UNIVERSITY OF MISKOLC

FACULTY OF
EARTH AND ENVIRONMENTAL
SCIENCES AND ENGINEERING

Production Engineering Fundamentals

MSc in Petroleum Engineering **MFKOT720025**

COURSE DESCRIPTION

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

2024. Spring Term

Course Data Sheet

Course Title: Production Engineering Fundamentals **Instructor:** Dr. Gábor TAKÁCS, professor emeritus	**Code:** MFKOT720025 **Responsible department/institute:** DPE/IPNG (OMTSZ/KFGI) **Course Element: Compulsory**
Position in curriculum* (which semester): 2 (1)	**Pre-requisites (if any):** no
No. of contact hours per week (lecture + seminar): 2+2	**Type of Assessment (examination / practical mark / other):** examination
Credits: 6	**Course:** full time

Course Description:

1. Properties of oilfield fluids and gases.
2. Inflow performance of oil wells.
3. Basics of single-phase flow: description and pressure drop prediction.
4. Multiphase flow: basic concepts, flow patterns.
5. Multiphase flow in oil wells: empirical correlations, mechanistic models, gradient curves.
6. Accuracy of pressure drop calculations.
7. Horizontal and inclined flow of multiphase mixtures.
8. Multiphase flow through chokes.
9. Temperature conditions in hydrocarbon producing wells.
10. Theory of continuous flow and intermittent gas lifting, design of installations.
11. Types of gas lift valves, their performance.
12. Gas lift installation types, surface gas supply systems.
13. Application of NODAL Analysis principles to gas lifted wells.
14. Unloading of continuous flow gas lift wells, unloading valve string design.

Competencies to evolve:

Knows the economic processes related to the hydrocarbon industry.

Knows the processes and phenomena occurring during production in petroleum and natural gas water wells.

Knows the equipment used for different types of production; and the methods ensuring the appropriate selection of the necessary equipment and procedures.

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 monitoring and forecasting the processes taking place in oil and natural gas water wells.

Able to choose the optimal production method, design and select the production equipment.

Able to supervise and inspect equipment related to pipeline transportation of crude oil, natural gas and water.

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.

Autonomously able to plan the production of fluid-producing wells, to achieve optimal production conditions; for the appropriate selection of the necessary equipment and procedures; to implement solutions that ensure maximum profit.

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:	Grading scale: % value Grade

Students will be assessed with using the following elements.		90 -100%	5 (excellent)
Attendance:	5 %	80 – 89%	4 (good)
Homework	10 %		3
Midterm exam	40 %	70 - 79%	(satisfactory)
Final exam	45 %		
Total	100%	60 - 69%	2 (pass)
		0 - 59%	1 (failed)

Compulsory or recommended literature resources:

- A.P. Szilas: Production and Transport of Oil and Gas. Part A, B., Akadémiai Kiadó, Budapest, 1986.
- Takács G.: Fundamentals of Production Engineering. okt. segédlet, Miskolci Egyetem, 2005, 161p.
- G. Takács: Gas Lift Manual., PennWell Corporation, Tulsa, USA. 2005. 478p, ISBN 0-87814-805-1.
- George V.Chilingarian et.al.: Surface Operations in Petroleum Production II, Elsevier, 1989
- Larry W. Lace: General Engineering, Petroleum Engineering Handbook Vol 1, SPE, 2006

Course Schedule for 2023/24 school year, spring term

Date	Topic
2024.02.13	Properties of oilfield fluids and gases.
2024.02.20	Inflow performance of oil wells.
2024.02.27	Basics of single-phase flow: description and pressure drop prediction.
2024.03.05	Multiphase flow: basic concepts, flow patterns.
2024.03.12	Multiphase flow in oil wells: empirical correlations, mechanistic models, gradient curves.
2024.03.19	Accuracy of pressure drop calculations. Horizontal and inclined flow of multiphase mixtures.
2024.03.26	Test writing.
2024.04.09	Multiphase flow through chokes. Temperature conditions in hydrocarbon producing wells.
2024.04.23	Theory of continuous flow and intermittent gas lifting, design of installations.
2024.04.30	Types of gas lift valves, their performance. Gas lift installation types, surface gas supply systems.
2024.05.07	Application of NODAL Analysis principles to gas lifted wells. Unloading of continuous flow gas lift wells, unloading valve string design.
2024.05.14	Test writing.

Test Example

CLOSED BOOK

NAME of STUDENT: _____ ID No.:_____

1. The volumetric liquid flow rate at the well bottom is always _____ than the rate measured at the stock tank.

   The relation between stock tank volume and actual volume is (give the formula and the definition of the terms):

   _____

2. How can you calculate the free gas volume (at standard conditions) if the well's oil rate (in STB), GOR and the solution GOR (R_s) at the given conditions are known:

   _____

3. The value of the volume factor for oil is always _____ .

4. Give the definition of the deviation factor for real gases in the relevant formula.

   Z =

5. List at least 3 assumptions that must be met for the validity of the productivity index formula.
   i. _____
   ii. _____
   iii. _____

6. How does the flow velocity change with pipe length in a horizontal pipe if only liquid is flowing?

   _____

7. List the possible flow patterns in an oil well, starting from the bottom.
   i. _____
   ii. _____
   iii. _____
   iv. _____

8. Give the definition of the superficial velocity in general if flow rate at standard conditions, q_{sc} is known; write down the formula.

