# UČNI NAČRT PREDMETA/COURSE SYLLABUS

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| **Predmet:** | Kvantitativna hidrogeologija |
| **Course title:** | Quantitative Hydrogeology |

| Študijski programi in stopnja | Študijska smer | Letnik | Semestri |
|---|---|---|---|
| Geologija, druga stopnja, magistrski | Aplikativna geologija (modul) | 1. letnik | Letni |

**Univerzitetna koda predmeta/University course code:** 715

| Predavanja | Seminar | Vaje | Klinične vaje | Druge oblike študija | Samostojno delo | ECTS |
|---|---|---|---|---|---|---|
| 45 | 0 | 30 | 0 | 0 | 75 | 5 |

**Nosilec predmeta/Lecturer:** Mihael Brenčič

**Vrsta predmeta/Course type:** Obvezni / Compulsory

| **Jeziki/Languages:** | | |
|---|---|---|
| | Predavanja/Lectures: | Angleščina, Slovenščina |
| | Vaje/Tutorial: | Angleščina, Slovenščina |

| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | **Prerequisites:** |
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| Zaključena dodiplomska (prva) stopnja.<br>Opravljeni izpiti Matematika 1, Matematika 2 in Fizika iz obsega 1. stopenjskega študija geologije. | Bachelor degree.<br>Completed exams in Mathematics 1, Mathematics 2, and Physics included in the curriculum of BcS in Geology. |

| **Vsebina:** | **Content (Syllabus outline):** |
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| Predavanja:<br>Prikaz osnovnih matematičnih orodij kvantitativne hidrogeologije.<br>Osnovne enačbe toka podzemne vode v medzrnskem poroznem mediju (zaprt vodonosnik, odprt vodonosnik in polzaprt vodonosnik).<br>Analitične rešitve enačb toka podzemne vode v medzrnskem poroznem mediju (stacionarni in nestacionarni sistemi).<br>Tok podzemne vode v razpoklinskem poroznem mediju.<br>Tok podzemne vode v dvojni poroznosti.<br>Tok podzemne vode v nezasičenem poroznem medzrnskem mediju.<br>Hidravlika vodnjakov v zaprtih, polzaprtih in odprtih vodonosnikih.<br>Hidravlika vodnjakov v razpoklinskih vodonosnikh in vodonosnikih z dvojno poroznostjo.<br>Poglobiti razumevanje širjenja onesnaževal v podzemni vodi in vodonosnikih<br>Razumevanje konceptov masnega toka v različnih poroznih medijih v geološkem okolju.<br>Vaje:<br>Seminarske vaje (računske vaje iz dinamike podzemne vode) | Lectures:<br>Illustration of basic mathematical tools applied in quantitative hydrogeology.<br>Basic equations of groundwater flow in intergranular porous media (confined aquifer, unconfined aquifer, leaky aquifer).<br>Analytical solutions of groundwater flow equations in intergranular porous media (stationary and non stationary systems).<br>Flow of groundwater in fissured porous media.<br>Flow of groundwater in double porosity media.<br>Flow of groundwater in unsaturated porous media.<br>Well hydraulics in confined, leaky and unconfined aquifers.<br>Well hydraulics in fissured aquifers and aquifers with double porosity.<br>Concepts of pollutant spreading in groundwater and aquifers.<br>Concepts of mass transport in various porous media in the geological environment.<br>Exercises:<br>Seminar exercises (mathematical exercises in the groundwater dynamics)<br>Laboratory exercises (application of mathematical models |

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| Laboratorijske vaje (uporaba matematičnih modelov za modeliranje toka podzemne vode). | in modelling groundwater flow). |

**Temeljna literatura in viri/Readings:**

Posamezna poglavja iz / Chapters from:
RUSHTON, K.K., 2005: Groundwater Hydrology. Wiley.
LEBBE, L.C., 1999: Hydraulic Parameter Identification. Springer.
BATU, V., 1998: Aquifer Hydraulic. Wiley.
BRENČIČ, M., 2009: Dinamika podzemne vode. NTF študijsko gradivo
FETTER, C.W., 1999: Contaminant hydrogeology. Prentice Hall.
KEHEW, A. E., 2001: Applied Chemical Hydrogeology. Prentice Hall.

