University of Zagreb Faculty of Agriculture
Svetošimunska cesta 25, 10000 Zagreb
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Hydrology and water resources (146033)

Course coordinator

Asst. Prof. Marina Bubalo Kovačić, PhD

Course description

The goal is to provide students theoretical and practical knowledge about hydrology, the importance of hydrology, hydrological processes and the modelling application in hydrology which are of great importance in the environment protection and for the proper implementation of precision agriculture.

ECTS: **6.00**

English language: **L1**

Teaching hours: 60
Lectures: 38
Auditory exercises: 10
Practicum: 10
Seminar: 2

Lecturer

- Prof. Radka Kodešova, PhD

Associate teacher for exercises

- Assoc. Prof. Vilim Filipović, PhD

Grading

Sufficient (2): 60-70%
Good (3): 71-80%
Very good (4): 81-90%
Excellent (5): 91-100%

Type of course

- Graduate studies / Environment, agriculture and resource management (Compulsory course, 1 semester, 1 year)

General competencies

The ability to collect and process data related to water hydrology, understanding of the basic hydrological processes (precipitation, infiltration and creation of runoff, flow and transport groundwater, evapotranspiration and streamflow routing), in order to use the knowledge to improve agricultural production and environmental protection..

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Types of instruction

- Lectures
  basic information about water characteristics, water appearance in environment and general environmental need for water; basic knowledge in hydrology - hydrologic cycle and processes, observations and measurements in hydrology and the global water balance; and ecohydrology, ecological principles and rules, global climate change, interdisciplinarity in science and sustainable developement
- Auditory Exercises
  solving basic hydrological equations - calculation of flow in uphill basins using different methods, determination of parameters necessary for simulation in HEC-HMS; simulation to HEC-HMS and required parameters and individual simulation of given basin and interpretation of results; and simulation in AquaCrop and required parameters and individual simulation for given location, water conditions and plant growth.
- Laboratory practice/exercises
  as part of the laboratory exercises analysis students will be able to carried out basic physical and chemical water analysis. Laboratory exercises are conducted in groups (10 students).

Learning outcomes

Learning outcome	Evaluation methods
To gain basic knowledge in hydrology and the global water balance	Participation in discussion during the lecture, seminar, final exam
To have gained a comprehensive knowledge of relevance to hydrology	Participation in discussion during the lecture, seminar, final exam
To understand and be able to apply knowledge about types and usage of accessible water	Participation in discussion during the lecture, seminar, independent work (exercises), final exam
To be able to solve basic hydraulic equations	Participation in discussion during the lecture, seminar, independent work (exercises), final exam
To apply knowledge about negative water impacts in its prevention	Participation in discussion during the lecture, seminar, independent work (exercises), final exam
To get introduction to interaction water-soil-plant	Participation in discussion during the lecture, seminar, independent work (exercises), final exam
Usage of modelling to understand transport processes in soil	Participation in discussion during the lecture, seminar, independent work (exercises), final exam

Working methods

Teachers' obligations

Preparation of teaching material and seminar themes. Preparation of individual tasks for exercises. Consultations and supervision of seminar and students’ individual work. Regular teaching, seminar and exercises activities. Preparation of partial and final exam.

Students' obligations

The student is required to attend all forms of teaching in accordance with the Regulations of studying at the Faculty of Agriculture University of Zagreb. Individual (practical) work within exercises and one individual seminar during semester. Partial or final exam.

Methods of grading

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Evaluation elements	Maximum points or Share in evaluation	Grade rating scale	Grade	Direct teaching hours	Total number of average student workload	ECTS
Attendance of lectures, seminars and exercises				60	60	1
Individual seminar	30%			12	24	1
Two partial or one final exam	70%	<60 % 60-70 % 71-80 % 81-90 % 91-100 %	Insufficient (1) Sufficient (2) Good (3) Very good (4) Excellent (5)	48	96	4
Total	100 %			60	180	6

Evaluation elements	Description	Deadline	Recoupment
Individual seminar	The structure and the content of the written seminar (50%) and short oral exam about the seminar theme (50%)		

