ENHANCED OIL RECOVERY - PET E 471

WINTER 2025

Dr. Tayfun Babadagli

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OFFICE HOURS: Anytime if the instructor is available, if not, ask for an appointment.

MEETING HOURS: Monday-Wednesday-Friday - 13:00-13:50, NRE 2-090
OFFICE HOURS: Anytime if the instructor is available, if not, ask for an appointment.

Teaching Assistants:
Lixing Lin (lixing.lin@ualberta.ca)

COURSE OUTLINE and SCHEDULE

1. Basic concepts in multiphase flow in porous media (rel. perm., cap. pressure, wettability). **1 wk.**
2. Natural drive mechanisms. Why EOR? Microscopic and macroscopic sweep efficiency. **1 wk.**
3. General classification of enhanced oil recovery methods. Screening criteria. **1 wk.**
4. Waterflooding. Buckley-Leverett Equation. **1 wk.**
5. Water cut, Welge approach:1-D waterflooding performance estimation **1 wk.**
6. Heterogeneity and its effect on EOR. Stiles and Dykstra-Parsons methods. **1 wk.**
7. Areal and vertical sweep efficiency. 2-D waterflooding performance estimation. **1 wk.**
8. Numerical simulation of EOR applications: 3-D waterflooding performance estimation **1 wk.**
9. Thermal methods. Cyclic steam injection. Marx-Langenheim method. Canadian cases. **1wk.**
10. Steam injection. Heat losses through injection well and formation during steam injection. **1 wk.**
11. Gas injection, concept of miscibility. Ternary diagrams. CO_2 injection. **1wk.**
12. Chemical methods (polymer and surfactant injection). Ternary diagrams. **1 wk.**
13. EOR applications in naturally fractured reservoirs. Heavy-oil recovery. **1 wk.**

Reference books and materials:

1. Class notes
2. Technical papers.
3. The Reservoir Engineering Aspects of Waterflooding (F. F. Craig, Jr.), SPE
4. Enhanced Oil Recovery (D. W. Green and G. P. Willhite), SPE
5. Enhanced Oil Recovery (M. Latil)
6. Miscible Flooding (F. Stalkup), SPE

GRADING

Semester work: 55%		**Final Exam: 45%**
1. Mid-term exam (1) on **Feb. 24, 2025.**	**20 %**	Comprehensive Exam
2. Homeworks (4) **to be submitted** one week from the assignment day.	**5 %**	
3. Open-ended design project: Group work on designing an EOR application(s) for a field. Must be submitted in written form on **April 9, 2025.**	**30 %**	**April 16, 2025 1:00pm**

Instructional Method

The course will be taught by the instructor during three teaching hours every week. Students will be asked to work on four homework problem sets and read the materials assigned to strengthen the concepts discussed in the classes. The solutions to the homework sets will be provided and, if needed, will be discussed in the classroom. The open-end design project will be assigned to get an insight into the practical aspects of the EOR processes. It will also serve as a tool to improve written communication skills and the ability of working in a group environment.

OPEN-ENDED DESIGN PROJECT

1. Form your group (three people) and select a field (preferentially small to mid-size, mature oil field),
2. Select a suitable EOR method(s) for this field,
3. Estimate the performance of the EOR method(s) selected using any technique(s) and compare the technical and economic successes (if you suggest more than a method).
4. Summarize the suggested (optimal) application procedure and specific design parameters for the selected EOR option(s) including number and location of injectors and producers (optimal), injection rates, injection strategies and duration of the project. Include other design related strategies such as well-design/completion requirements, supply of the injectant, recycling of injected EOR fluid and evaluate the environmental and social effects (if there is any).

Reports should not exceed 10 pages and the work performed by each group member must be specified. Submission date is April 9, 2025.

Useful papers: IPTC 13346, SPE 27055, SPE 92006, SPE 123030, SPE 175881

Please note the following:

"CODE OF STUDENT BEHAVIOUR", updated May 30, 2016
(http://www.governance.ualberta.ca/CodesofConductandResidenceCommunityStandards/~/media/Governance/Documents/Codes%20of%20Conduct%20and%20Residence%20Community%20Standards/Code%20of%20Student%20Behaviour/COSB-Updated-May-30-2016.pdf)

"30.3.2 Inappropriate Academic Behaviour

30.3.2(1) **Plagiarism**
No Student shall submit the words, ideas, images or data of another person as the Student's own in any academic writing, essay, thesis, project, assignment, presentation or poster in a course or program of study.

30.3.2(2) **Cheating**
30.3.2(2) a No Student shall in the course of an examination or other similar activity, obtain **or attempt to obtain** information from another Student or other unauthorized source, give or attempt to give information to another Student, or use, attempt to use or possess for the purposes of use any unauthorized material.
30.3.2(2) b No Student shall represent or attempt to represent him or herself as another or have or attempt to have himself or herself represented by another in the taking of an examination, preparation of a paper or other similar activity. See also misrepresentation in 30.3.6(4).
30.3.2(2) c No Student shall represent another's substantial editorial or compositional assistance on an assignment as the Student's own work.
30.3.2(2) d No Student shall submit in any course or program of study, without the written approval of the course Instructor, all or a substantial portion of any academic writing, essay, thesis, research report, project, assignment, presentation or poster for which credit has previously been obtained by the Student or which has been or is being submitted by the Student in another course or program of study in the University or elsewhere.
30.3.2(2) e No Student shall submit in any course or program of study any academic writing, essay, thesis, report, project, assignment, presentation or poster containing a statement of fact known by the Student to be false or a reference to a source the Student knows to contain fabricated claims (unless acknowledged by the Student), or a fabricated reference to a source."

"30.3.4 Inappropriate Behaviour towards Individuals or Groups
30.3.4(1) **Disruption**
30.3.4(1) a No Student shall disrupt a Class in such a way that interferes with the normal process of the session or the learning of other Students." **Comment:** ***This includes use of laptops, phones and working on assignments distracting others***

Plagiarism and cheating

Plagiarism and cheating under the University of Alberta Code of Student Behaviour are defined in sections 30.3.2(1) and 30.3.2(2) as stated above.

Cheating can take many forms, such that it is possible to cheat without plagiarizing. However plagiarizing within the context of assignments, papers, lab reports, tests and examinations is also an attempt to take academic advantage over others in the same class; such that a better grade may be achieved. Taking academic advantage over others is hence also cheating. If you find yourself being suspected of plagiarism then it is likely that the Faculty of Engineering will also investigate you on a count of cheating simultaneously.