| **Cilji in kompetence:** | **Objectives and competences:** |
|---|---|
| CILJI: Poglobiti razumevanje toka podzemne vode in njene porazdelitve v geološkem poroznem mediju. Razumevanje konceptov različnih poroznih medijev v geološkem okolju. Podati teoretične osnove dinamike toka podzemne vode v različnih vodonosnikih in poroznih medijih z namenom uporabe znanj pri praktičnih primerih izkoriščanja podzemne vode za oskrbo prebivalstva s pitno vodo in zaščite vodnih virov.<br>KOMPETENCE: Sposobnost izbire primernega modela ter kalibracije in validacije izbranega modela za posamezne primere toka podzemne vode. | OBJECTIVES: To deepen the understanding of groundwater flow and its distribution in the geological porous media. Understanding the concepts of various porous media in the geological environment. Toillustrate the theoretical basis of the dynamics of groundwater flow in different aquifers and porous media with a emphasis on the application of knowledge to practical cases of exploitation of underground water for supplying the population with drinking water and protection of water resources.<br>COMPETENCES: The ability to choose an appropriate model, and calibration and validation of the model chosen for individual cases of groundwater flow. |

| **Predvideni študijski rezultati:** | **Intended learning outcomes:** |
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| Pridobljeno poglobljeno znanje iz hidravlike podzemne vode. Poglobljeno znanje o toku podzemne vode v sedimentih in razpoklinskih kamninah ter v kamninah z dvojno poroznostjo. Hidrogeoloških podatkov in njihova analiza, kvantifikacija toka podzemne vode v različnih poroznih medijih. Sposobnost hidrogeološkega obravnavanja geoloških problemov. Interpretacija hidrogeoloških podatkov. Sinteza geoloških, fizikalnih in tehničnih podatkov ter rezultatov raziskav. Razumevanje osnovnih fizikalnih zakonov toka vode v poroznem mediju. Sposobnost uporabe kompleksne programske opreme. Sposobnost uporabe matematičnih orodij. | The acquired in-depth knowledge of hydraulics of groundwater. In-depth knowledge about the flow of groundwater in sediments and fractured rocks and in rock with dual porosity. Hydrogeological data and their analysis, quantification of groundwater flow in different porous media. Ability to treat hydrogeological problems in geological contects. Interpretation of hydrogeological data. Synthesis of geological, physical and technical information and research results. Understanding the basic physical laws of water flow in porous media. The ability to use complex software. The ability to use mathematical tools. |

| **Metode poučevanja in učenja:** | **Learning and teaching methods:** |
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| Predavanja, laboratorijske vaje, seminar. | Lectures, laboratory practices, seminar. |

| **Načini ocenjevanja:** | **Delež/Weight** | **Assessment:** |
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| snov predavanj | 70,00 % | knowledge from the lectures |
| snov vaj | 30,00 % | knowledge from exercises |
| Ocene: 6-10 (pozitivno) ob upoštevanju Statuta UL in fakultetnih pravil. | | Marks: 6-10 (positive) according to the UL Statute and faculty rules. |

**Reference nosilca/Lecturer's references:**

BRENČIČ, Mihael, VREČA, Polona, 2006: Identification of sources and production processes of bottled waters by stable hydrogen and oxygen isotope ratios. Rapid communication in mass spectrometry, 20/21, 3205-3212.
VREČA, Polona, BRENČIČ, Mihael, LEIS, Albrecht, 2007: Comparison of monthly and daily isotopic composition of precipitation in the coastal area of Slovenia. Isotopes in environtal and health studies 43, 307-321.

BRENČIČ, Mihael, DAWSON, Andrew, FOLKESON, Lennart, FRANÇOIS, Denis, LEITǍO, Teresa E., 2008: Pollution mitigation. In: DAWSON, Andrew (ed.). Water in road structures : movement, drainage & effects. Springer, pp. 283-297.