

Petroleum Production

1. **Course number and name:** 020PRPCS5 Petroleum Production
2. **Credits, contact hours:** 3 ECTS credits, 3x1:15 contact hours
3. **Names of instructors:** Bassam Riachi
4. **Instructional materials:**
 - Course handouts
 - References
 - Petroleum production systems, Micheal J. Economides, 2013
 - Petroleum Engineering Handbook, Larry W. Lake, Volume IV Production Operations Engineering, 2006
5. **Specific course information**
 - a. **Catalog description:** A course on theoretical and practical methods of calculations and operations of petroleum production: Production from Undersaturated, two-phase and NG Oil Reservoirs; Wellbore Flow Performance and deliverability; Forecast of well production; Artificial production; Well stimulation techniques
 - b. **Prerequisites:** 020MEFCS2 Fluid mechanics - 020DTFCS3 Drilling technologies
 - c. **Required/Selected Elective/Open Elective:** Selected Elective
6. **Specific goals for the course**
 - a. **Specific outcomes of instruction:**

By the end of the course, the students will be able to:

 - Identify, classify and explain basic types of petroleum reservoirs
 - Determine and identify thermodynamic states of reservoirs
 - Perform calculations on reservoir properties: porosity, permeability, compressibility, viscosity, density, specific gravity, bubble point pressure, oil and gas formation volume factors, solution and produce oil/gas ratio, water saturation, original oil/gas in place ...
 - Identify and explain production systems components
 - Perform calculations and analysis of production from undersaturated, two-phase and NG reservoirs, (Darcy and non-Darcy flow)
 - Apply fluid mechanics equations and theories to solve problems of flow in well bores and chokes
 - Construct and analyze Inflow Performance Relationship IPR and Vertical Flow Performance VFP
 - Identify, analyze and perform design calculations of different artificial lift production systems: gas lift, pump assisted lift
 - Perform material balance for reservoirs and apply theories of petroleum production forecast
 - Identify different stimulation techniques such as acidizing and hydraulic fracturing

b. PIs addressed by the course:

PI	1.1	1.2	1.3	2.1	2.2
Covered	x	x	x	x	x
Assessed	x	x	x	x	x

7. Brief list of topics to be covered

- **Production from Undersaturated Oil Reservoirs:** Steady-State Well Performance; Transient Flow of Undersaturated Oil; Pseudosteady-State Flow; Transition to Pseudosteady State from Infinite Acting Behavior; Wells Draining Irregular Patterns; Inflow Performance Relationship; Effects of Water Production, Relative Permeability
- **Production from Two-Phase Reservoirs;** Properties of Saturated Oil; Two-Phase Flow in a Reservoir; Oil Inflow Performance for a Two-Phase Reservoir; Generalized Vogel Inflow Performance; Fetkovich's Approximation
- **Production from Natural Gas Reservoirs;** Gas Gravity; Real Gas Law; Correlations and Useful Calculations for Natural Gases; Pseudocritical Properties from Gas Gravity; Presence of Nonhydrocarbon Gases; Gas Compressibility Factor Correction for Nonhydrocarbon Gases; Gas Viscosity; Gas Formation Volume Factor; Gas Isothermal Compressibility; Approximation of Gas Well Deliverability; Gas Well Deliverability for Non-Darcy Flow; Transient Flow of a Gas Well
- **Wellbore Flow Performance;** Single-Phase Flow of an Incompressible, Newtonian Fluid; Laminar or Turbulent Flow; Velocity Profiles; Pressure-Drop Calculations; Annular Flow; Single-Phase Flow of a Compressible, Newtonian Fluid; Multiphase Flow in Wells; Holdup Behavior; Two-Phase Flow Regimes; Two-Phase Pressure Gradient Models; Pressure Traverse Calculations
- **Well Deliverability;** Combination of Inflow Performance Relationship (IPR) and Vertical Flow Performance (VFP); IPR and VFP of Two-Phase Reservoirs; IPR and VFP in Gas Reservoirs
- **Gas Lift;** Well Construction for Gas Lift; Continuous Gas-Lift Design (Natural versus Artificial Flowing Gradient; Pressure of Injected Gas; Point of Gas Injection; Power Requirements for Gas Compressors); Unloading Wells with Multiple Gas-Lift Valves; Optimization of Gas-Lift Design; Gas-Lift Performance Curve; Gas-Lift Requirements versus Time
- **Pump-Assisted Lift;** Positive-Displacement Pumps (Sucker Rod Pumping; Progressing Cavity Pumps); Dynamic Displacement Pumps (Electrical Submersible Pumps); Lifting Liquids in Gas Wells; Plunger Lift
- **Forecast of Well Production;** Transient Production Rate Forecast; Material Balance for an Undersaturated Reservoir and Production Forecast Under Pseudosteady-State Conditions; The General Material Balance for Oil Reservoirs; Production Forecast from a Two-Phase Reservoir: Solution Gas Drive; Gas Material Balance and Forecast of Gas Well Performance

- **Introduction to Acidizing:** Matrix Acidizing: Acid/Rock Interactions; Sandstone Acidizing Design; Carbonate Acidizing Design
- **Introduction to Hydraulic Fracturing**