UNIVERSITY OF MISKOLC

FACULTY OF
EARTH AND ENVIRONMENTAL
SCIENCES AND ENGINEERING

RESERVOIR MANAGEMENT AND SIMULATION LAB

MSc in Petroleum Engineering **MFKOT740015**

COURSE DESCRIPTION

**FACULTY OF EARTH AND
ENVIRONMENTAL SCIENCES AND ENGINEERING
MINING AND ENERGY INSTITUTE**

2024. Spring Term

Course Data Sheet

Course Title: Reservoir Management simulation lab. **Instructor:** Dr. Zoltán TURZÓ associate professor	**Code:** MFKOT730015 **Responsible department/institute:** DPE/IPNG (OMTSZ/KFGI) **Course Element: Compulsory**
Position in curriculum* **(which semester)**: 4 (3)	**Pre-requisites (if any):** Flow in Porous Media MFKOT730035
No. of contact hours per week (lecture + seminar): 0+3	**Type of Assessment (examination / practical mark / other):** practical mark
Credits: 3	**Course:** full time

Course Description:

1. Definition of reservoir management.
2. Short history.
3. Basics of reservoir management. Goals.
4. Realization.
5. Monitoring.
6. Evaluation.
7. Case studies.
8. Data acquisition and analysis.
9. Material Balance calculations.
10. Numerical simulation.
11. Economic considerations.
12. Risk analysis.
13. EOR methods.
14. Case studies

Competencies to evolve:

Knows the economic processes related to the hydrocarbon industry.

Knows the properties of the fluids found in petroleum, natural gas and geothermal reservoirs, as well as the storage rocks; characteristics of flow in such reservoirs.

Knows the production mechanisms of underground reservoirs and the primary or enhanced extraction mechanisms that ensure optimal production.

Knows the basics of numerical simulation of underground storages.

Knows the methods and tools of computerized design and analysis in the hydrocarbon industry.

Ability:

Able to interpret the economic processes related to the hydrocarbon industry and to give adequate answers to them.

Capable of predicting the behavior of fluids in petroleum, natural gas, and geothermal reservoirs, the properties of reservoir rocks, and the characteristics of flow in such reservoirs.

Able to recognize the production mechanisms of underground reservoirs and select the primary or enhanced extraction mechanisms that provide optimal production.

Capable of numerical simulation of underground storages.

Able to select equipment for field and transmission line transport and supervise the operation of the equipment and manage the participating groups.

Capable of hydrocarbon industrial computer design and analysis.

Attitude:

Autonomy and responsibility:

Able to independently manage hydrocarbon industrial complex planning works and perform project management tasks, or participate in them.

Capable of independently choosing the appropriate mechanisms for the production of underground reservoirs; to implement the most favorable "reservoir management".

Able to autonomously plan the use of energy carriers produced from renewable natural resources and residual materials in the energy supply system, and manage the operation of the established system.

Takes responsibility for his/her professional decisions and the work processes carried out by him/her or under his/her control.

Assessment and grading: Students will be assessed with using the following elements.	Grading scale: % value Grade

Attendance:	5 %	90 -100%	5 (excellent)
Midterm exam	40 %	80 – 89%	4 (good)
Final exam	55 %	70 - 79%	3 (satisfactory)
Total	100%	60 - 69%	2 (pass)
		0 - 59%	1 (failed)

Compulsory or recommended literature resources:

- Fanci: Principles of Applied Reservoir Simulation, Gulf Publishing Co. 2001, ISBN 0-88415-372-X
- Ertekin – AbouKassem - King: Basic Applied Reservoir Simulation, SPE Textbook Series, 2001, ISBN 1-55563-089-8
- T. Ahmed: Advanced Reservoir Engineering, Gulf Publishing Co. 2005, ISBN-13: 978-0-7506-7733-2
- A. Satter: Integrated Petroleum Reservoir management: A Team Approach. Pennwell Books, 1994, ISBN 0-87814-408-0
- A. Satter: Computer Assisted Reservoir Management Pennwell Books**, ISBN:** 978-0-87814-777-9

Course Schedule for 2023/24 school year, spring term

Date	Topic
2024.02.16	Definition of reservoir management. Short history. Basics of reservoir management. Goals.
2024.02.23	Realization. Monitoring.
2024.03.01	Evaluation. Case studies.
2024.03.08	Data acquisition and analysis.
2024.03.22	Numerical simulation.
2024.04.12	Economic considerations. Risk analysis.
2024.04.19	EOR methods. Case studies
2024.04.26	Test writing.

Test example

CLOSED BOOK

(10 minutes)

NAME of STUDENT: __________________________ ID No.:________________

1. Mark the correctness of the following statements.

	TRUE	FALSE
The liquid expansion drive effective of early stage of production in saturated reservoir, when the reservoir pressure less than the bubble-point pressure		
The strong water influx will decrease the recovery factor of gas reservoir		
The high vertical permeability is favorable condition of in bottom water drive reservoir (results higher recovery factor)		
The EOR can only start after the depletion of a hydrocarbon reservoir.		
At EOR procedures different fluids (gas, vapor or liquid) are injected into the annulus to support lifting the liquid in the tubing to the surface.		

2. Make a list of natural production mechanism:

a. ………………………………………………

b. ………………………………………………

c. ………………………………………………

d. ………………………………………………

e. ………………………………………………

f. ………………………………………………

"I pledge that I have neither given nor received any unauthorized assistance on this quiz."

