جامعة الملك عبدالله
للعلوم والتقنية
King Abdullah University of
Science and Technology

Course Syllabus: Reservoir Engineering Fundamentals & App - ERPE 250

Division	Physical Science and Engineering Division
Course Number	ERPE 250
Course Title	Reservoir Engineering Fundamentals & App
Academic Semester	Spring
Academic Year	2018/2019
Semester Start Date	01/27/2019
Semester End Date	05/23/2019
Class Schedule (Days & Time)	10:30 AM - 12:00 PM | Sun , 09:00 AM - 10:30 AM | Thu

Instructor(s)

Name	Email	Phone	Office Location	Office Hours
Hussein Ali Hoteit	HUSSEIN.HOTEIT@KAUST.EDU.SA	+966128084897	3221, 5, Al-Kindi (bldg. 5)	Email for appointment

Teaching Assistant(s)

Name	Email

Course Information

Comprehensive Course Description	Reservoir Engineering (RE) aims to understand the state of hydrocarbon fluids in the subsurface, quantify uncertainties, manage risks, and economically optimize the development and production of hydrocarbons during multiple phases in the reservoir lifecycle. The course covers the fundamentals of reservoir engineering that is a crucial knowledge for students aiming to have a career or research related to upstream petroleum engineering. The course will also address the practical aspects of RE including best practices and workflows that are typically practiced in the Oil&Gas industry. Students will learn about the basics about key steps involved in field development, from initial planning stages, through reservoir analysis and subsurface design. Realistic field cases will be discussed and students will get exposed to real life RE challenges. Modeling approaches covering the range from analogues to simulation will be discussed. Students will learn the basis of reservoir simulation and will get training to use a commercial reservoir simulator (CMG or Eclipse). The course will include the following main topics: 1) Basic concepts: hydrocarbon PVT/thermodynamics, material balance, uncertainty analysis, drive mechanisms, vertical equilibrium, capillarity and J-functions; 2)Primary depletion: recovery mechanism, performance evaluation; 3)Secondary depletion: displacement efficiency, Buckley-Leverett theory, mobility ratio, sweep efficiency, well placement, water flood evaluation, tracer concept; 4) Reservoir simulation: governing equations, linear/nonlinear solvers, IMPES/FI/AIM formulations, well model/control, numerical error, history-match concept, prediction uncertainties; 5)Enhanced oil recovery (EOR): hydrocarbon trapping mechanisms, concepts of miscible/immiscible gas flood, chemical EOR, thermal EOR, EOR screening; 6)Field management: workflow, economics, decision analysis.
Course Description from Program Guide	Basic concepts: hydrocarbon PVT/thermodynamics, material balance, uncertainty analysis, drive mechanisms, vertical equilibrium, capillarity and J-functions. Primary depletion: recovery mechanism and performance evaluation. Secondary depletion: displacement efficiency, Buckley-Leverett theory, mobility ratio, sweep efficiency, well placement, water flood evaluation and tracer concept. Reservoir simulation: governing equations, linear/nonlinear solvers, IMPES/FI/AIM formulations, well model/control, numerical error, history-match concept and prediction uncertainties. Enhanced oil recovery (EOR): hydrocarbon trapping mechanisms, concepts of miscible/immiscible gas flood, chemical EOR, thermal EOR and EOR screening. Field management: workflow, economics, decision analysis. Reservoir Simulation project. Course programming assignments will use MATLAB and Excel-VBA. Reservoir simulations will use CMG and/or Eclipse.

