COURSE OUTLINE

Title: PtE 582
Fluid Flow and Transport Processes in Porous Media

Description: This is a graduate engineering course in fluid flow and transport processes in porous media. We study mass, momentum and energy transport in single- and multiphase flow in porous media. Emphasis is placed on use of classical methods for describing these processes. Surface and interfacial phenomena are also presented. Application of theory to various problems in petroleum engineering and groundwater hydrology are emphasized.

Instructor: V.M. (Vic) Ziegler
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Meeting Dates: Wednesdays 6:40-9:10 p.m. (Starts Aug. 27)
Office hours – 4:00-6:00 p.m. Wednesdays - HEDCO Lecturer Office

Place: OHE 136

Text: Selected SPE papers and notes

Additional References

R.E. Collins, *Flow of Fluids Through Porous Materials,* Petr. Pub. Co., 1976.

J. Bear, *Dynamics of Fluids in Porous Media,* Elsevier, 1972; Dover, 1988.

Grading:

Weekly Homework	100 points *(10 of 11 HW counted)*	
Midterm	175 points (October 15)	
Term Project	50 points (December 3)	
Final	175 points (December 10)	
Total	500 points	

Term Project: Individual solution of an engineering problem of medium complexity related to the course material. Projects to be chosen from a specified list.

SUBJECT	DATE(S)
Structure and Properties of Porous Media	8/27
Statics of Fluids in Porous Media	9/3
Interfacial Phenomena	9/10-9/17
Single-Phase Flow	9/24
Unconfined Flow (Gravity Drainage)	10/1
Solution Gas Drive Process *(Review of Term Project topics)*	10/8
Midterm Exam	10/15
Immiscible Displacement	10/22– 10/29
Flow Instabilities and Mobilization of Residual Phases	11/5
Miscible Displacement, Dispersion and Reactive Flow	11/12
Chromatographic & Energy Transport Methods	11/19
Energy Transport	12/3
Final Exam	12/10

<u>Term Project List</u>

<u>Engineering Problems: (Document in a PowerPoint file and an Excel workbook or computer code – *preferably FORTRAN, but MatLab or C++ are acceptable*)</u>

1. Develop a spreadsheet tool for predicting gravity drainage performance in a horizontal well completed in a dipping oil reservoir.
2. Develop a spreadsheet tool for predicting the performance of gravity drainage aided by gas injection in a horizontal reservoir.
3. Develop a spreadsheet tool for estimating waterflood performance in a layered, linear reservoir.
4. Determine reservoir conditions under which foam would be a suitable injectant for achieving mobility control (i.e., $M \leq 1$) in an enhanced oil recovery (EOR) process.
5. Extend Koval's method for predicting miscible displacement to include the effects of gravity and inaccessible pore volume.
6. Develop an analytical model for predicting oil recovery from a fractured reservoir by hot water injection.
7. Build a 1-D finite-difference simulator for predicting the single-phase transport of a chemical subject to both adsorption and reactive decay. Predict solute profiles. Compare against analytical solutions.
8. Build a spreadsheet model to predict the rate of reservoir cooling in a steamflood reservoir following the cessation of steam injection.
9. **Any other approved problem, which is related to your work or research.**

Reading List: PtE 582, Fall 2014

V. M. Ziegler - Lecturer

Lecture(s)	Reading List
Structure and Properties of Porous Media	Collins, R.E.: Flow of Fluids .., Chptr. 1, SPE 574 (Fatt)
Statics of Fluids in Porous Media	Collins, R.E.: Flow of Fluids .., Chptr. 2, SPE 110050 (Comisky et al)
Interfacial Phenomena	SPE 1361-G (Handy), SPE 68837 (Zhou et al)
Single-Phase Flow	Bear, J.: Dynamics of Fluids…, Chptr. 4
Unconfined Flow (Gravity Drainage)	SPE 665-G (Matthews & Lefkovits), SPE 6548- PA (Dykstra) Bear, J.: Dynamics of Fluids…, Chptr. 9, Section 4
Solution Gas Drive	SPE 797-G (Handy)
Immiscible Displacement	SPE 7660 - PA (Pope)
Flow Instabilities and Mobilization of Residual Phases	SPE 5050 (Abrams)
Miscible Displacement, Dispersion and Reactive Flow	SPE 480 (Perkins & Johnston), SPE 450 (Koval)
Chromatographic Transport Methods	SPE 16263 (Hong & Shuler)
Energy Transport	Lauwerier, H.A.: Appl. Sci. Res. Sec. A, 5, No. 2-3, 145-150 (1955)

12 papers