<table>
<thead>
<tr>
<th>Identification</th>
<th>Subject</th>
<th>PETE 542: Advanced Gas and Gas-Condensate Reservoir Engineering – 8 ECTS credits</th>
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</thead>
<tbody>
<tr>
<td>Department</td>
<td>Petroleum Engineering</td>
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<tr>
<td>Program</td>
<td>Graduate</td>
<td></td>
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<tr>
<td>Term</td>
<td>Fall 2017</td>
<td></td>
</tr>
<tr>
<td>Instructor</td>
<td>Tahir Mammadov</td>
<td></td>
</tr>
<tr>
<td>E-mail:</td>
<td><a href="mailto:tahir.mammadov@hotmail.com">tahir.mammadov@hotmail.com</a></td>
<td></td>
</tr>
<tr>
<td>Phone:</td>
<td>(+994 12) 421-79-16</td>
<td></td>
</tr>
<tr>
<td>Classroom/hours</td>
<td>11 Mehseti str. (Neftchilar campus), Room #xxxN, Wednesday, 18:40-21:00</td>
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<tr>
<td>Office hours</td>
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**Prerequisites**
Consent of instructor

**Language**
English

**Compulsory/Elective**
Required

**Required textbooks and course materials**
*Core textbook:*
John Lee, Gas Reservoir Engineering, 1996
Boyun Guo, Natural Gas Engineering Handbook, 2005
H. Dale Beggs, Gas Production Operations? 2002
L. P. Dake, The practice of reservoir engineering, SPE papers and etc., 2001

**Course outline**
This course is prepared to gain high knowledge about Gas and Gas-Condensate Reservoir Engineering discipline. Reservoir analysis is the main concern of the course. The course combines theoretical foundations with practical applications. We will begin with a general overview in each topic and then go into more detail on several concepts. Finally, we will create ability to carry out gas engineering analysis and make optimization on Field Development Plans (FDP).

**Course objectives**
*Generic Objective of the Course:*
This course explains the fundamentals of gas and gas-condensate reservoir engineering and their practical application in conducting a comprehensive field study. 1st mid-term includes the origin and characteristics of natural gas, PVT requirements for gas-condensate systems, gas well testing and etc. Here the fundamental mathematical expressions that are used to describe the gas reservoir flow behavior in porous media. A principle of gas well performance calculation is also discussed. Parallel you will be deeply familiar with estimation of gas deliverability.
In the 2nd mid-term, it is introduced natural gas transmission and design of gathering systems. Later, Oil rim development concepts and Underground Gas Storage (UGS) will be discussed. After gaining knowledge about Gas-condensate reservoir engineering, field special problems will be discussed and illustrated at the end of the course. During the project work, simulation concepts will be repeated and applied for synthetic hydrodynamic model.

*Projects* will cover main course topics. In this project the students will apply their knowledge from assignments and course materials. Data of X field will be given and students should be generated 3D synthetic hydrodynamic model of gas-condensate reservoir and predicted the reservoir performance.

*Quizzes* will be assigned every week.

**Learning outcomes**
*By the end of the course the students should be able:*
- Identify and articulate gas and gas-condensate reservoirs
- Estimation of gas reservoir volume
- Understand cycling processes
- Familiarize with Gas-condensate development with Oil rim
- Familiarize with Underground gas storage (UGS)
- Classification of special problems
- Management techniques of gas-condensate reservoirs

**Teaching methods**

<table>
<thead>
<tr>
<th>Lecture</th>
<th>x</th>
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<tr>
<td>Group discussion</td>
<td>x</td>
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</table>
Experiential exercise | 
Simulation | 
Case analysis | 
Course paper | 
Others

<table>
<thead>
<tr>
<th>Evaluation</th>
<th>Methods</th>
<th>Additional information</th>
<th>Percentage (%)</th>
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<tbody>
<tr>
<td>Midterm Exam</td>
<td></td>
<td></td>
<td>30</td>
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<tr>
<td>Case studies</td>
<td></td>
<td></td>
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<tr>
<td>Class Participation</td>
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<td></td>
<td>5</td>
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<tr>
<td>Assignment and quizzes</td>
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<td>15</td>
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<tr>
<td>Project</td>
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<tr>
<td>Presentation/Group Discussion</td>
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<tr>
<td>Final Exam</td>
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<td>40</td>
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<td>Others</td>
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Policy

- **Preparation for class**

  The structure of this course makes your individual study and preparation outside the class extremely important. The lecture material will focus on the major points introduced in the text. Reading the assigned chapters and having some familiarity with them before class will greatly assist your understanding of the lecture. After the lecture, you should study your notes and work relevant problems.

