Wydział Instalacji Budowlanych, Hydrotechniki i Inżynierii Środowiska

Politechnika Warszawska

ZARZĄDZENIE nr 8/2020
Dziekana Wydziału Instalacji Budowlanych, Hydrotechniki i Inżynierii Środowiska
z dnia 16czerwca 2020r.

w sprawie wprowadzenia zmian do programu kształcenia dla studiów stacjonarnych anglojęzycznych drugiego stopnia Environment Protection Engineering na kierunku Inżynieria Środowiska

Na podstawie § 1 pkt. 12 Zarządzenia nr 54/2019 Rektora PW z dnia 1 października 2019r. *w sprawie określenia zakresu zadań i kompetencji dziekana i dyrektora kolegium w Politechnice Warszawskiej* oraz § 4 ust. 1 pkt. 5 i 6 Zarządzenia nr 53/2019 Rektora PW z dnia 27 września 2019r. *w sprawie procedury tworzenia studiów w PW oraz wprowadzania zmian do dokumentacji studiów i zasad ustalania liczebności grup studenckich na zajęciach*, zarządza się co następuje:

§ 1

Wprowadza się następujące zmiany do programu kształcenia dla studiów stacjonarnych anglojęzycznych drugiego stopnia Environment Protection Engineering na kierunku Inżynieria Środowiska, po pozytywnym zaopiniowaniu przez Radę Wydziału (Uchwała nr 33/2020) oraz Samorząd Studentów:
Przedmioty obieralne (III semestr):

1. Przedmiot obieralny "Elements of Hydrogeology": zmiana nazwy na: "Data processing for Groundwater Models".
2. Przedmiot obieralny "Groundwater flow and transport": zmiana nazwy na: "Subsurface modeling".
3. Przedmiot obieralny "Groundwater management and optimization": zmiana nazwy na: "Optimization of Groundwater Systems".
4. Przedmiot obieralny "Groundwater protection": zmiana nazwy na: "Smart Groundwater Management".
5. Przedmiot obieralny "Hydro-Europe Working as virtual company/institute": zmiana nazwy na: "WaterEurope – Collaborative Engineering".

§ 2

1. Przyjmuje się zaktualizowany plan studiów stacjonarnych anglojęzycznych drugiego stopnia Environment Protection Engineering na kierunku Inżynieria Środowiska o profilu ogólnoakademickim zawarty w załączniku nr 1 do zarządzenia.
2. Zatwierdza się karty przedmiotów wymienionych w § 1, pkt 1-5 zamieszczone w załączniku nr 2 do zarządzenia.

§ 3

Zarządzenie wchodzi w życie z dniem podpisania, a wprowadzone zmiany obowiązują od semestru zimowego roku akademickiego 2020/2021.

Dziekan

dr hab. inż. Andrzej Kulig, prof. uczelni

Siatka godzin dla kierunku *Inżynieria Środowiska (Environmental Engineering)*

Specjalność: *Environment Protection Engineering*

Załącznik nr 1 do uchwały RW nr 33/2020 z dnia 16.06.2020

Studia stacjonarne II stopnia (MSc, anglojęzyczne)

