



No. \_\_\_\_\_ of \_\_\_\_\_

## SUBJECT OUTLINE

### 1. Information on the programme

1.1. Higher education institution	University of Agricultural Sciences and Veterinary Medicine of Cluj-Napoca
1.2. Faculty	Agriculture
1.3. Department	Environmental and plant protection
1.4. Field of study	Environment engineering
1.5. Cycle of study <sup>1</sup>	Bachelor
1.6. Specialization/ Study programme	Environment engineering
1.7. Form of education	Full time

### 2. Information on the discipline

2.1. Discipline name	Groundwater engineering							
2.2. Course coordinator	Șef lucr. dr.ing. Călin Safirescu							
2.3. Seminar/ laboratory/ project coordinator	Șef lucr. dr. ing. Călin Safirescu							
2.4. Year of study	II	2.5. Semester	I	2.6. Evaluation type	Sumative	2.7. Discipline status	Content <sup>2</sup>	D
							Compulsoriness <sup>3</sup>	DI

### 3. Total estimated time (teaching hours per semester)

3.1. Hours per week - full time programme	4	out of which: 3.2. lecture	2	3.3. seminar/ laboratory/ project	2
3.4. Total number of hours in the curriculum	56	out of which: 3.5. lecture	28	3.6. seminar/laboratory	28
Distribution of the time allotted					hours
3.4.1. Study based on books, textbooks, bibliography and notes					16
3.4.2. Additional documentation in the library, electronic platforms and field experiences					12
3.4.3. Preparing seminars/ laboratories/ projects, subjects, reports, portfolios and essays					12
3.4.4. Tutorials					4
3.4.5. Examinations					4
3.4.6. Other activities					
3.7. Total hours of individual study	48				
3.8. Total hours per semester	104				
3.9. Number of credits <sup>4</sup>	4				

### 4. Prerequisites (if applicable)

4.1. curriculum-related	Fluid mechanics
4.2. skills-related	Team communications skills, organization, use of internet for research

### 5. Conditions (if applicable)

5.1. for the course	The course is interactive, students can ask questions about the content of the exhibition. Academic discipline is required for the entire time of the lecture. There are not tolerated others activities during the lecture, mobile phones must be switched off. The classroom has video-projector.
5.2. for the seminar/ laboratory/ project	The classroom has video-projector, blackboard. Academic discipline is required throughout the duration of the work. Laboratory room with process specificity.

### 5. Cumulated specific competences

Professional competences	<p><b>1. Knowledge and understanding</b> (knowledge and proper use of discipline-specific notions)- The capability to apply general knowledges about the quality of groundwater resources; knowledge of the principles and notions specific to the technological process related to groundwater management.</p> <p><b>2. Instrumental-applicative</b> – Use of mechanisms characteristic of engineering in order to maintain groundwater quality</p> <p><b>3. Aptitudinal-</b> manifesting a positive and responsible attitude towards the scientific field, based on the knowledge of the events and the practical connections;- development of a scientific environment focused on democratic values and relationships; - the optimal and creative exploitation of its own potential in scientific activities; - engaging in the partnership relationship with other people: colleagues, teachers, people from the economic department,etc.-participation in their own scientific development</p>
Transversal competences	<p>To develop the skills to work effectively with people with different personalities and backgrounds. To have competences for analyzing the usefulness of different types of programs in different contexts.</p>

### 7. Discipline objectives (based on the cumulated specific competences)

7.1. General objective	Acquiring the basics of groundwater engineering
7.2. Specific objectives	<p>Knowledge and understanding of the different basic concepts of groundwater engineering. To develop the capacity for analysis and synthesis using specific terms. Enrichment of specialized vocabulary, knowledge of the laws that dominate the groundwater.</p>

### 3. Content

8.1. COURSE Number of hours – 28	Teaching methods	Observation
<b>Chapter 1. General notions regarding water resources</b>	Lecture	2 hours
1.1 The particularities of water as an environmental factor		
1.2 Legislative aspects regarding water resources		
<b>Chapter 2. Groundwater – characteristics and importance</b>	Lecture	2 hours
<b>Chapter 3. Aquifer layers</b>		
3.1 Formation of aquifer layers	Lecture	4 hours
3.2 Classification of aquifer layers		
<b>Chapter 4. The movement of groundwater</b>	Lecture	6 hours
4.1 Hydrogeological characteristics of aquifer layers		
4.2 Darcy's law		
4.3 Groundwater flow in conservative stationary regime		
4.3 Groundwater flow in non-conservative stationary regime		
<b>Chapter 5. Groundwater capture</b>	Lecture	6 hours
5.1 Hydrogeological drilling		
5.2 Types of groundwater catchments. Characterization		
5.3 Optimization of capture works		
5.4 Sanitary protection of groundwater catchments		
5.5 Methods of enrichment of aquifer layers		
5.6 Exploitation of groundwater catchments. Indicators of performance	Lecture	2 hours
<b>Chapter 6. Control of groundwater level</b>		
6.1 Works carried out at groundwater level		
6.2 Particular issues regarding groundwater flow control		
<b>Chapter 7. Control of groundwater pollution</b>	Lecture	6 hours
7.1 Sources of groundwater pollution		
7.2 Indicators of groundwater quality		
7.3 Methodes of control of groundwater quality		
7.4 Gorundwater remediation		

