Identification	Subject	PETE542, Advanced Gas and Gas Condensate Reservoir Engineering, 6 ECTS
	Department	Petroleum Engineering
	Program	Graduate
	Term	Spring 2026
	Instructor	Mangushev Rufat
	E-mail:	rufat.mangushev@gmail.com
	Phone:	
	Classroom/hours	11 Mehseti str.(Neftchilar campus) TBD
	Office hours	TBD
Prerequisites		
Language	English	
Compulsory/Elective	Compulsory	
Required textbooks and course materials	*Core textbook:* • Phase Behavior of Petroleum Reservoir Fluids (2023), Karen Schou Pedersen; • Holditch, S.A., Spivey, J.P., & Wang, J.Y. (2020). Tight Gas Reservoirs.	
Course outline	This course is designed for master's students to address the complexities of retrograde condensate systems and high-pressure gas reservoirs. The objective is to provide students with the numerical algorithms and suitable models needed to predict phase behavior, condensate banking effects, and liquid recovery optimization.	
Course objectives	Objective of the Course: This course provides graduate students with an advanced introduction to the principal concepts and methods governing gas and gas condensate reservoir behavior. Topics covered in the curriculum include complex thermodynamics, phase behavior near the critical point, and the physics of retrograde condensation. Students will utilize control volume analysis to understand multi-phase fluid flow and mass conservation within the reservoir. The course emphasizes the application of momentum conservation for moving fluids in high-pressure and high-temperature environments. Detailed studies will be conducted on viscous fluid flows and the specific impact of non-Darcy effects on gas well deliverability. **Quizzes** will be provided during the classes based on the topic covered previously. Two quizzes will be provided during semester. **Presentation** Each student has one presentation during this course. Students should make a presentation on given topics and presents for other students on week 13. **Project objectives** Students should research about given topic from book. Students should hand in two reports in .docx and .PDF format about their research and presentation. Deadline for handing in all reports and presentations on one DVD is until final exam day. It should be noticed that students lecture, or presentations will consider as references for their quizzes and exams.	

Learning outcomes	By the end of the course the students should be able to learn:	
	• Identify and articulate gas and gas-condensate reservoirs	
	• Estimation of gas reservoir volume	
	• Operate different equations of State: Van der Waals, Peng-Robinson, and SRK tuning.	
	• Model Well Testing	
	• Understand Fluid Phase Behaviour through PVT-bomb experiments.	
	• Perform Compositional simulation of dry gas injection for liquid recovery.	
	• Familiarize with offshore equipment.	
	• Understand concept of critical choke flow. Difference between sonic and subsonic flows.	
	• Understand all contemporary ways of gas separation.	
	• Operate Weimouth and Panhandle equations for pressurized gas flow through pipelines.	

Teaching methods		
	Lecture	x
	Group discussion	x
	Experiential exercise	x
	Simulation	x
	Case analysis	x
	Course paper	x
	Others	

Evaluation	Methods	Date/deadlines	Percentage (%)
	Midterm Exam		30
	Case studies		
	Class Participation		
	Assignment and quizzes		10
	Project		15
	Presentation/Group Discussion		10
	Final Exam		35
	Others		
	Total		100

Policy	▪ **Preparation for class**
	There will be 2 quizzes worth 3 points each and 4 assignments worth 1 point each. Quizzes are of random pop-up nature (not more than 30 minutes per quiz). Midterm exam will consist of variety of types of questions including, but not limited to multiple choice, calculations, open questions, true-false questions, etc. Multiple choice questions are not limited to a single correct answer. Different weights will be assigned to different midterm questions depending on their difficulty. Group project is a 30 pages long report on a specific novel topic that will be assigned on week 3 of the classes and will be due on week 13 (10 weeks in total). Presentation will be based on the group project. All parts of the course will be evaluated based on zero tolerance towards cheating,

plagiarism and use of AI in any form other than inspirational. Inspirational use of AI constitutes topic suggestion, material (books/articles) search, and nothing more.

- **Withdrawal (pass/fail)**

This course strictly follows grading policy of the School of Science and Engineering. Thus, a student is normally expected to achieve a mark of at least 65% to pass. In case of failure, they will be required to repeat the course the following term or year.

- **Cheating/plagiarism**

Cheating or other plagiarism during the Mid-term and Final Examinations will lead to paper cancellation.

- **Professional behavior guidelines**

The students shall behave in the way to create favorable academic and professional environment during the class hours. Unauthorized discussions and unethical behavior are strictly prohibited.

Tentative Schedule

Week	Date/Day (tentative)	Topics	Textbook/Assignments
1	Week 1	- Introduction - Vertical and Areal Heterogeneity - Isotropy	[2.1]
2	Week 2	- NG Content - NG Formation Types - Basics of Flow Diagrams	[1.1]
3	Week 3	- States of Matter - Review of Thermodynamics - Internal Energies	[1.3]
4	Week 4	- Ideal Gas Laws Review - Real Gas Behavior	[1.3]
5	Week 5	- Estimation of Z Factor - Van-der-Vaals Equation of State - Benedict-Webb-Rubin EoS	[1.4]

6	Week 6	• Reserves Estimation • Material Balance Equation for Gases • Redlich-Kwong Equation	[2.3, 1.4]
7	Week 7	• IPR • Pseudo-Steady State Gas Flow • Stabilized Flow Test • Isochronal Test • Modified Isochronal Test	[1.6]
8	Week 8	**Midterm Exam**	
9	Week 9	• Constant Mass Expansion • Deferential Liberation Experiment • Constant Volume Depletion • Separator Testing	[1.7]
10	Week 10	• EOR PVT Experiments: Solubility Test • Equilibrium Contact Test • Multi-Contact Test • Sum Tube Test • Gas Revaporization Test	[1.7]
11	Week 11	• Gas Cycling: Compositional simulation of dry gas injection for liquid recovery.	[2.5]
12	Week 12	• CO_2 Injection: Enhanced Gas Recovery (EGR) • Carbon sequestration in gas fields.	[2.6]
13	Week 13	**Presentation & Project Delivery**	
14	Week 14	• Unconventional Gas: Flow in shale gas and coalbed methane (CBM) systems.	[2.6]
15	Week 15	• Rel-Perm Effects. • Velocity-dependent relative permeability and capillary number.	[2.4]
	TBD	**Final Exam**	

This syllabus is a guide for the course and any modifications to it will be announced in advance.