obowiązuje studentów rozpoczynających studia od roku 2020/2021

Nazwa bloku	Lp	Wykaz przedmiotów	Liczba godzin						Liczba godzin w semestrze			
			W	C	L	K	P	Pkt.	I	II	III	IV
przedmioty kształcenia ogólnego	1	Physical Education (Sport)		30				0		30		
	2	Searching and Sharing of Knowledge (HES)	15					2	15			
	3	Reliability and Safety of Engineering Systems	30					2	30			
przedmioty podstawowe	4	Environmental Protection Management (HES)	15				30	3	45			
	5	Computational Methods in Environmental Engineering	30			15		4	45			
	6	Geostatistics	30	15				4		45		
	7	Environmental Fluid Mechanics	30			15		4	45			
	8	Surface Water Protection	30				15	3	45			
	9	Principles of Soil Diagnostic Techniques	15			15	15	3	45			
	10	Air Pollution Control	30				15	3		45		
	11	Biological Techniques for Environmental Monitoring	15		15			3		30		
	12	Environmental Chemistry II	15		30			3		45		
	13	Environmental Physics	30			15		4			45	
przedmioty kierunkowe i specjalizacyjne	14	Acquisition and Management of Environmental Data	30			15		3	45			
	15	Monitoring of Environment	15				15	2	30			
	16	Scientific Programming and Data Analysis				60		3		60		
	17	Spatial Data Analysis	15			30		3		45		
	18	Applied Climatology	30			15		4	45			
	19	Global Climate Change	30			15		3			45	
	20	Groundwater Protection	15				30	4		45		
	21	Municipal Solid Waste Treatment Technology	30				15	4		45		
	22	Pro-ecological Technologies	15				30	3			45	
	23	Introduction to Remote Sensing of Environment	15			30		3			45	
	24	Irrigation and Drainage	15				30	3		45		
	25	Land Reclamation and Development	15		15		15	4				45
	26	Environmental Risk Assessment	15		30			3				45
	27	Alternative Energy Sources	15				30	3				45
	28	Energy Systems Modelling and Optimization	30			15		3				45
	29	Elective courses (fall)	30				60	6			90	
	30	Elective courses (spring)	30				60	6				90
	31	Diploma seminar (fall)		15				1			15	
	32	Diploma seminar (spring)		15				1				15
	33	MSc Diploma						20			X	X
	34	Internship (praktyka zawodowa)	4 tygodnie					4			X	
1395		Sumaryczna liczba godzin zajęć dydaktycznych	630	75	90	240	360		390	435	285	285
25		Liczba godzin zajęć dydaktycznych w tygodniu							26	29	19	19
		Liczba punktów w semestrze						124	30	30	20	40
		Semestralna liczba egzaminów							3	3	1	1
przedmioty obieralne	1	Forecasting of Meteorological Hazards	15				30	3			45	
	2	Biological Hazards and Biodeterioration in Environmental Engineering	15	30				3			45	
	3	Odour Abatement Techniques	15		15		15	3			45	
	4	Environment Protection in Transport Systems	15	15			15	3			45	
	5	Data Bases	15			30		3			45	
	6	Energy Audit of Buildings and Industry	15				30	3			45	
	7	Integrated Waste Management in Urban Areas	15				30	3			45	
	8	Advanced Chemical Wastewater Treatment Methods	15		30			3				45
	9	Advanced Biological Methods of Wastewater Treatment	15	30				3				45
	10	Elements of Bioeconomy	15				30	3				45
	11	Rationalization of Heat and Energy Use	15				30	3				45
	12	Remote Sensing Imagery Processing	15			30		3				45
	13	Urban Climate - Adaptation and Planning	15				30	3				45
	14	Planning and Management of Water Resources Systems	15				30	3				45
	15	Data Processing for Groundwater Models	15				30	3			45	
	16	Subsurface Modelling	30				30	5			60	
	17	Optimization of Groundwater Systems	30				30	5			60	
	18	Smart Groundwater Management	15				45	5			60	
	19	WaterEurope – Collaborative Engineering	30				30	6			60	

po 2 *przedmioty do wyboru na semestrze 3 i 4*

Zał. 2.1

MODULE INFORMATION SHEET

Name of Module Unit	**Data processing for Groundwater Models**
Name in polish language	Przetwarzanie danych w modelowaniu wód podziemnych
Module type	compulsory
Form of studying	full-time day courses
Level of study	graduate course (M.Sc. level)
Type of study (for extra-mural courses)	-
Programme	Environmental Engineering
Speciality	Environment Protection Engineering
Responsible department	Chair of Environmental Protection and Management
Responsible persons	dr inż. Maria Grodzka-Łukaszewska

Semester	Lectures(E)	Tutorials	Laboratory	Computer Exercises	Projects	ECTS
2	15				30	3

Learning outcomes (knowledge, skills, competencies)

Groundwater is important as a resource but also as an environmental contamination pathway; it also has an impact on engineering and mining projects. The module covers all these aspects and provides a detailed practical introduction to groundwater and how it can be investigated and modelled. This module gives an overview on hydrogeology and the associated engineering activities that are today interested to introduce more technologies for monitoring and operational management purposes. This module gives also an introduction to groundwater management and to the global understanding of integrated river basin management and planning.