   _____

9. Give the formula for calculating the mixture density in multiphase flow. Define the parameters!

_____	_____
_____	_____
_____	_____

10. List the main components of the multiphase vertical pressure drop along with their contribution to the total pressure drop, in case of an onshore oil well.

Component	Contribution, %
_____	___
_____	___
_____	___

11. What are the two main problems when calculating the pressure drop in an inclined oil well.

i. _____
ii. _____

12. In the vertical mist flow pattern where and in what form does the liquid flow.

i. _____
ii. _____

Problem Statement :

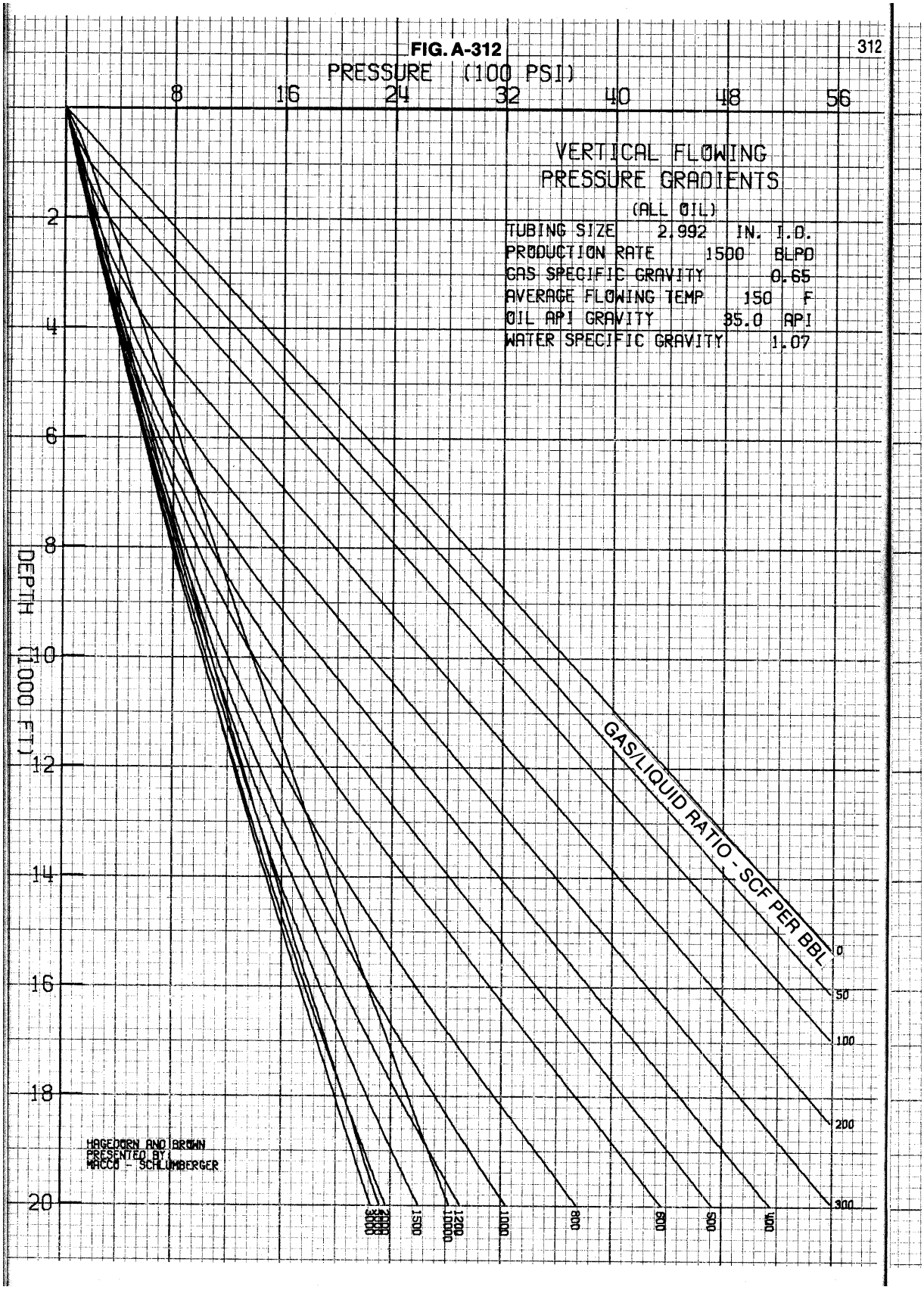
Part A: Find the flowing bottomhole pressure in a flowing well using the pressure gradient curve sheet supplied. Well data are the following:

Depth = 12,000 ft
Oil rate = 1,500 bpd
Tubing size = 3 in (2.992 in ID)
GLR = 800 scf/bbl
Wellhead pressure = 400 psi

Part B: Using the same data as in ***Part A***, find the wellhead pressure if the flowing bottomhole pressure equals 3,280 psi.

Instructions :

You can plot your graphical solution to the above problems directly on the gradient curve sheet.



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

Student's Signature: _____

Examination review questions

Properties of oilfield fluids

Properties of oilfieldgases.

Inflow performance of oil wells.

Single flow in pipes: calculation of pressure drops.

Multiphase flow in pipes: calculation of pressure drops.

Fundamentals of NODAL Analysis.

Theory of continuous flow gas lifting.

Theory of intermittent gas lifting.

Gas lift installation types

Surface gas supply systems.

Application of NODAL Analysis principles to gas lifted wells.

Unloading of continuous flow gas lift wells, unloading valve string design.