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 technology

   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 Fow 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 Fow 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**