Student's Signature: _________________________

Examination review questions

Final Exam
Open BOOK

(max 80 minutes)

Student Name:…………………………………..

Student ID No.:…………………………………..

Question No.	Marks	Score
1	12	
2	25	
Total	37	

"I pledge that I have neither given nor received any unauthorized assistance on this exam."

Student's Signature: ________________________

Question No. 1

Task-1
Determine the type of the hydrocarbon reservoir,
when the following data is known!
You can use the phase envelop curve.

Reservoir pressure	220	BARg
Reservoir temperature	110	^{o}C
Reservoir depth	2100	m

Measured well stream composition is

Component	Mol%	Molecular Weight	Density at 15 ^{o}C, 1	Atmospheric Boiling Point
N_2	0.000			
CO_2	0.000			
C_1	91.350			
C_2	4.030			
C_3	1.530			
i-C_4	0.390			
n-C_4	0.430			
i-C_5	0.150			
n-C_5	0.190			
C_6	0.390			
C_7	0.361			
C_8	0.285			
C_9	0.222			
C_{10+}	0.672	142.3		174.150

Determine the following parameters	
Type of Hydrocarbon reservoir	
Specific gravity C_{10+} at 15 ^{o}C, 1.01 BARa	
Cricondentherm temperature oC	
Cricondentherm pressure BARa	
Cricondenbar temperature oC	
Cricondenbar pressure BARa	

Question No. 2

PVT data
Reservoir temperature 164 deg F
Solution GOR = 475 scf/STB
Oil gravity = 54.2 ^{o}API
Gas specific gravity= 0.700
Water Salinity = 20 000 ppm

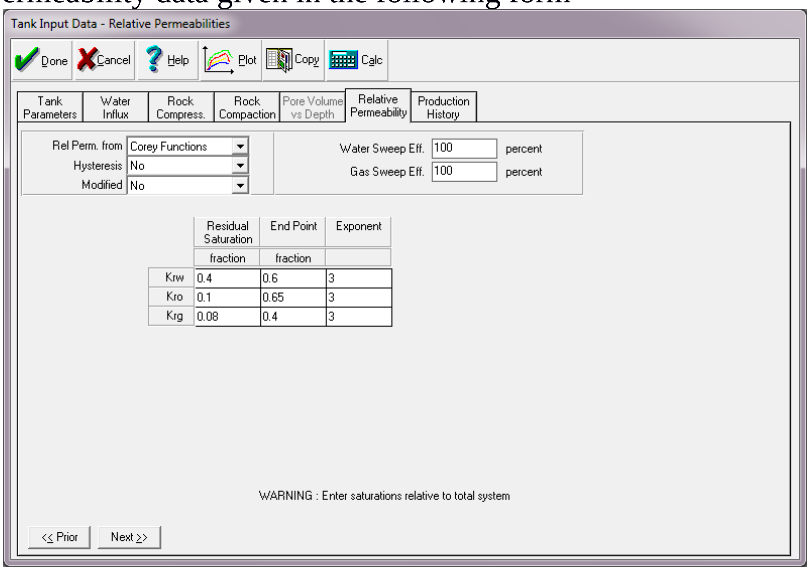
Measured data
Bubble point pressure (p_b) = 1080 psig
Formation volume factor at bubble point = 1.48 RB/STB
Initial reservoir pressure (p_i) = 2779
Formation volume factor at (p_i) initial reservoir pressure = 1.41 RB/STB
Oil viscosity at (p_i) initial reservoir pressure = 0.33 cP
Gas-oil ratio at (p_i) initial pressure = 475 scf/STB

With PVT matching determine which correlation method is the best of calculate the buble point pressure, gas oil ratio, oil formation volume factor (oil FVF), and the oil viscosity.

	The best correlation formulae is
P_b. R_s, B_o	
Oil viscosity	

The following dates were calculated for given oil reservoir by volumetric reserve estimation method:
Reservoir temperature 164 deg F
Initial reservoir pressure (p_i) = 2779
Average porosity ϕ = 16.8 %
Connate water saturation S_{wi}= 40 %
Rock compressibility cr= 4 10^{-6} 1/psi
O.O.I.P = 8.0 MMSTB

The relative permeability data given in the following form



The oil production start at 1, January 1966
The production history listed below

Date	P (psia)	N_p (MSTB)	G_p (Mscf	W_p (MSTB)
1966.01.01	2779	0	0	0
1966.02.01	2685	20.821	10206	0
1966.04.01	2473	79.405	42651	0.374
1966.08.01	2259	166.065	82485	0.822
1967.02.01	1959	314.099	160170	12.887
1968.01.01	1660	580.419	282150	27.631
1970.01.01	1309	1089.315	512110	56.637
1972.01.01	1172	1436.899	688090	84.795
1974.01.01	1122	1633.927	780260	111.865
1976.01.01	1095	1693.737	802200	143.256
1980.01.01	1080	1761.704	803360	289.432

Use the history matching of MBAL program and determine is there any water influx or not

1. Mark the correctness of the following statements.

	TRUE	FALSE
There is a water influx into the examined oil reservoir		

If the above answer yes, then the following information can be obtained from a geologist.

Reservoir thickness h=10 ft
Reservoir radius r_{res}=3526 ft
Outer/inner radius ration r_D=5
Encroachment angle θ=180 degre
Aquifer permeability k_w= 8.5 mD

Determine the following parameters	
O.O.I.P	
Outer/inner radius ration	
Encroachment angle	
Aquifer permeability	