Weekly class schedule

1. Water appearance in the environment, Significance of hydrology, basic terms in hydrology, hydrometeorology L - Distribution of water in the environment, global water balance, hydrologic cycle and environmental need for water in general. Hydrologic cycle and processes, observations and measurements in hydrology and definition of hydrometeorology
2. General principles of ecohydrology, Natural habitats and water users in environment L - Ecohydrology, ecological principles and rules, global climate change, interdisciplinarity in science and sustainable developement. Natural habitats - balance in evironment, demands and its vulnerability, urbanization, industrialization, pollution and disturbance of habitats.
3. Rainfall climatology, Physical characteristics of basin, Processes in the basin, rainfall transformation to runoff L - Definition and characteristics of climatology and its major parameters, definition, observation, measurement and interpreting data on precipitation, effective and brutto rainfall. Definition of basin and hydrographic network, height relations, decline. Infiltration, intercept, evapotranspiration, percolation, retention, genesis of surface runoff.
4. Processes in the basin, rainfall transformation to runoff, Hydrograph of surface runoff and its components L - Infiltration, intercept, evapotranspiration, percolation, retention, genesis of surface runoff. Surface runoff hydrograph and its components, definiton of all parameters that have impact on hydrograph shape and hydrograph separation on components.
5. Correlation between water lavels and water flow, Principles of water flow L - Hydraulic background on correlation between water levels and water flow, definition of correlation curve and its extrapolation. Definition of three types of water flow: surface, subsurface and grounwater flow, physical description and assumptions significant for those types of water flow.
6. Description of surface water flow - runoff in the basin and flow in open courses, Chezy's equation, The fundamental hydraulic equations - Darcy flow and Dupuit flow L - Description of surface water flow - runoff in the basin and flow in open courses,

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Chezy's equation and its approximation. Parameters, assumptions and conditions for solving Darcy and Dupuit flow and its application.

7. Solute transport in soils, Water resources and their use L - Basic knowledge, equations and parameters for solute transport in different soils. Ecological engineering in water resources management, traditional and modern approaches and solutions and their impact on ecology.
8. Water regime impact on habitats, prevalence and impact of floods and droughts, Interventions for soil and water conserving as a desired anthropogenic impact L - Introduction to water regime impact on different habitats and prevalence and impact of flood and drought situations on environment with focus on adequate water management. Standard and modern methods of soil and water protection and sustainable water management using interdisciplinatity in science.
9. Interventions for soil and water conserving as a desired anthropogenic impact, Basic hydrological problems L+E - Standard and modern methods of soil and water protection and sustainable water management using interdisciplinatity in science. Solving basic hydrological equations - calculation of flow in uphill basins using different methods, determination of parameters necessary for simulation in HEC-HMS.
10. Runoff simulation using HEC-HMS, Modelling in AquaCrop E - Introduction to simulation to HEC-HMS and required parameters and individual simulation of given basin and interpretation of results. Introduction to simulation in AquaCrop and required parameters and individual simulation for given location, water conditions and plant growth.
11. Modelling in AquaCrop, Transport processes in soil E+L - Introduction to simulation in AquaCrop and required parameters and individual simulation for given location, water conditions and plant growth. Introduction of water, contaminant, gas and heat transport processes in soils.
12. Modeling in soil science, Modeling of groundwater contamination L - Introduction to different models that are commonly used for derivation and prediction of the soil properties and for description of the soil processes. Introduction to modeling techniques for assessment of a soil contamination and consequently a surface and subsurface water contamination from point or diffused sources.
13. Modeling of groundwater contamination, Modeling with HYDRUS-1D, Simulation in HYDRUS-1D L+E - Introduction to modeling techniques for assessment of a soil contamination and consequently a surface and subsurface water contamination from point or diffused sources. Introduction to HYDRUS-1D, computer software for 1D water flow and solute transport simulation in (un)saturated zone. Application of definite elements method in 1D water flow and solute transport simulation in (un)saturated zone with demontration on specific example with an emphasis on parameter estimation and invese modelling.
14. Simulation in HYDRUS-1D, Simulation on specific project E - Application of definite elements method in 1D water flow and solute transport simulation in (un)saturated zone with demontration on specific example with an emphasis on parameter estimation and invese modelling. Using HYDRUS 1D model in specific field condition for simulating water flow and contaminant transport.
15. Introduction to HYDRUS 2D/3D, Exam (written) E+S - Introduction to HYDRUS-2D/3D with demonstation on specific example.

Obligatory literature

1. Viessman, W. Introduction to hydrology, 4th Edition, Harper Collins College Publishers, New York, 1996.
2. Ward, R.C. Principles of hydrology, McGraw-Hill Book Company, London, 1990.
3. Wilson, E.M. Engineering hydrology, 4th Edition, MacMillan Press, London, 1990.
4. Chow, Ven Te. Applied hydrology, McGraw-Hill Book Company, New York, 1988.
5. Radcliffe D. E., Šimunek J., Soil Physics with HYDRUS, CRC Press, NW, 2010.

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Similar course at related universities

- Applied Hydrology, KTH Royal Institute of Technology, Stockholm, Sweden
- Hydrology and Quantitative Water Management, University of Wageningen, Netherlands