STUDY MODULE DESCRIPTION FORM

Name of the module/subject **Systems of Water Treatment**		Code **1010102221010100358**
Field of study **Environmental Engineering Second-cycle**	Profile of study (general academic, practical) **(brak)**	Year /Semester **1 / 2**
Elective path/specialty **Water Supply, Water and Soil Protection**	Subject offered in: **Polish**	Course (compulsory, elective) **obligatory**
Cycle of study: **Second-cycle studies**	Form of study (full-time,part-time) **full-time**	
No. of hours Lecture: **45** Classes: **15** Laboratory: **15** Project/seminars: **15**		No. of credits **6**
Status of the course in the study program (Basic, major, other) **(brak)**	(university-wide, from another field) **(brak)**	
Education areas and fields of science and art **technical sciences** **Technical sciences**		ECTS distribution (number and %) **6 100%** **6 100%**

Responsible for subject / lecturer:

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Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	Student should have a basic knowledge about water technology (I degree of study), mathematics, chemistry, fluid mechanics and hydrology (I and II degree of study).
2	**Skills**	Student should be able to perform mathematical calculations, physical, chemical, mechanics of the fluids and calculation of equipment and facilities of water treatment plants (I degree of study).
3	**Social competencies**	Awareness to constantly update and supplement knowledge and skills.

Assumptions and objectives of the course:

Knowledge of principles of design of processes and water treatment technological systems. Skill of pilot research design and procedures at pre-design study of processes and objects of water treatment as well as ability of managing of design, inwestment and operation of water treatment plants.

Study outcomes and reference to the educational results for a field of study

Knowledge:

1. Student knows the rules and methods of water treatment systems and processes design. - [[[K2_W03, K2_W04, K2_W05, K2_W07]]]
2. Student has structured knowledge of possibilities and methods of intensification of treatment effectiveness. - [[[K2_W04, K2_W05, K2_W07]]]
3. Student knows the rules of research and literature study planing. - [[[K2_W01, K2_W05]]]
4. Student knows the method of research on water treatment processes in pilot and laboratory scale. - [[[K2_W05, K2_W07]]]
5. Studen has the ability to describe the chemical and technological consept of water treatment as well as to select processes and parameters. - [[[K2_W05, K2_W07]]]
6. Sudent knows the rules of preparing a concept of water treatment sludge treatment and disposal. - [[[K2_W01, K2_W04, K2_W06]]]

Skills:

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1. Student can describe the water treatment system, including the proceses selction and sequence. - [[K2_U08, K2_U09, K2_U10]]]
2. Student knows how to design the processes of water treatment based on pre-design research. - [[K2_U01, K2_U08, K2_U11]]]
3. Student knows how to do the conception of analytical control for treatment system, as well as prepear the operating instructions. - [[[K2_U08, K2_U09]]]
4. Student can determine the technological system of sludge treatment and desposal. - [[[K2_U08, K2_U11, K2_U14]]]

Social competencies:

1. Student understands the need for a systematic deepening and broadening his/her competences - [[[K2_K01, K2_K07]]]
2. Student knows that there are often several solusions for technical problems with respect to technical conditions and economic aspects. - [[K2_K02, K2_K04, K2_K06]]]
3. Student understands the need for teamwork in solving theoretical and practical problems - [[[K2_K03., K2_K04, K2_K06]]]

Assessment methods of study outcomes

Lecture

Lecture activity checkup

Written-oral final exam

- Laboratory

Short entrance test before each laboratory

Written report of each laboratory exercise, defence.

Written final test regarding all exercises

Activity evaluation during each laboratory

- Excercises

Written partial and final tests

- Design exercises

Verification of project advancements and independent design work on each project

Written report, written final test and oral defence of the report.

Course description

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Sources of anthropogenic contamination of natural water: surface water, groundwater. Classification of anthropogenic pollutants: toxicity, biodegradability. Water quality, mineralization, trophic. Experiment in water treatment designing, conception of treatment, pilot research, treatment train selection. Technological systems: effectiveness and reliability of treatment, multiple barrier treatment rule. Design of processes: sedimentation, coagulation with pH adjustment and adsorption, adsorptive resins, rapid and membrane filtration, chemical and catalytic oxidation, biological processes, disinfection, by-products, post disinfection reactivation of microorganism. Water quality in distribution systems: organoleptic quality, chemical stability of water, chemical and electrochemical corrosion, biological stability, biological corrosion, water conservation. Sludge management: mass and volume balance of backwash water and sludge, sedimentation, gravital thickening, mechanical dewatering, non-newtonian flow of sludge, drying, freezing, final sludge disposal and utilization.

Laboratory:

1. Iron removal in filtration proces trough oxidative and non-chemicaly active filtration materials.
2. Katalytic manganese oxidation in filter bed.
3. granulometric and beckwash parametrs of rapid filters.
4. Coagulation af surface water.
5. Colour removal inGAC filter and in silica sand bed.

Excercise:

1. Static and dynamic adsorption parameters.
2. Nomogram and mathematical models for backwash parameters evaluation.
3. Mathematical models for iron removal from groundwater.
4. Mathematical models for manganese removal from groundwater.
5. Mathematical models for desinfection and by-products formation.
6. Coagulation calculations.

Design:

Design of surface water treatment plant:

1. Raw water evaluation.
2. Concept of water treatment.
3. Processes calculations.
4. Selection of devices.
5. Site map and objects pictures.

Basic bibliography:

1. Apolinary L. Kowal, Maria Świderska - Bróż, Oczyszczanie wody, PWN, Warszawa 2009
2. Zbigniew Heidich i inni, Urządzenia do uzdatniania wody, zasady projektowania i przykłady obliczeń, Arkady, Warszawa 1987
3. Hanna Majcherek, Podstawy hydromechaniki w inżynierii oczyszczania wody, wyd. Politechniki Poznańskiej, Poznań 2006
4. Marek M. Sozański, Peter M. Huck, Badania doświadczalne w rozwoju Technologii Uzdatniania Wody, Monografie Komitetu Inżynierii Środowiska PAN, vol. 42, Lublin 2007

Additional bibliography:

1. Praca zbiorowa, Wodociągi i Kanalizacja w Polsce, tradycja i współczesność, Polska Fundacja Odnowy Zasobów Wodnych, Poznań ? Bydgoszcz 2002
2. AWWA, Technical Editor F. W. Pontius, Water Quality and Treatment, McGraw ? Hill, Inc, New York. 1990
3. MWH, Water Treatment Principles and Design (Secondo Editio, Revised by J. C. Crittenden, R. R. Trussell, D. W. Hanol, K. J. Howe and G. Tchobanoglous), John Wiley & Sons, Inc., Hoboken, NY, 2005.

Result of average student's workload

Activity	Time (working hours)
1. Lectures	45
2. Laboratory	15
3. Project	15
4. Classes	15
5. Design consulting	1
6. Laboratory report consulting	1
7. Design preparation	10
8. Design evaluation preparation	10
9. Laboratory evaluation preparation	10
10. Exam preparation	28

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Student's workload		
Source of workload	**hours**	**ECTS**
Total workload	150	6
Contact hours	92	4
Practical activities	30	1

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