Prerequisites

Rules for integrated grade setting

40% of test results + 60% of mark for guided project

Recommended readings

Hamblin, W.K. and Christiansen, E.H. Earth's Dynamic Systems, 10th edition, New Jersey: Prentice-Hall, Inc., 2004.
Hiscock K., Bense V. Hydrogeology: Principles and Practice, 2nd edition, Wiley-Blackwell, 2014.

Contents of lectures (syllabus)

	Topics	Time (hrs.)	Scope (S / Ex)
1	Principles of geology. Basic concepts of geology.	4	
2	Principles of hydrogeology. Basic concepts of hydrogeology.	4	
3	Geological and hydrogeological maps.	2	
4	Geophysical methods used for investigating properties of aquifers and aquitards. Measurements of water level.	2	
5	Sources of environmental data. Methods of their interpretation.	2	
6	Test	1	
	Total	**15**	**hours**

S – topics listed in the legal study programme standards from 12.07.2007
Ex – extended topics

Lecturers

dr inż. Maria Grodzka-Łukaszewska

Assessment method

Written paper consisting of a multiple choice test or open questions.

Contents of guided projects

	Topics	Time (hrs.)	Scope (S / Ex)
1	Understanding and interpreting geological profiles. Reconstructing 2D geological cross-sections from geological profiles. Guided consultation for the Project	10	
2	Reading hydrogeological maps. Creating a hydrogeological map based on given hydrogeological profiles. Reconstructing 2D cross-sections of aquifers/aquitards from geological profiles. Guided consultation for the Project	10	
3	Analysis of environmental data necessary to perform the groundwater model. Guided consultation for the Project	10	
	Total	**30**	**hours**

S – topics listed in the legal study programme standards from 12.07.2007
Ex – extended topics

Persons responsible for guided projects

dr inż. Maria Grodzka-Łukaszewska

Assessment method for guided projects

Assessment of projects delivered by students and defence of the project by students.

MODULE INFORMATION SHEET

Name of Module Unit	**Subsurface Modelling**
Name in polish language	Modelowanie w wodach podziemnych
Module type	compulsory
Form of studying	full-time day courses
Level of study	graduate course (M.Sc. level)
Type of study (for extra-mural courses)	-
Programme	Environmental Engineering
Speciality	Environment Protection Engineering
Responsible department	Chair of Environmental Protection and Management
Responsible persons	dr inż. Grzegorz Sinicyn

Semester	Lectures(E)	Tutorials	Laboratory	Computer Exercises	Projects	ECTS
2	30				30	5

Learning outcomes (knowledge, skills, competencies)

The purpose of this module is to introduce variables and parameters used in hydrogeology together with their physical interpretation explained. The module will provide an in-depth knowledge of the physical principles of groundwater flow and associated mass transport as the basis for water management modelling involving subsurface phenomena. Starting from the theoretical principles the participants will be exposed to and exercised with 2D and 3D groundwater analytical and numerical models used for solving realistic problems of groundwater monitoring, abstraction and protection. Specialized methods and models applied in conjugate use of groundwater resources are addressed in this module.

Prerequisites

Hydrology. Engineering Hydrology and Hydrogeology. Water Protection. Water Management.

Rules for integrated grade setting

40% of test results + 60% of mark for guided project

Recommended readings

Appelo,, C.A.J., D. Postma, 2005. Geochemistry, Groundwater and Pollution, A.A. Balkema Publishers, Leiden.
Wood, E.F., R.A. Ferrara, W.G.Grey and G.F.Pinder, 1984. Groundwater contaminations from hazardous wastes. Prentice-Hall, Inc., Englewood Cliffs, NJ, 163 p.
Shwartz F.W. (at al), Ground Water Models. Scientific and Regulatory Applications. National Academy Press, Washington, D.C., 1990
Gorelick S.M, Freeze R.A., Donohue D., Keely J.F., Groundwater Contamination. Optimal Capture and Containment, Lewis Publishers, USA, 1993

Contents of lectures (syllabus)

	Topics	Time (hrs.)	Scope (S / Ex)
1	Definitions. Variables and parameters used in hydrogeology and their physical interpretation. Microscopic and macroscopic description of groundwater flow.	4	
	The groundwater flow equation in 3D. Simplified models of 2D horizontal groundwater flow for steady state and transitional groundwater flow.	8	
2	Groundwater pollution transport theory – principle transport mechanisms of mass in groundwater; equilibrium chemistry of aquatic subsurface systems; sorption .	6	
3	Numerical approximation of solutions to groundwater flow equations	8	
5	Specialized methods and models applied in conjugate use of groundwater resources	2	
6	Test	2	
	Total	**30**	**hours**

S – topics listed in the legal study programme standards from 12.07.2007
Ex – extended topics

Lecturers

dr inż. Grzegorz Sinicyn, dr inż. Wiktor Treichel

Assessment method

Written paper consisting of a multiple choice test or open questions.