Goals and Objectives	After completing this course, students will be able to : - identify the models and uncertainties associated with material balance and hydrocarbon volume estimate in the reservoir - understand the concept of primary, secondary and tertiary recovery schemes - know about practical methods to evaluate HC production performance and screening concept for different EOR methods - understand the pros and cons of different analytical and numerical methods in RE - perform simple reservoir simulations with ability to QC associated static and dynamic input data - understand the concepts of history-matching, deterministic and probabilistic forecasts - explain how reservoir simulation fits into the reservoir management process
Required Knowledge	Basic familiarity with: 1)multi-phase flow in porous media, 2)thermodynamic of hydrocarbon fluids 3)programming in Matlab
Reference Texts	- Course material - LP Dake, Fundamentals of reservoir engineering, Shell Learning and Development, 1977 (available online) - Larry Lake, Enhanced Oil Recovery, 1989 - T. Ertekin, J. Abou-Kassem and G. King; Basic Applied Reservoir Simulation, SPE 2001.
Method of evaluation	**30.00**% - Group Project(s) **20.00**% - Midterm exam **20.00**% - Homework /Assignments **20.00**% - Final exam **10.00**% - Active participation
Nature of the assignments	- Model coding in Excel or Matab - Written assignments - Paper presentation - Group project (case study) with a memo and a presentation
Course Policies	For absense and late assignements, discusss with instructor beforehand
Additional Information	

Tentative Course Schedule *(Time, topic/emphasis & resources)*		
Week	**Lectures**	**Topic**
1	Sun 01/27/2019	Basic concepts in RE: hydrocarbon PVT/thermodynamics, material balance,vertical equilibrium, capillarity and J-functions;
1	Thu 01/31/2019	Basic concepts in RE: hydrocarbon PVT/thermodynamics, material balance,vertical equilibrium, capillarity and J-functions;
2	Sun 02/03/2019	Primary depletion: recovery mechanism, performance evaluation;
2	Thu 02/07/2019	Primary depletion: recovery mechanism, performance evaluation;
3	Sun 02/10/2019	Secondary depletion: displacement efficiency, Buckley-Leverett theory, mobility ratio, sweep efficiency, well placement, water flood evaluation, tracer concept;
3	Thu 02/14/2019	Secondary depletion: displacement efficiency, Buckley-Leverett theory, mobility ratio, sweep efficiency, well placement, water flood evaluation, tracer concept;
4	Sun 02/17/2019	Reservoir simulation: governing equations, linear/nonlinear solvers;
4	Thu 02/21/2019	Reservoir simulation: governing equations, linear/nonlinear solvers;
5	Sun 02/24/2019	IMPES/FI/AIM formulations, well model/control, numerical error, history-match concept, prediction uncertainties;
5	Thu 02/28/2019	IMPES/FI/AIM formulations, well model/control, numerical error, history-match concept, prediction uncertainties;
6	Sun 03/03/2019	Reservoir simulation training (CMG or Eclipse)
6	Thu 03/07/2019	Reservoir simulation training (CMG or Eclipse)
7	Sun 03/10/2019	Reservoir simulation training (CMG or Eclipse)
7	Thu 03/14/2019	Reservoir simulation training (CMG or Eclipse)
8	Sun 03/17/2019	EOR methods; EOR screening
8	Thu 03/21/2019	EOR methods; EOR screening
9	Sun 03/24/2019	Spring Break
9	Thu 03/28/2019	Midterm Exam;
10	Sun 03/31/2019	Gas-EOR overview
10	Thu 04/04/2019	Gas- EOR overview
11	Sun 04/07/2019	CO2-EOR overview
11	Thu 04/11/2019	CO2-EOR overview
12	Sun 04/14/2019	CO2-sequestration overview
12	Thu 04/18/2019	Chemical-EOR overview
13	Sun 04/21/2019	Final project assignment description
13	Thu 04/25/2019	Chemical-EOR overview
14	Sun 04/28/2019	Thermal-recovery overview
14	Thu 05/02/2019	Thermal-recovery overview
15	Sun 05/05/2019	Field management
15	Thu 05/09/2019	Field management
16	Sun 05/12/2019	Workflows, economics, decision analysis
16	Thu 05/16/2019	Workflows, economics, decision analysis
17	Sun 05/19/2019	Final Exam Week
17	Thu 05/23/2019	Final Exam Week

Note

The instructor reserves the right to make changes to this syllabus as necessary.