UCG Univerzitet Crne Gore

FACULTY OF CIVIL ENGINEERING

Groundwater Hydraulics

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June 2021

Introduction

NAME OF THE SUBJECT:
Groundwater Hydraulics

LECTURER:
Milan Radulović, PhD in Geology (Hydrogeology)

METHODS:
Lectures, exercises, tests, colloquiums.

Introduction

WORKLOAD:

3.0 credits x 40/30 = 4 hours

Total workload for the Subject 3.0 x 30 = 90 hours

EXAMINATION METDODS:

- Attendance to lectures and exercises: max 4 pt;
- Graphic works: max 4 pt;
- Seminary Essays: max 10 pt;
- Tests: max 12 pt;
- Colloquiums: max 40 pt;
- Final exam: max 30 pt;
- Pass requires minimum 50 pt.

Topics

Week 1

- Introduction
- Groundwater as part of the water cycle
- Structures of rocks porosity
- The hydrogeological function of rocks masses
- Recharge and discharge of aquifers
- Examples from the territory of Montenegro

Topics

Week 2

- Aquifer parameters:
  - hydraulic conductivity,
  - porosity,
  - groundwater velocity,
  - hydraulic gradient, etc.
- Darcy law.
- Heterogeneity and anisotropy of aquifer.

Topics

Labaratory exercises

Topics

Week 3

- Groundwater flow through a saturated zone
- Flow lines and flow mesh
- Basic equitation of groundwater flow
- Mass balance equitation
- Generalization of Darcy law

Topics

Week 4

- Steady-state groundwater flow in confined and unconfined aquifers.

Week 5

- Transient groundwater flow in confined and unconfined aquifers.

Week 6

- Methods for solving the differential equitation of groundwater flow.

First Testing Week

Week 7

- I TEST
- I COLLOQUIUM

Topics

Week 8

- Numerical models
- Transfer of the conceptual model to the numerical model
- MODFLOW code
- The geometry of a groundwater model
- Parameters of a groundwater model.

Topics

Week 9

- Boundary conditions
- Calibration of groundwater model
- Sensitivity analysis
- Verification of model

Topics

Week 10

- Groundwater flow to the well
- Pumping test data processing

Week 11

- Groundwater flow in a karst aquifer
- Limits of Darcy law in karst aquifers

Topics

Week 12

- Field investigations
- Groundwater flow through and under dams and embankments

Week 13

- Groundwater inflow to the tunnels and excavations.

Second Testing Week

Week 14

- II TEST
- II COLLOQUIUM

Learning outcomes

After having passed the exam, students will be able to:

1. Explain the functioning of hydrogeological systems;
2. Explain parameters of porous media;
3. Understand equations of groundwater streaming;
4. Apply methods for the solution of differential equations of groundwater streaming;
5. Create conceptual hydrogeological model;
6. Use MODFLOW-based software;
7. Develop a mathematical model of groundwater streaming.

References for the subject

Anderson M.P., Woessner W.W., Hunt R (2015) Applied groundwater modeling – simulation of flow and advective transport, second edition. Elsevier & Academic Press, San Diego, p 564

Cherry JA, Freeze RA (1979) Groundwater. Prentice-Hall, Inc., Englewood Cliffss, New Jersey

Krešić N., Vujasinović S., Matić I. (2006): Remediation of groundwater and geo-media (in Serbian). University of Belgrade, p. 385

Radulovic M. (2003) Basics of gelogy (in Serbian). Faculty of Civil Engineering, Podgorica

Radulovic M.M. (2013) Lectures about groundwater hydraulics (in Serbian). Faculty of Civil Engineering, Podgorica