Contents of guided projects

	Topics	Time (hrs.)	Scope (S / Ex)
1	The calculation skills (analytic solutions): water exchange between river and aquifer using simple models; drawdown caused by galleries of abstracting wells; dewatering of excavations; distribution coefficient and retardation factor for selected pollutants in rocks, travelling time of pollutant within an aquifer – protection zones. Fresh water – saline water interaction and occurrence of the inverse depression cone.	10	
2	Idea of groundwater modelling. Conceptual model. Spatial discretization of model domain. Model data input, parameters estimation.	2	
3	Software tutorial. Groundwater flow model (MODFLOW code).	2	
4	Software tutorial. Groundwater pollution transport model (MT3D code).	2	
5	Introduction to the Project	2	
6	Guided consultation for the Project	10	
10	Defence of the Project by students	2	
	Total	**30**	**hours**

S – topics listed in the legal study programme standards from 12.07.2007
Ex – extended topics

Persons responsible for guided projects

dr inż. Grzegorz Sinicyn

Assessment method for guided projects

Assessment of project delivered by students and defence of the project by students.

MODULE INFORMATION SHEET

Name of Module Unit	**Optimization of Groundwater Systems**
Name in polish language	Optymalizacja systemów wód podziemnych
Module type	elective
Form of studying	full-time day courses
Level of study	graduate course (M.Sc. level)
Type of study (for extra-mural courses)	-
Programme	Environmental Engineering
Speciality	Environment Protection Engineering
Responsible department	Department of Informatics and Environment Quality Research
Responsible persons	dr inż. Wiktor Treichel

Semester	Lectures(E)	Tutorials	Laboratory	Computer Exercises	Projects	ECTS
3	30				30	5

Learning outcomes (knowledge, skills, competencies)

The aim of this module is to introduce the scientific background and provide practical guidance in formulating and solving groundwater optimization problems. A simulation-optimization approach, which couples a predictive simulator model with a mathematical optimization algorithm to calculate the best strategy for a user-defined problem will be presented. The simulation-optimization models are usually applied in groundwater management problems to develop optimal well systems and pumping strategies for extracting groundwater and recharging aquifers. They help both in better and cost-effectively providing groundwater of adequate quantity and quality. Some aspects of mulitobjective optimization will also be discussed. The practical exercises with use of numerical models of groundwater flow and mass transport coupled with appropriate optimization techniques will allow the students to gain not only theoretical knowledge on sustainable groundwater management but will develop the practical skills in finding optimal strategies for flow, contaminant management, and conjunctive use of groundwater and surface water problems.

Prerequisites

Hydrology, Engineering Hydrology and Hydrogeology, Water Protection, Water Management.

Rules for integrated grade setting

40% of test results + 60% of mark for guided project

Recommended readings

Peralta C. R., 2012. Groundwater Optimization Handbook – Flow, Contaminant Transport, and Conjunctive Management, CRC Press Taylor & Francis Group, Boca Raton.
Ahlfeld D. P., Mulligan A. E., 2000. Optimal Management of Flow in Groundwater Systems, Academic Press
Gorelick S.M, Freeze R.A., Donohue D., Keely J.F., 1993. Groundwater Contamination. Optimal Capture and Containment, Lewis Publishers, USA,

Contents of lectures (syllabus)

