WATER CHEMISTRY

Hydrogeology Engineer MSc

2022/23 Semester II.

COURSE COMMUNICATION FOLDER

**University of Miskolc
Faculty of Earth and Environmental Science and Engineering
Institute of Water Resources and Environmental Management**

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1. Course introduction, teacher, number of lessons, credits

Course Title: Water chemistry	**Code:** MFKHT726005
Instructor: Dr. Márton Tóth, assistant professor	**Responsible department/institute:** Institute of Water Resources and Environmental Management
	Type of course: Compulsory
Position in curriculum (which semester): 2	**Pre-requisites (if any):**
No. of contact hours per week (lecture + seminar): 1+1	**Type of Assessment (examination/ practical mark / other):** practice mark
Credits: 2	**Course:** full time

Course Description:
The students will be familiar with the structure and chemical properties and reactivity of water molecule, and will learn about the main principle of the equilibriums exist in aquatic system.

The short curriculum of the subject:
Physical and chemical properties of water. The state diagram of water. Properties of ice, liquid water and steam. Supercritical state of water. The chemical structure of water molecule and its consequences. Behavior of water as a solvent. Dissolution process of gases, liquids and solids in water. Behavior of water as a chemical partner. Acid base equilibria, hydrolysis, complex formation and redox reactions. Isotopic, and chemical compositions of different waters. The main characteristic parameters used for description of water quality.

Compatencies to evolve:
Knowledge: T1, T2, T6, T7, T8
Ability: K1, K6, K9, K10, K11, K12, K15
Attitude: A2, A5
Autonomy and responsibility:F2, F5, F6

Assessment and grading:
Students will be assessed with using the following elements.

Final exam   100%
Total   100%

Grading scale:

% value	Grade
90 -100%	5 (excellent)
80 – 89%	4 (good)
70 - 79%	3 (satisfactory)
60 - 69%	2 (pass)
0 - 59%	1 (failed)

Compulsory or recommended literature resources:
- Appelo, C. and Postma, D. (2005) Geochemistry, Groundwater and Pollution. 2nd Edition, Balkema, Rotterdam.
- Stumm, W. and Morgan, J.J. (1996) Aquatic Chemistry, Chemical Equilibria and Rates in Natural Waters. 3rd Edition, John Wiley & Sons, Inc., New York.
- Brezonik, P. and Arnold, W. (2011) Water Chemistry: An Introduction to the Chemistry of Natural and Engineered Aquatic Systems. Oxford University Press, Oxford.

2. Course syllabus

Water chemistry
Syllabus
Spring semester
Hydrogeological Engineer MSc, Semester II., Compulsory course

03.01	The structure and physical properties of water
03.08	Inorganic chemical composition of natural waters
03.15	Holiday
03.22	Dissolution
03.29	Thermodynamic basis for equilibrium chemistry
04.05	Acid-base systems
04.12	Acid-base systems – The carbonate system
04.19	Holiday
04.26	Redox equilibria I.
05.03	Redox equilibria II.
05.10	Labor I
05.17	Labor II.
05.24	Test
05.31	Test repetition

3. Example Test

Water chemistry
TEST 1.
2022.05.04

Short questions: **Total point: 10**

1. What is electrostriction?
2. What are the most common anions in water?
3. Exothermic process when…?
4. What is carbonate alkalinity?
5. What is reduction?
6. What is evaporation heat?
7. What is incongruent solution?
8. What is Raoult-law?
9. How the pH changes during solution of Na_2CO_3?
10. What is reducing agent?

Questions: **Total point: 20**

1. What do you know about viscosity of water?
2. What do you know about the major anions chemical properties in water?
3. What do you know about the solution of CO_2 in water? (forms, pH dependency, alkalinity definitions)
4. Derive the redox equation of oxidation of Fe(II) by O_2?

Calculation exercises: **Total point: 20**

1. What is the $\Delta G°$ for acid-mediated dissolution of goethite (FeOOH)? (take care about the stochiometric coefficients)
   ($G_f°$ for FeOOH is -488.6 kJ/mol, $G_f°$ for Fe^{3+} is -4.6 kJ/mol, $G_f°$ for H_2O is -237.18 kJ/mol)
2. The chemical analysis of a water sample is:

Ca	K	Mg	Na	SO_4^{2-}	Cl^-	HCO_3^-
ppm	ppm	ppm	ppm	ppm	ppm	ppm
83.2	9.9	23.5	60.2	92.5	25.7	421.4

   Is there charge balance between cations and anions? If there is not balance give suggestion what could be the problem!
3. Calculate the ionic strength of the previous water sample!
4. Calculate the activity coefficient of SO_4^{2-} in the previous water sample by Davis equation?
   (A=0.5042 (T=20°C))