KOMAR UNIVERSITY OF SCIENCE AND TECHNOLOGY
(KUST)

RESERVOIR SIMULATION AND WELTEST SYLLABUS			
Course Title	**Reservoir Simulation and Weltest**		
Course Code	**PTE 4370**	**No. of Credits**	**3 CR**
Department	**Petroleum Engineering**	**College**	**College of Engineering**
Pre-requisites Course Code	**PTE 4345**	**Co-requisites Course Code**	
Course Coordinator(s)	**Hiwa Sidiq**		
Email	**hiwa.sidiq@komar.edu.iq**	**IP No.**	**Nil**
Other Course Teacher(s)/Tutor(s)	**None**		
Class Hours	**Mon and Wed: 16:00 – 17:30**	**Room: Lab B 16-17**	
Contact Hours	**TUE: 13:00 - 16:00**	**Room: 218**	
Course Type	**Departmental Requirement**		
Offer in Academic Year	**Spring 2015**		

COURSE DESCRIPTION

This course describes the importance and application of modern reservoir simulation programs that are used for studying reservoir in real time in order to optimize production and field development. These computer programs are designed to model fluid flow in porous media. The application of reservoir simulation is to investigate many reservoir parameters and scenarios that can be used to efficiently operate the field from exploration to abandonment.

COURSE OBJECTIVES

On completion of this course students are expected to be able to use simulation model for reservoir management and production optimization. Furthermore, to be able to describe why and in what circumstances simple or complex reservoir models are required to model reservoir processes. Students are also expected to become a good user of some industry standard software that KUST has license of them. Examples are: Sandra, Petex, PVTP, GAP, Kappa suits etc.

COURSE LEARNING OUTCOMES

After participating in the course, students should be able to:

1. Explain reservoir simulation fundamentals - the mathematical background and the techniques used to run simulation. (ABET A and E)
2. Design a reservoir simulation deck, run simulations, and analyze simulation results using post-processing software. (ABET K and D)
3. QC the simulation data and conduct the calibration of a reservoir simulation model. (ABET A and E)
4. Predict and optimize future performance of petroleum reservoirs using reservoir simulation. (ABET E & K)
5. Use reservoir simulation results to solve the production problems at individual wells or at field scale. (ABET A and E)
6. Apply compositional reservoir simulation to solve production and reservoir engineering problems(ABET E)
7. Present the results of simulation projects in a written report. (ABET G and K)

KOMAR UNIVERSITY OF SCIENCE AND TECHNOLOGY
(KUST)

RELATED PROGRAM OUTCOMES:	
A	An ability to apply knowledge of mathematics, science, and engineering
D	An ability to function on multidisciplinary teams
E	An ability to identify, formulate, and solve engineering problems
G	An ability to communicate effectively
K	An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Reference: http://www.abet.org/eac-criteria-2014-2015/

GUIDELINES ON GRADING POLICY

Points	*Percentage Scores*	*Grade*
A	*95–100*	*4.0*
A-	*90-94*	*3.7*
B+	*87–89*	*3.3*
B	*83-86*	*3.0*
B-	*80-82*	*2.7*
C+	*75–79*	*2.3*
C	*70-74*	*2.0*
C-	*65-69*	*1.7*
D+	*60–64*	*1.3*
D	*55-59*	*1.0*
D-	*50-54*	*0.7*
F	*0–49*	*0*
I	*Incomplete Course Work*	
W	*Official Withdrawal*	
Passing Grade is 65% or above		

COURSE CONTENTS

Course topics include:

- Intro. to conventional simulation and basic equations governing multiphase flow in porous media
- Discretization methods, implicit and explicit solutions
- Matrix assembly and linear solvers
- Geological models and upscaling
- Simulation deck assembly
- Modeling well performance
- History matching and scale-up
- EOS fluid models and compositional simulation
- Introduction to Streamline Simulation

Note: Adding more chapters is governed by the time.

Course Teaching and Learning Activities:

Lectures: during week, the theoretical and practical lectures will be presented throughout the semester; the discussion of practical work within lab will be organized and illustrated with activities.

Assignments: after the lectures, the assignment will be explained and given to students. It is expected to be done on fortnightly bases.

Quizzes: the contents of each lecture will be discussed during class for open question and answer to make sure every student will participate and active.

Test: In class test on the subjects have been studied during the course.

In class brainstorming sessions: provide students with enough sources and background knowledge briefly within the topics during class to top up their challenge packs to be more active.

CLASS REQUIREMENT

- A Scientific Calculator
- Notebook

***Note: Students must bring a notebook, a pen, notebook, calculator, and the periodic table to every class**

Assessment Tool	Description	Weight
Simulation Projects	Four different reservoir simulation projects covering from simple to geologically complicate models (ABET G, K and D)	24 %
Presentation	Presenting the results of simulation project(ABET G)	6 %
Tests	Two tests before and after midterm exam (ABET A, E and K)	10 %
Quizzes	The open questions and answer during class (ABET A and E)	10 %
Midterm Exam	Examination questions from lectures W1 to W7 (ABET A, E and K)	20 %
Final Exam	Examination questions from all lectures and topics (ABET A and E)	30 %

ESSENTIAL READINGS: (Journals, textbooks, website addresses etc.)