	Topics	Time (hrs.)	Scope (S / Ex)
1	Introduction to simulation-optimization concepts. Examples of groundwater management problems.	4	
2	Elements of mathematical optimization. Linear programming formulation. Global optimization, classical and heuristic algorithms	4	
3	Mathematical optimization for groundwater strategy design. Types and categories of optimization problems. Decision variables, constraints and objectives.	4	
4	Groundwater optimization with embedded numerical and analytical equations	4	
5	Response matrix simulators. Computation of influence coefficients. Steady and unsteady state problems.	4	
6	Addressing uncertainty in optimization. Uncertainty analysis. Multiple realization and chance-constrained optimization.	4	
7	Multiobjective optimization approaches. E-constraint method. Weighted method. Goal programming	4	
8	Test	2	
	Total	**30**	**hours**

S – topics listed in the legal study programme standards from 12.07.2007
Ex – extended topics

Lecturers

dr inż. Wiktor Treichel

Assessment method

Written paper consisting of a multiple choice test or open questions or oral exam.

Contents of guided projects

	Topics	Time (hrs.)	Scope (S / Ex)
1	Formulating optimization problems and selecting simulation-optimization tools. Simple examples in Excel and MATLAB	4	
2	Examples of groundwater optimization with MGO	6	
3	Examples of well optimization design using Visual Modflow	6	
4	Introduction to the Project	2	
5	Guided consultation for the Project	10	
6	Defence of the Project by students	2	
	Total	**30**	**hours**

S – topics listed in the legal study programme standards from 12.07.2007
Ex – extended topics

Persons responsible for guided projects

dr inż. Wiktor Treichel

Assessment method for guided projects

Assessment of projects delivered by students and defence of the project by students.

Zał. 2. 4

MODULE INFORMATION SHEET

Name of Module Unit	**Smart Groundwater Management**
Name in polish language	Odpowiedzialne zarządzanie wodami podziemnymi
Module type	compulsory
Form of studying	full-time day courses
Level of study	graduate course (M.Sc. level)
Type of study (for extra-mural courses)	-
Programme	Environmental Engineering
Speciality	Environment Protection Engineering
Responsible department	Chair of Environmental Protection and Management
Responsible persons	dr inż. Grzegorz Sinicyn

Semester	Lectures(E)	Tutorials	Laboratory	Computer Exercises	Projects	ECTS
2	15				45	5

Learning outcomes (knowledge, skills, competencies)

The aim of the module is to present students with the principles, legal aspects and technical methods of groundwater protection. Knowledge on designing of protection zones and monitoring systems in the vicinity of groundwater intakes will be passed to students. Particular methods of protecting groundwater from leakage from waste disposal sites (mechanical and hydraulic isolation) will be detailed. Methods of polluted groundwater remediation will be presented. Project exercises will be based on use of numerical models of flow and mass transport in subsoil. The project will concern several aspects: predicting the direction of groundwater flow and contamination movement, understanding the interaction between groundwater and surface waters, developing an ability to calculate wellhead protection area, simulating groundwater remediation action. The projects will aim towards developing practical skills in groundwater protection.

Prerequisites

Hydrology. Engineering Hydrology and Hydrogeology. Water Protection. Water Management.

Rules for integrated grade setting

40% of exam results + 60% of mark for guided project

Recommended readings

Appelo,, C.A.J., D. Postma, 2005. Geochemistry, Groundwater and Pollution, A.A. Balkema Publishers, Leiden.
Wood, E.F., R.A. Ferrara, W.G.Grey and G.F.Pinder, 1984. Groundwater contaminations from hazardous wastes. Prentice-Hall, Inc., Englewood Cliffs, NJ, 163 p.
Shwartz F.W. (at al), Ground Water Models. Scientific and Regulatory Applications. National Academy Press, Washington, D.C., 1990
Gorelick S.M, Freeze R.A., Donohue D., Keely J.F., Groundwater Contamination. Optimal Capture and Containment, Lewis Publishers, USA, 1993

Contents of lectures (syllabus)

	Topics	Time (hrs.)	Scope (S / Ex)
1	Principles of groundwater protection. Legal aspects of groundwater pollution.	2	
2	Sources of groundwater pollution.	2	
3	Groundwater balance	2	
4	Protection zone design.	2	
5	Groundwater resources protection	2	
6	Techniques of WDS isolation (mechanical and hydraulic isolation).	2	
7	Groundwater remediation methods.	2	
8	Test	1	
	Total	**15**	**hours**

S – topics listed in the legal study programme standards from 12.07.2007
Ex – extended topics

Lecturers

dr inż. Grzegorz Sinicyn

Assessment method

Written paper consisting of a multiple choice test or open questions or oral exam.

