



# **GAS PROCESSING**

## *MSc in Petroleum Engineering* **MFKOT7703**

### Course Description

Olaj- és gázmérnöki mesterszak  
MSc Angol Olaj

Nappali munkarend  
Daily work schedule

TANTÁRGYI KOMMUNIKÁCIÓS DOSSZIÉ  
CURRICULUM COMMUNICATION FILE

Miskolci Egyetem  
Műszaki Földtudományi Kar  
Kőolaj és Földgáz Intézet

Miskolc University  
Faculty of Earth Science and Engineering  
Institute of Petroleum and Natural Gas

Miskolc, 2022/2023 I. félév / Semester

### Course Data Sheet

| <p><b>Course Title:</b> Compulsory elective I.<br/>Gas Processing<br/><b>Instructor:</b> Dr. László KIS,<br/>senior lecturer</p>   | <p><b>Code:</b> MFKOT77003<br/><b>Responsible department/institute:</b><br/>DPE/IPNG (OMTSZ/KFGI)<br/><b>Course Element: Compulsory Elective</b></p> |     |          |      |               |      |              |      |            |      |       |      |   |         |       |          |                  |          |          |          |                     |          |          |         |            |
|--|--|-----|----------|------|---------------|------|--------------|------|------------|------|-------|------|---|---------|-------|----------|------------------|----------|----------|----------|---------------------|----------|----------|---------|------------|
| <p><b>Position in curriculum*<br/>(which semester):</b> 1<br/>(4)</p>  | <p><b>Pre-requisites (if any):</b> -</p>   |     |          |      |               |      |              |      |            |      |       |      |   |         |       |          |                  |          |          |          |                     |          |          |         |            |
| <p><b>No. of contact hours per week (lecture<br/>+ seminar):</b> 2+0</p>   | <p><b>Type of Assessment (examination /<br/>practical mark / other):</b> practical mark</p>  |     |          |      |               |      |              |      |            |      |       |      |   |         |       |          |                  |          |          |          |                     |          |          |         |            |
| <p><b>Credits:</b> 2</p>   | <p><b>Course:</b> full time</p>  |     |          |      |               |      |              |      |            |      |       |      |   |         |       |          |                  |          |          |          |                     |          |          |         |            |
| <p><b>Course Description:</b></p> <ol style="list-style-type: none"> <li>1. Gas laws</li> <li>2. Equation of states and their usage.</li> <li>3. Physical properties of hydrocarbon systems.</li> <li>4. Vapor-liquid equilibrium calculations 1.</li> <li>5. Vapor-liquid equilibrium calculations 2.</li> <li>6. Gas hydrates and their formation.</li> <li>7. Basics of separation,</li> <li>8. Basics of separator types, separator design 1.</li> <li>9. Basics of separator types, separator design 2.</li> <li>10. Absorption gas drier and treating system.</li> <li>11. Adsorption technology.</li> <li>12. Cold separation.</li> <li>13. Cold separation technology</li> <li>14. Computer modelling of gas treating technologies.</li> </ol> <p>Competencies to evolve:<br/>Knowledge: T1, T4, T5, T11<br/>Ability: K1, K4, K5, K9, K10, K11<br/>Attitude:<br/>Autonomy and responsibility: F1, F3, F6, F7</p> |  |     |          |      |               |      |              |      |            |      |       |      |   |         |       |          |                  |          |          |          |                     |          |          |         |            |
| <p><b>Assessment and grading:</b><br/>Students will be assessed with using the following elements.</p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 40%;">Attendance:</td> <td style="width: 20%; text-align: right;">5 %</td> </tr> <tr> <td>Homework</td> <td style="text-align: right;">10 %</td> </tr> <tr> <td>Short quizzes</td> <td style="text-align: right;">10 %</td> </tr> <tr> <td>Midterm exam</td> <td style="text-align: right;">40 %</td> </tr> <tr> <td>Final exam</td> <td style="text-align: right;">35 %</td> </tr> <tr> <td>Total</td> <td style="text-align: right;">100%</td> </tr> </table>  | Attendance:  | 5 % | Homework | 10 % | Short quizzes | 10 % | Midterm exam | 40 % | Final exam | 35 % | Total | 100% | <p><b>Grading scale:</b></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 40%;">% value</th> <th style="width: 60%;">Grade</th> </tr> </thead> <tbody> <tr> <td>90 -100%</td> <td>5<br/>(excellent)</td> </tr> <tr> <td>80 – 89%</td> <td>4 (good)</td> </tr> <tr> <td>70 - 79%</td> <td>3<br/>(satisfactory)</td> </tr> <tr> <td>60 - 69%</td> <td>2 (pass)</td> </tr> <tr> <td>0 - 59%</td> <td>1 (failed)</td> </tr> </tbody> </table> | % value | Grade | 90 -100% | 5<br>(excellent) | 80 – 89% | 4 (good) | 70 - 79% | 3<br>(satisfactory) | 60 - 69% | 2 (pass) | 0 - 59% | 1 (failed) |
| Attendance:  | 5 %  |     |          |      |               |      |              |      |            |      |       |      |   |         |       |          |                  |          |          |          |                     |          |          |         |            |
| Homework   | 10 %   |     |          |      |               |      |              |      |            |      |       |      |   |         |       |          |                  |          |          |          |                     |          |          |         |            |
| Short quizzes  | 10 %   |     |          |      |               |      |              |      |            |      |       |      |   |         |       |          |                  |          |          |          |                     |          |          |         |            |
| Midterm exam   | 40 %   |     |          |      |               |      |              |      |            |      |       |      |   |         |       |          |                  |          |          |          |                     |          |          |         |            |
| Final exam   | 35 %   |     |          |      |               |      |              |      |            |      |       |      |   |         |       |          |                  |          |          |          |                     |          |          |         |            |
| Total  | 100%   |     |          |      |               |      |              |      |            |      |       |      |   |         |       |          |                  |          |          |          |                     |          |          |         |            |
| % value  | Grade  |     |          |      |               |      |              |      |            |      |       |      |   |         |       |          |                  |          |          |          |                     |          |          |         |            |
| 90 -100%   | 5<br>(excellent)   |     |          |      |               |      |              |      |            |      |       |      |   |         |       |          |                  |          |          |          |                     |          |          |         |            |
| 80 – 89%   | 4 (good)   |     |          |      |               |      |              |      |            |      |       |      |   |         |       |          |                  |          |          |          |                     |          |          |         |            |
| 70 - 79%   | 3<br>(satisfactory)  |     |          |      |               |      |              |      |            |      |       |      |   |         |       |          |                  |          |          |          |                     |          |          |         |            |
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| 0 - 59%  | 1 (failed)   |     |          |      |               |      |              |      |            |      |       |      |   |         |       |          |                  |          |          |          |                     |          |          |         |            |

