pressure, specific heat; latent heat; heat of combustion; boiling range, flash point; pour point, sulfur content; aniline point; penetration number; softening point; crude oil evaluation; fractional distillation and TBP curve; analysis of fraction; dehydration of crude oil; natural gas properties; oilfield water properties.

GE208: English LanguageII / 1st Semester & 2nd Semester / 2 Credits

New Headway Plus/ Pre-Intermediate

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THIRD YEAR

PE300: Petroleum Reservoir EngineeringI / 1st Semester & 2nd Semester / 8 Credits

Types of traps; Fluids distribution; Types of oil reservoirs; Porosity, compressibility; permeability; Poueseli law, Kozeny Equation, Darcy's law; measurements of permeability, Klinkenberg effect; Gas flow equation; Radial flow; Productivity equation; radial flow of gas; average permeability for stratified reservoirs; Flow through channels and fractures; Saturation; Capillary pressure; Wettability; Multiphase flow through porous media; Linear flow (piston like, leaky piston); Effective and relative permeability; Calculation of relative permeability; Fractional flow equation; Buckley-Leveret equation; Gas properties (Boyle and Charles laws; Avogadro law; Dalton law, equation of state); compressibility factor; liquids properties (PVT); viscosity, classification of reservoirs according to P-T diagram, Phase behavior; calculation of bubble point and dew point; behavior of non-ideal liquids; flash and differential degassing; determination of reservoir liquids; properties of formation water; Volumetric calculation of reservoirs; Isobar, Isopach, Isoporosity and bubble maps. Material balance equation; Material balance for water derives and gas derive reservoirs; Calculation of reservoir pressures.

PE301: Petroleum Drilling EngineeringI / 1st Semester & 2nd Semester / 8 Credits

Introduction to drilling; classification of drilling operations; Properties and functions of drilling fluid; types and properties of clay in water; types of drilling fluids; drilling hazards dependent on mud control; drilling mud calculations, drilling methods (cable tool drilling, rotary drilling), basic component of rotary drilling equipment; drilling string and accessories; types of bits; casing of oil wells; functions of casing, types of casing, strings, parameters of casing design, selection of casing and bit types, design of string, graphical design of casing; cementing of oil wells, classification and properties of cements,

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classification of cementing operations, cementing equipment, methods and calculations of cementing; Hydraulics of primary cementing operations.

PE302: Well Logging / 1st Semester & 2nd Semester / 6 Credits

Basic rock properties, petrophysics; SP log; conventional resistivity log, induction log; lateral log, macro resistivity log, sonic log, density log, neutron log, gamma ray log, TDT log, CBL log and quick method in (HC) detection.

PE303: Engineering Mathematics / 1st Semester & 2nd Semester / 6 Credits

Ordinary differential equations, partial differential equations, solutions of ordinary differential equations, applications of first and second order ordinary differential equations; Solutions by Laplace transforms; Bessel Functions; Fourier Series; Taylor Series; Numerical Methods.

PE304: Petroleum Production EngineeringI / 1st Semester & 2nd Semester / 4 Credits

Well completion operations (parameter of design, completion methods, equipment, completion fluids); perforation of oil and gas wells (perforation methods, selection of perforation intervals); water and gas coning; methods for determining oil production rate without coning; completion efficiency, drill stem test (DTS) (test method, equipment, pressure versus time curve, theory of pressure buildup, reservoir properties obtained, depletion); Helical buckling of tubing (forces, homogeneous completion, packers permitting free and limited motions, compound completion of wells); surface gathering systems (types of gathering systems, behavior of fluid flow, flow lines, essential flowing lines, valves); separation of oil, gas, & water (types of separators, components of separators and functions); oil storage (storage tanks and accessories, calibration, measurement of liquid level); Production by pumps (sucker and submersible pumps).

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PE305: Petroleum Engineering Economics / 1st Semester & 2nd Semester / 4 Credits

Oil and gas reserve, organizations of petroleum exporting and importing countries, international supply and demand of petroleum, classification of petroleum, petroleum pricing, alternative energy, international strategy of energy, time value of money, types of interest rates, rate of return, methods of engineering decisions, depreciation, depletion, amortization, taxation, inflation, sensitivity analysis of engineering projects, risk analysis production decline curves, evaluation of future production of oil and gas well sand Expenditure and Net present value.

GE306: Engineering Statistics / 1st Semester / 2 Credits

Importance of statistics; descriptive and inferential statistics; pictorial description of data; random sample selection; data classifications; frequency distributions; cumulative frequency distributions; graphical representation of data histograms; frequency polygon; measures of probability variation and the binomial distributions; Poisson distribution; normal distribution; correlation and regression analysis.