Textbooks:

Principles of Applied Reservoir Simulation, John R. Fanchi, 2006, 3rd Edition. 978-0-7506-7933-6

Reservoir Simulation: Mathematical Techniques in Oil Recovery, Zhangxin Chen, 2007. ISBN 978-0-898716-40-5

References:

- *Petroleum Reservoir Simulation: A Basic Approach*. Kassem, J.H., Ali, S., Islam, M., Gulf Publishing Company, Houston. 2006. ISBN 978-0976511366
- Basic Applied Reservoir Simulation. Turgay Ertekin, et al. SPE, 2001. ISBN 1-55563-089-8
- Basics of Reservoir Simulation with the Eclipse Reservoir Simulator, Øystein Pettersen, Lecture notes, 2006.

COURSE POLICY *(including plagiarism, academic honesty, attendance etc)*

KUST Academic Policy
http://sar.komar.edu.iq/files/Student%20hand%20Book%202013.pdf

Attendance:

- Students are expected to attend all lectures and must attend all examinations, quizzes, and practical exercises.
- There is no make-up work for students who miss classes without official permission.
- Student must arrange with the faculty to make-up the missed class.
- Students are subject to the regulation and policies mentioned in the KUST Student Handbook.
- KUST guidelines for lateness are as follows: Three occasions of lateness count as one absence. (You can be considered late the first minute of the lecture time).

GUIDELINES FOR SUCCESS

1. Be able to work independently and in groups,
2. Pay-attention in the classes is the guarantee of success,
3. Extend your knowledge beyond the given textbooks to master the subject, and
4. Try not to miss the classes

KOMAR UNIVERSITY OF SCIENCE AND TECHNOLOGY
(KUST)

Course calendar: Please check the academic calendar for 2015/2016

Week	Beg/End Dates	Topics	Assessment
1	28 Feb – 3 Mar	- Basic fluid flow equation in porous media - Finite differencing - Implicit and explicit methods	
2	6– 10 Mar	- Hand on simulation: - Introduction to conventional simulation - Developing grids from structural map - Digitizing the grids using surfer software - Regular cartesian grids (Dip-normal and block-centre geometry)	
3	13– 17 Mar	- Pressure (diffusivity) Equation and FD Solution - Permeability Tensor and Directional Permeability - Linear Solvers - Discretization methods - Finite Element and Mixed Finite Element	Project 1 (19th Mar) (CLO 2 & 3)
20-24 March Nowroz Holiday			
4	27– 31 Mar	- Hand on simulation: - Populating grid model with reservoir properties - Import grid file to simulation deck - Introduction into Sandra reservoir modelling	Quiz 1 (W1-W2) (CLO 1)
5	3– 7 Apr	- Buckley-Leverett solution - Numerical solution and transmissibility - Well and well model - Steady-state Well Index - Transient Well Index	
6	10– 14 Apr	- Hand on simulation: - Developing circular grid geometry - Well performance analysis - Investigate near wellbore heterogeneity	Test 1 (7th Apr) (W1-W4) (CLO 1-4)
7	17– 21 Apr	- Type curve matching - History matching of single well - Modeling Well Performance / Coning	Quiz 2 (W5-W6) (CLO 4)
22-28 April Midterm Exam			
8	1– 5 May	- Black Oil model - Two phase flow reservoir model - Three phase flow reservoir model - Streamline model solution	Project 2 (3rd May) (CLO 5)
9	8– 12 May	- Hand on simulation: - Method of upscaling - Grid refinement - Dual porosity model - Surface networking	Quiz 3 (W8) (CLO 5)

10	15– 19 May	- EOS Compositional simulation - Two components water and C1 and C2+ - Three components water and C1, C2 and C3+ - Thermal and steam modeling - Polymer Injection modeling	Project 3 (21th May) (CLO 5 & 6)
11	22– 26 May	- Hand on simulation: - Thermal and Hydraulic Fracturing - Steam Injection - Mobility Control - Phase Emulsification	Quiz 4 (W10) (CLO 6)
12	29 May– 2 Jun	- Presentation of simulation results for the projects that have been done	Test 2 (30th May) (W8-W11) (CLO 5 - 7)
13	5 – 9 Jun	- Hand on simulation: Prosper - Production System Analysis - Inflow performance models (IPR)s - Horizontal well with pressure drop in well - Hand on simulation: GAP - Surface gathering system models with constraints - Looped networks - Gas and condensate gathering systems	Project 4 (9th Jun) (CLO 6)
14	12– 16 Jun	- Rate transient analysis Topaz - Pressure transient analysis Saphir - Well performance analysis Amethyste	Quiz 5 (W12-W13) (CLO 5 & 6)
15	19 – 23 Jun	Review Week	
26 -30 Jun Final Exam (W1-W15)			

*The above timetable is an indicative schedule and may change.