- **Withdrawal (pass/fail)**

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

- **Cheating/plagiarism**

  Cheating or other plagiarism during the Quizzes, Mid-term and Final Examinations will lead to paper cancellation. In this case, the student will automatically get zero (0), without any considerations.

- **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**

<table>
<thead>
<tr>
<th>Week</th>
<th>Date/Day (tentative)</th>
<th>Topics</th>
<th>Textbook/Assignments</th>
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<tbody>
<tr>
<td>1</td>
<td>20.09.17</td>
<td>The origin and characteristics of natural gas</td>
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<tr>
<td></td>
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<td>- Natural gas composition &amp; properties</td>
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<td>- Ideal and real gas EOS</td>
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<td></td>
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<td>- Gas reservoirs types</td>
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<td></td>
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<td>- Natural gas resources types</td>
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<td>- Comparison of Conventional and unconventional gas reservoirs</td>
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<td>- Field studies of the South Caspian Basin</td>
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<tr>
<td>Week</td>
<td>Date</td>
<td>Topic</td>
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</table>
| 2    | 27.09.17 | PVT lab experiments  
• Constant Volume Depletion  
• Constant Composition Expansion  
• High Pressure / High Temperature Fluids  
• PVT reports |
| 3    | 04.10.17 | Gas reserves  
• Volumetric method  
• Material balance method  
• Reservoir Simulation method  
• Decline curve |
| 4    | 11.10.17 | Gas well testing  
• Dynamic Characterization  
• Formation testing  
• Well testing  
• Drill Stem Test (DST)  
• Well test equipments  
• Wellbore storage effect |
| 5    | 18.10.17 | Estimation of gas deliverability  
• Reservoir deliverability  
• Well deliverability |
| 6    | 25.10.17 | Gas flow measurement  
• Methods of measurements  
• Factors for method selections  
• Volumetric measurement  
• Orifice metering  
• Recording charts  
• Problems |
| 7    | 01.11.17 | Gas well performance  
• Static & following BHP  
• Basic Energy Equation  
• Adjusting for liquid production  
• Calculation of static BHP  
• Gas-liquid flow in wellbore |
| 8    | 08.11.17 | Midterm Exam |
| 9    | 15.11.17 | Gas gathering & transportation  
• Friction factor  
• Reynolds number  
• Relative roughness  
• Pipeline flow calculation  
• Gas-liquid flow in pipelines |
| 10   | 22.11.17 | Field treatment and processing of natural gas  
• Raw natural gas  
• Natural gas processing  
• Field treatment unit |
| 11   | 29.11.17 | Underground Gas Storage (UGS)  
• Storage role  
• Storage modulation  
• Main definitions  
• Storage history  
• Main types  
• Storage in the world wide |
| 12   | 06.12.17 | Gas-condensate reservoir engineering  
• Mole composition |
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<tr>
<td></td>
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<td>This syllabus is a guide for the course and any modifications to it will be announced in advance.</td>
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| 13 | 13.12.17 | Development of Gas-condensate reservoirs with Oil rim  
- Introduction  
- How to get the most out of your Oil rim reservoirs  
- Oil rim production and depletion strategy  
- Oil rim development traffic light screening  
- Oil rim development key success elements  
- Peculiarities of thin oil rim development  
- Improved well design maximizes oil rim profitability  
- Effective management of thin oil rims  
- Field examples from Worldwide and South Caspian Basin |
|   |   |   |
| 14 | 20.12.17 | Gas reservoir management  
- Some reservoir engineering applications of producing logging  
- Selective inflow performance  
- Field data collection  
- Pro-active management of fluid contacts  
- Claymore Reservoir engineering study  
- Permanenat downhole gauges and venture flowmeters  
- Saturation monitoring  
- Paleo hydrocarbon contacts |
|   |   |   |
| 15 | 27.12.17 | Special problems  
- Pressure-cumulative production plots  
- Hydrate formation  
- Sour gas production  
- Pipeline cleaning |
|   | TBA | Final Exam |