PE307: Geophysics / 2nd Semester / 2 Credits

Gravity prospecting: principles, instruments, field measurements & reductions; interpretations; seismic prospecting: wave propagation, instruments, refraction and reflection methods, interpretation; magnetic prospecting: principles, instruments, measurements & interpretation; airborne magnetometer.

GE308: English LanguageIII / 1st Semester & 2nd Semester / 2 Credits

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FOURTH YEAR

PE400: Petroleum Reservoir EngineeringII / 1st Semester & 2nd Semester / 6 Credits

Fundamental concepts; oil reservoirs: depletion drive; gas cap drive, water drive, gravity drainage reservoir, combination drive reservoirs; pressure maintenance; secondary recovery; gas reservoirs; gas- condensate reservoirs; miscellaneous subjects.

PE401: Petroleum Production Engineering II / 1st Semester & 2nd Semester / 6 Credits

Types of reservoirs and radial flow in the reservoirs, productivity index, inflow performance relationship (IPR), effect of stratification and water cut on IPR, productivity index test, Vogel method, Standing method, Couto method, Fetkovich method, Al-Saadoon method, mathematical and physical principles for pressure drop calculations, flow pattern and its relation with pressure drop, Poettman and Carpenter method, Dukler method, working charts, analysis of choke performance, prediction of restricted and unrestricted production, effect of other parameters on well performance, derivation and solutions of diffusivity equation, application of Horner solution, multi-rates test, build-up test ,draw-down test, effect of skin factor on well testing, analysis.

PE402: Petroleum Drilling EngineeringII / 1st Semester & 2nd Semester / 6 Credits

Casing landing (landing as cemented, landing in tension at the freeze point, landing in compression at the freeze point); buckling phenomenon, wellhead loads, blowout and blowout prevention, well kick (methods of control, driller's method, engineer's method); factors affecting drilling rate (effect of pressure, effect of physical properties of drilling mud, effect of weight on bit and rotary speed, economical effect), hole problems (pipe sticking, surge and swab pressure, hole deviation);

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directional drilling; factors affecting hole inclination of directional wells; types of directional wells; geometry of a directional well; methods of calculations of directional wells; horizontal drilling; types of horizontal wells; air drilling; design of air drilling operations.

PE403: Numerical Methods & Reservoir Simulation / 1st Semester & 2nd Semester / 6 Credits

Interpolation, (Linear; Lagrange); Matrices, Review of matrix properties, Determinants, inverse of matrix; Solution of system of linear equations (Gaussian elimination, Gauss Jordan method, Jacobi method, Gauss Seidel method); Least square method (Linear equations; Polynomial equations); Reservoir simulation (Introduction, types of simulators); Flow through Porous Media (derivation of single-phase, one-dimensional flow equation. Two and three-dimensional flow equation); , finite Difference Method (Taylor series; Forward difference; Backward difference; Central difference; Concepts of explicit and implicit methods); Solution of system of difference equations (tridiagonal algorithm); Use of Irregular Gridding: Transmissibility; The finite difference form of the flow equation in terms of Transmissibility; Averaging of rock and fluid properties; Solution of radial form of the flow equation; Two dimensional flow, setting up the finite difference form; Ordering schemes; Standard row ordering; Standard column ordering: Resulting matrix structure; Introduction to multi-phase flow through porous media.

PE404: Secondary Oil Recovery / 1st Semester & 2nd Semester / 6 Credits

Principles and definitions, choice of proper methods for enhanced oil recovery, recovery by water displacement, Buckley-Leveret method, Weldge method, Stiles method, original and improved Dykstra-Parsons method, pattern of flooding, sweep efficiency, properties of injected water, injected pressures, recovery by immiscible gas, Tamer method, Muskat method,

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recovery by miscible gas, dry gas injection, enriched gas injection, CO₂ injection, N₂ injection, thermal recovery, heat flow through rocks, steam injection, insitu combustion, tertiary oil recovery, surfactant flooding, solvent injection, polymer injection.

PE405: Engineering Project / 1st Semester & 2nd Semester / 4 Credits

To implement an engineering project requires a group of students to study one of the problems focused/related to petroleum engineering under the supervision of the faculty members. Each group should submit a presentation, documented project before the discussion session, the faculty committee which is assigned by the department.

PE406: Gas Technology / 1st Semester / 3 Credits

Properties of gases; Gas system analysis; Gas flow through P. M.; Gas transportation; Gas treatment & liquefaction; Gas sweetening and dehydration.

PE407: Operation Researches / 2nd Semester / 3 Credits

Introduction, applications in optimization, Linear programming, applications in linear programming, Graphical method, applications in graphical method, Simplex method, applications in simplex method, Transportation method, applications in transportation method, Nonlinear programming, applications in nonlinear programming, Lagrange multiplier method, applications in Lagrange multiplier method.

GE408: English LanguageIV/ 1st Semester &2nd Semester / 2 Credits

New Headway Plus/ Upper-Intermediate