Course Number: 28606

Course Name: Multiphase Flows in Porous Media

Course Type: Optional	Type & Max Unit: 3 theory
Prerequisite: None	Co-requisite: None
Level: MSc and PhD	First Presentation:
Group:	Last Edition: 25 Oct 2017

Objectives:

This course introduces physics of multiphase fluid (such as hydrocarbon mixtures) flows in natural porous media (such as oil and gas reservoirs). The course presents various physical and mathematical models used for such flows and analytical and numerical methods for solving the governing equations are presented. Materials in this course were designed with particular emphasis on their applications in hydrocarbon reservoir engineering.

Topics:

1. Introduction and applications
2. Physical properties of porous media (porosity, permeability, wettability, …)
3. Physical properties of multi-component multi-phase fluids (density, viscosity, capillary pressure, interfacial tension, …)
4. Basic assumptions and governing equations for multiphase flows in porous media
5. Thermodynamics of mixtures (stability and phase equilibrium), equation of state, flash calculations
6. Darcy's law for single phase flows and its extension to multiphase flows
7. Other effects: compressibility, miscibility, non-Darcy effects, heterogeneity, anisotropy
8. Fractured reservoirs: Dual porosity and dual permeability models
9. Two-phase incompressible flows: Buckley-Leverett equations
10. Three-phase flows: black-oil and compositional models
11. Numerical solution of governing equations

References:

1. P. Donnez, Essentials of Reservoir Engineering, TECHNIP, France, 2007.
2. J. Bear, Dynamics of Fluids in Porous Media, Dover Publications, 1988.

3. K. Aziz and A. Settari, Petroleum Reservoir Simulation, Applied Science Publishers, London, 1979.
4. Z. Chen, Reservoir Simulation-Mathematical Techniques in Oil Recovery, SIAM, 2007.
5. Z. Chen, G. Huan, Y. Ma, Computational methods for multiphase flow in porous media, SIAM, 2006.
6. N. Ezekwe, Petroleum Reservoir Engineering Practice, Prentice Hall, 2011.
7. K. Vafai, Handbook of Porous Media, 2nd Ed., CRC Press, Taylor & Francis Group, 2005.
8. T. Ahmed, Reservoir Engineering Handbook, 3rd Ed., Elsevier, Gulf Professional Publishing, 2006.
9. T. Ertekin, J.H. Abu-Kassem, G.R. King, Basic Applied Reservoir Simulation, SPE, Texas, 2001.
10. R. Cosse, Basics of Reservoir Engineering, Technip, 1993.
11. A. Danesh, PVT and Phase Behaviour of Petroleum Reservoir Fluids, Elsevier, 1998.