
Instructors

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Course Materials
Recommended Textbook

- Unconventional Oil and Gas Resources: Exploitation and Development
By: Dr. Usman Ahmed & Dr. Nathan Meehan
Available at University of Alberta library: [Unconventional oil and gas resources: exploitation and development - University of Alberta](#)
- Presentation slides and complementary course materials will be uploaded regularly on Canvas.

Course Description

This course covers fundamental reservoir engineering concepts, hydrocarbon production techniques, rock characterization, and rock-fluid interactions in unconventional reservoirs. Students examine hydraulic fracturing operations and well completion methods to understand complex flow geometry. The course introduces modern frameworks for flowback and production data analysis to estimate effective fracture volume, fracture surface area, and stimulated reservoir volume. Using available public data through GeoLOGIC systems, students gain hands-on experience collecting and analyzing field data, with a focus on current production practices in the Western Canadian Sedimentary Basin. Special core analysis methods, including tight rock analysis and Rock-Eval pyrolysis, are reviewed to build a bridge between laboratory-scale petrophysics and field-scale performance for sweet spot identification. Students evaluate the performance of major Canadian formations such as Montney and Duvernay, examine enhanced oil recovery techniques using field pilot and lab data, and participate in laboratory tours to observe core-to-field scale workflows firsthand.

Course Evaluation

Components	Due Dates	Weight (%)
Homework (4 assignments)	10 days after being posted on Canvas	40
Midterm exam	TBD	20
Final exam	TBD	40

Course Prerequisites

Open to undergraduate and graduate students across Engineering (Petroleum, Chemical, Civil and Environmental, and Mechanical) and Science (Earth and Atmospheric, Geophysics). Students with strong background in fluid flow in porous media from other disciplines are also encouraged to take the course.

Course Outline

**Chapter 1****Introduction to Unconventional Resource Plays**

- Introducing classic and modern definitions of unconventional resources
- Introducing shales as resource plays and reservoirs and the challenges
- Reviewing major shale and tight resources in North America and worldwide
- Identifying and evaluating the resource potential

Chapter 2**Fracturing Operations and Completion Design in Horizontal Wells**

- Reviewing horizontal drilling and multistage hydraulic fracturing techniques
- Identifying and optimizing design parameters of multistage-fracture completion
- Introducing novel techniques in fracturing and completion of horizontal well-pads

Chapter 3**Flowback and Production Data Analysis**

- Exploring the dynamics of hydraulic fracturing treatments, shut-in strategies, and water flowback behavior
- Estimating effective fracture volume by analyzing high-resolution pressure and rate data measured during the flowback period
- Characterizing fracture network complexity and rock-fluid interaction through flowback water salinity tracking and geochemical fingerprinting
- Introducing dual- and triple-porosity analytical models for production data analysis of multifractured horizontal wells
- Characterizing fracture network using production data analysis. Case studies from Western Canadian Sedimentary Basin

Chapter 4**Sweet Spot Identification in Tight and Shale Reservoirs**

- Reviewing classical petrophysical techniques for characterizing tight/shale rocks
- Introducing advanced laboratory techniques for characterizing hydrocarbon flow in tight/shale rocks
- Establishing the link between laboratory observations and field-scale production performance
- Applying type curves and production data analysis to identify sweet spots in the Montney and Duvernay Formations

Chapter 5**Improving Hydrocarbon Recovery from Tight and Shale Reservoirs**

- Understanding the primary mechanisms driving low recovery factors in tight and shale reservoirs
 - Reviewing the current industry practices designed to enhance hydrocarbon recovery from tight and shale reservoirs
 - Evaluating the performance of chemical additives applied both during and post-fracturing operations
 - Evaluating solvent-based EOR methods, field feasibility, and operational challenges
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