**Compulsory or recommended literature resources:**

- J. M. Campbell (2014): Gas Conditioning and Processing, Vol. 1.: The Basic Principles, 9<sup>th</sup> edition, ISBN 978-0-9703449-2-2
- J. M. Campbell (2014): Gas Conditioning and Processing, Vol. 2.: The Equipment Modules, ISBN 978-0-9703449-5-3
- R. N. Maddox, D. J. Morgan (2006): Gas Conditioning and Processing, Vol. 4.: Gas Treating and Sulphur Recovery, ISBN 978-0-9703449-3-7
- F. S. Manning, R. E. Thompson (1991): Oilfield Processing of Petroleum, Volume 1.: Natural Gas, ISBN 978-0-87814-343-6
- A. Bahadori: Natural Gas Processing: Technology and Engineering Design, Gulf Professional Publishing, 2014. ISBN 9780124202047

### Course Schedule for 2022/23 school year

| <b>Date</b> | <b>Topic</b>  |
|-------------|---|
| 9/8/2022    | Gas laws  |
| 9/15/2022   | Equation of states and their usage.   |
| 9/22/2022   | Physical properties of hydrocarbon systems.                                 |
| 9/29/2022   | Vapor-liquid equilibrium calculations 1.                                    |
| 10/6/2022   | Vapor-liquid equilibrium calculations 2.                                    |
| 10/13/2022  | Gas hydrates and their formation. Basics of separation, Test writing.       |
| 10/20/2022  | Break   |
| 10/27/2022  | Break   |
| 11/3/2022   | Basics of separator types, separator design                                 |
| 11/10/2022  | Absorption gas drier and treating system.                                   |
| 11/17/2022  | Adsorption technology.  |
| 11/24/2022  | Cold separation.  |
| 12/1/2022   | Cold separation technology Computer modelling of gas treating technologies. |
| 12/8/2022   | Test writing.   |

## Test Example

### Gas Processing Test

1. List the known basic hydrocarbon groups (4) with their formula and at least one member. (20p)
2. List the most common impurities in the produced hydrocarbons (4). Mention at least one associated problem for every impurity. (13p)
3. Why is the treating of the produced natural gas essential? (8p)
4. What is the Wobbe number? Write down its formula. (7p)
5. Find the higher heating value for the following gas mixture. (10p)

| Composition     | mol% | MW [kg/kmol] | HHV [MJ/m <sup>3</sup> ] |
|-----------------|------|--------------|--------------------------|
| C1              | 77.5 | 16           | 37.7                     |
| C2              | 7.5  | 30           | 66.0                     |
| C3              | 10.0 | 44           | 94.4                     |
| N <sub>2</sub>  | 2.0  | 28           | 0.0                      |
| CO <sub>2</sub> | 3.0  | 44           | 0.0                      |
| Total           | 100  |              |                          |

6. How the required water-content of a natural gas mixture is defined (2)? (3p)
7. What is the gas sweetening procedure? (3p)
8. List different methods for dehydration. (7p)
9. Estimate the water content of the natural gas containing 10% H<sub>2</sub>S and 30% CO<sub>2</sub> at 30°C and 15000 kPa. Find the equivalent H<sub>2</sub>S concentration. Correct the water content with the obtained factor. (10p)
10. Water is separated in an inlet scrubber upstream of a compressor at 3 MPa and 45°C. The gas is then compressed to 20 MPa and cooled to 60 °C before entering the dehydrator. Is the gas saturated when entering the dehydrator? If not, find the temperature when it is saturated. (8p+10p)

## ***Examination review questions***

1. Gas laws
2. Equation of states and their usage.
3. Physical properties of hydrocarbon systems.
4. Vapor-liquid equilibrium calculations 1.
5. Vapor-liquid equilibrium calculations 2.
6. Gas hydrates and their formation. Basics of separation,
7. Basics of separator types, separator design 1.
8. Basics of separator types, separator design 2.
9. Absorption gas drier and treating system.
10. Adsorption technology.
11. Cold separation.
12. Cold separation technology Computer modelling of gas treating technologies.