8.2. PRACTICAL WORKS Number of hours – 28	Teaching methods	Observation
1.1 The general issue of groundwater resources worldwide and in Romania. Benchmarking	Presentation,Brainstorming.	2 Hours
1.2 Characterization of aquifer layers	Presentation,Brainstorming	2 Hours
1.3 Groundwater balance	Exercise method	4 Hours
1.4 Determining the value of the hydrogeological characteristics of groundwater	Presentation,Brainstorming.	4 Hours
1.5 Sizing groundwater catchments	Exercise method	4 Hours
1.6 Case studies. Construction made in Romania for the capture of groundwater	Presentation,Brainstorming.	4 Hours
1.7 Methods of investigation and evaluation of hydrostructures	Exercise method	4 Hours
1.8 Groundwater quality control: sampling, determination of physical-chemical indicators (pH, turbidity, conductivity, total nitrogen)	Exercise method	4 Hours
1.9 Knowledge checking	Method of verification	2 Hours
<p><i>Compulsory bibliography:</i></p> <ol style="list-style-type: none"> <li>1. Odagiu Antonia, 2014, <i>Ingineria apelor subterane</i>, suport de curs</li> <li>2. Mănescu Alexandru, 2009, <i>Ingineria apelor subterane</i>, Editura Conspress, București</li> <li>3. Păunescu, D., 2014, <i>Ingineria apelor subterane</i>, Editura Națiunea, București</li> <li>4. Marinov A.M., G.E. Dumitran, M.A. Diminescu, 2007, <i>Monitorizarea apelor subterane și remedierea acviferelor</i>, Ed. Politehnica Press, București</li> <li>5. Vulpașu E., 2008, <i>Tratarea apei. Coagularea - flocularea suspensiilor din apă</i>, Editura Conspress, București</li> </ol>		
<p><i>Optional bibliography:</i></p> <ol style="list-style-type: none"> <li>1. Delleur J. (Ed.), 2006, <i>The Handbook of Groundwater Engineering</i>, II<sup>nd</sup> Edition, CRC Press, USA</li> <li>2. Kresic, N., <i>Hydrogeology and Groundwater Modelling</i>, II<sup>nd</sup> Edition, CRC Press, USA</li> <li>3.***, 2009, Comisia Europeană, Direcția generală de mediu, Protecția apelor subterane în Europa, <a href="http://ec.europa.eu/environment/water/water-framework/groundwater/pdf/brochure/ro.pdf">http://ec.europa.eu/environment/water/water-framework/groundwater/pdf/brochure/ro.pdf</a></li> </ol>		

**9. Corroborating the discipline content with the expectations of the epistemic community representatives, of the professional associations and of the relevant employers in the corresponding field**

The content of the discipline is in accordance with what is studied in other university centers in the country and abroad.

The content and structure of the course are aspects adapted to the needs of the students and the demands of the employers in the field of environmental engineering.

The graduates of this course can use their knowledge gained in the job market offers, in institutions with a technological profile in general and in those with an environmental engineering profile in particular, including in companies and or non-governmental organizations that provide consultancy in the field.

At the same time, the specific knowledge of the course is a starting point towards the higher level of preparation, represented by the doctoral programs, in the field of environmental protection.

**10. Evaluation**

Type of activity	10.1. Evaluation criteria	10.2. Evaluation type	10.3. Percentage of the final grade
10.4. Course	<p><b>Minimum requirements for 5</b> (how to awarde 5) Note 5 is awarded following the individual evaluation of each subject, which must obtain note 5 individually;</p>		
	<p>The final average will be a simple arithmetic resulting from the final note at the periodic verification</p> <p><b>Requirements for 10</b> 10 is awarded following the individual evaluation of each subject, at the higher level of subject learning. It follows the student's ability to make logical connections between concepts, as well as the global vision he has on the subject.</p>	Oral exam	70%

<p><b>10.5.</b> <b>Seminar/Laboratory</b></p>	<p>The mode of public presentation of the reports. The correctness of the answers to the questions.</p>	<p>Performance evaluation at final verification. Questions for students.</p>	<p>30%</p>
<p><b>10.6. Minimum performance standards</b></p>			
<p>60% knowledge of the information taught at the course.</p>			

- 1 Cycle of studies - choose one of the three options: Bachelor/Master/Ph.D.
- 2 according to the educational plan
- 3 Discipline status (compulsoriness) - choose one of the options - **DI** (compulsory discipline) **DO** (optional discipline) **DFac** (facultative discipline).
- 4 One credit is equivalent to 25-30 hours of study (teaching activities and individual study).

Filled in on  
04.09.2019

Course coordinator  
Şef lucr. dr. ing. Călin SAFIRESCU

Laboratory work/seminar coordinator  
Şef lucr. dr. ing. Călin SAFIRESCU

Approved by the  
department on  
05.09.2019

Head of the Department  
Prof. dr. Ioan OROIAN