Contents of guided projects

	Topics	Time (hrs.)	Scope (S / Ex)
1	Gathering and interpreting geological and hydrogeological data. Preparing conceptual model.	10	
2	Flow model (MODFLOW code) – data input.	6	
3	Transport model (MT3D code) – data input.	6	
4	Models calibration.	6	
8	Introduction to the Project	2	
9	Guided consultation for the Project	10	
10	Defence of the Project by students	5	
	Total	**45**	**hours**

S – topics listed in the legal study programme standards from 12.07.2007
Ex – extended topics

Persons responsible for guided projects

dr inż. Grzegorz Sinicyn, dr inż. Maria Grodzka-Łukaszewska

Assessment method for guided projects

Assessment of projects delivered by students and defence of the project by students.

Zał. 2.5

MODULE INFORMATION SHEET

Name of Module Unit	**WaterEurope – Collaborative Engineering**
Name in polish language	WaterEurope – współpraca inżynierska
Module type	compulsory
Form of studying	full-time day courses
Level of study	graduate course (M.Sc. level)
Type of study (for extra-mural courses)	
Programme	Environmental Engineering
Speciality	Environment Protection Engineering
Responsible department	Chair of Environmental Protection and Management
Responsible persons	dr inż. Maria Grodzka-Łukaszewska

Semester	Lectures(E)	Tutorials	Laboratory	Computer Exercises	Projects	ECTS
3	30				30	6

Learning outcomes (knowledge, skills, competencies)

WaterEurope is an intensive course focused on collaborative engineering. The main objective for the participants is to acquire and to validate collaboration and professional skills through a virtual environment. International teams composed with participants from each academic partners work collaboratively remotely applying different hydroinformatics ICT tools on a real case study. Field activities accompany this activity and final presentations take place at University of Nice Sophia Antipolis (Nice, France).

Prerequisites

Hydrology, Engineering Hydrology and Hydrogeology, Water Protection, Water Management.

Rules for integrated grade setting

40% for online phase (quizzes and reports), 60% for team work in Nice (presentations and reports)

Recommended readings

1. Ven Te Chow "Open Channel Hydraulics", McGraw-Hill Book Company,Inc; New York 2010
2. Keith J. Beven "Rainfall-Runoff Modelling: The Primer", John Wiley & Sons 2011
3. Mauro Naghettini "Fundamentals of Statistical Hydrology" Springer 2016
4. C. Shekhar P "Engineering Hydrology", Oxford University Press 2008

Contents of lectures (syllabus)

	Topics	Time (hrs.)	Scope (S / Ex)
1	Some Challenges in numerical modeling	4	
2	Flood Modeller in River Modelling A Practical Perspective	4	
3	Integrated Hydrologic Modelling with MIKE SHE	4	
4	SAGE (Management Plan) for groundwater and the Lower Var Valley	2	
5	Project AquaVar and Lower Var River Valley	4	
6	High Resolution topographic data use for 2D hydraulic modelling: - Applications & uncertainties	4	
7	Modeling hydraulics A case of study with Iber	4	
8	The geological history of Var Valley	4	
	Total	**30**	**hours**

S – topics listed in the legal study programme standards from 12.07.2007
Ex – extended topics

Lecturers

Paweł Gilewski

Assessment method

Assessment based on final presentations at University of Nice and reports of each team

Contents of guided projects

	Topics	Time (hrs.)	Scope (S / Ex)
1	Preprocessing: Catchment & subcatchment delimitation with GIS tools	6	
2	Hydrological modelling: Calculate the discharge by using physical based and lumped rainfall-runoff models	6	
3	Hydraulic modelling: Produce floodmap by using shallow water equation model implemented in different softwares	6	
4	Groundwater modelling: Perform groundwater flow simulations	6	
5	Flood damage & resilience: Analyse the flood resilience with the local landuse information and floodmap	6	
	Total	**30**	**hours**

S – topics listed in the legal study programme standards from 12.07.2007
Ex – extended topics

Persons responsible for guided projects

Paweł Gilewski

Assessment method for guided projects

Assesment based on online quizes results and weekly team reports.