

Introduction to hydrogeology and sustainable groundwater management
- COURSE SYLLABUS



1.	Course title:	
		<i>Introduction to hydrogeology and sustainable groundwater management</i>
2.	Lecturer:	
		<i>dr inż. Anna Kuczyńska – course supervisor; lecturers: dr Małgorzata Woźnicka, dr Krzysztof Józwiak, dr Lidia Razowska – Jaworek, prof. Tetyana Solovey, mgr Grzegorz Olesiuk, mgr Magdalena Nidental, mgr Agnieszka Piasecka, mgr Agnieszka Kowalczyk, mgr Michał Wyszomierski, mgr Lech Śmietański</i>
3.	Field, type and level of studies, year of study:	
		<i>Geology, hydrogeology, all-year</i>
4.	Course character:	
		<i>GeoPlanet interdisciplinary lecture</i>
5.	Teaching method:	
		<i>Lectures and one site workshop</i>
6.	Language:	<i>English</i>
7.	Course type and number of hours:	
		<i>Lecture 28 hrs, site workshop 2 hrs</i>
8.	Estimated load of student's independent work:	<i>20 hrs</i>
9.	Total workload and number of ECTS points:	<i>3</i>
10.	Short description and main focus of the course:	
		<p><i>Groundwater is one of the most vital resources for humans. It is the world's most extracted raw material with withdrawal rates estimated at nearly 1000 km³/year. It provides almost half of all drinking water worldwide and 70% of the total use of water for agricultural purposes. The total volume of groundwater in the upper 2 km of the Earth's continental crust is approximately 22.6 million km³, of which 0.1 million km³ to 5.0 million km³ is less than 50 years old. Groundwater is a renewable resource, however its' long-lasting sustainability depends on proper water managed.</i></p> <p><i>This course will provide students with basic information on groundwater occurrence, flow dynamics, quality characterisation and rules for sustainable groundwater management. The course will discuss issues of hydrogeological assessments, identification of pressures to groundwater and their mitigation. Quality assurance and quality management in groundwater monitoring as well as numerical modelling of groundwater flow and chemistry are useful tools in groundwater management.</i></p>
11.	References:	

Akhauri S., Akhauri H.M., 2015 – *Fundamentals of Hydrogeology*, Zorba Books.

Appelo C.A.J., Postma D., 2005 - *Geochemistry, Groundwater and Pollution*, CRC Press, London.

Bear J., 1972 – *Dynamics of fluids in porous media*. Am. Elsevier. New York – London – Amsterdam.

Bedient P. B., Rifai H.S., Newell Ch. J., 1999 – *Groundwater contamination transport and remediation*. Prentice Hall. Upper Saddle River.

Berner E.K., Berner R.A, 1996 – *Global environment: water, air and geochemical cycles*. Prentice Hall. New Jersey.

Deutsch W. J., 1997 – *Groundwater geochemistry. Fundamentals and applications to contamination*. CRC Press. Boca Raton, Florida, USA.

Domenico P.A., Schwartz F., 1991 – *Physical and chemical hydrogeology*. J. Willey & Sons Inc., New York, USA.

Drever J.I., 1997 – *The geochemistry of natural waters: surface and groundwater environments*. 3 edition, Prentice-Hall. Upper Saddle River.

Driscoll F. G., 1995 – *Hydrogeology and Wells*. Johnson Division., St. Paul, Minnesota.

Fetter C.W., Kreamer D., 2022 – *Applied Hydrogeology Fifth Edition*, Waveland Press, Inc.

Fitts Ch., 2012 - *Groundwater Science*, Elsevier Inc.

Freeze R.A., Cherry J.A., 1980 – *Groundwater*, Prentice Hall Inc.

Gilli E., Mangan Ch., Mudry J., 2013 - *Hydrogeology - Objectives, Methods, Applications*, CRC Press, Taylor and Francis Group.

Jiao J., Post V., 2019 – *Coastal hydrogeology*. Cambridge University Press. TJ International Ltd. Padstow Cornwall.

Krasny J., Sharp J.M., 2007 – *Groundwater in fractured rocks. Selected papers from the Groundwater in Fractured Rocks International Conference, Prague, 2003*. CRC Press. Taylor and Francis Group.

McBride M.B., 1994 – *Environmental chemistry of soils*. Oxford University Press New York-Oxford.

Pinneker, E.V., 2010 - *General Hydrogeology*, Cambridge University Press.

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Poeter E., Fan Y., Cherry J., Wood W., Mackay D., 2020 – *Groundwater in Our Water cycle. Getting to know Earth's most important Fresh Water Source, The Groundwater Project*, Guelph, Ontario, Canada.

White D.E., Hem J. D., Waring G. A., 1963 – *Chemical composition of subsurface waters*. U.S. Geol. Survey Professional Paper 440-F.

Zekâi Ş., 2015 – *Practical and Applied Hydrogeology*, Elsevier Inc.

12.	Prerequisites:	
	none	
13.	Educational outcomes:	<u>PQF level 8 codes:</u>
	Knowledge: The student knows basics of groundwater flow dynamics and hydrochemistry with its implication to sustainable water management in line with current EU regulations.	P8U_W
	Practical Skills: The student knows basic practical tools used for characterisation and analysis of groundwater flow and its chemistry. Can analyse and creatively synthesise scientific and creative achievements to identify and solve research problems as well as those related to innovative and creative activities; independently plan one's own development and participate in the exchange of experiences and ideas, also in the	P8U_U

	<i>international community</i>	
	Social Skills: <i>The student is ready to conduct independent research which contributes to existing scientific and creative achievements; assume professional and public challenges taking into consideration their ethical dimension, responsibility for their results and develop models of good practice in such situations</i>	<i>P8U_K</i>
14.	Evaluation of the educational outcomes: <i>Attendance (80%) + essay (20%). Selection of essay topics will be provided during in the month of lectures.</i>	
15.	Criteria to complete the course: <i>80% attendance, 20% essey</i>	
16.	Contact with the lecturer: <i>anna.kuczynska@pgi.gov.pl</i>	