Under the module/student Code Systems of Water Treatment Fordite of study Year /Semester Environmental Engineering Second-cycle Second-cycle studies Year /Semester Environmental Engineering Second-cycle Subject offered in: Second-cycle studies Course (computers) Second-cycle studies full-time Outpet/second Outpet/second No. of rends Second-cycle studies full-time Outpet/second Status of the course in the study program (Basic, major, other) (unversity-wide, from another field) (brack) Base and fields of science and at ECTS distribution (number and %) ECTS distribution (number and %) Base and fields of science and at ECTS distribution (number and %) ECTS distribution (number and %) Base and fields of science and at ECTS distribution (number and %) ECTS distribution (number and %) Base and fields of science and at Student should have a basic knowledge about water technology (1 degree of study), Base and Student should have a basic knowledge about water technology (1 degree of study), Student should have a basic knowledge about water technological systems. Skill of piol research design and social competencies Assumptions and objectives of the course: Student should be			STUDY MODULE D	ESCRIPTION FORM				
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Litration Litration Education areas and fields of science and at ECTS distribution (number and %) Education areas and fields of science and at ECTS distribution (number and %) Responsible for subject / lecturer: dr inz. Joanna Je2-Walkowiak @ put.poznan.pl tei. 665-3662 Faculty of Civil and Environmental Engineering u. u. Protrovo 560-956 Poznań 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 Awareness to constantly update and supplement knowledge and skills. Competencies Awareness to constantly update and supplement knowledge and skills. Student should of processes and water treatment technological systems. Skill of pilot research design and zocodeures at pre-design study of processes and objects of water treatment as well as ability of managing of design, newstment and operation of water treatment plants. Student knows the rules and methods of water treatment systems and processes design, - [[[K2_W04, K2_W05, K2_W07]]] 1. Student knows the rules of research and literature study planing - [[[K2_W01, K2_W05]]] 2. Studen ta she ability to des	Status of the c	course in the study	program (Basic, major, other)	(university-wide, from another f	ield) (brak)			
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Responsible for subject / lecturer: dr inz. Joanna Jez-Walkowiak email: joanna jez-walkowiak@put.poznan.pl tel. 665-3662 Faculty of Civil and Environmental Engineering ul. Piotrowo 5 60-965 Poznań Prerequisites in terms of knowledge, skills and social competencies: 1 Knowledge 2 Skills 3 Social competencies 4 Anareness to constantly update and supplement knowledge additions, 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 Study of processes and water treatment 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, newestiment and operation of water treatment plants. Ktudy outcomes and reference to the educational results for a field of study Knowledge: 1 1. Student knows the rules and methods of water treatment systems and processes design [[K2_WOM, K2_WOM, K2_WOT]]] 2. Student knows the rules of research and literature study planing [[[K2_WOM, K2_WOT]]] 3. Usdent knows the rules of presarch and literature study planing [[[K2_WOM, K2_WOT]]] 4. Student knows the rules of presarch and water treatment processes in					and %)			
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email: joanna jez-walkowiak @put.poznan.pl tel. 665-3662 Prerequisites in terms of knowledge, skills and social competencies: 1 Knowledge 2 Skills 3 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: (nowledge 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, newestment 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_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 ilterature study planing [[[[K2_W04, K2_W05, K2_W07]]] 3. Student knows the rules of research a	dr inż. Joa	anna Jeż-Walkov	viak					
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3. Student knows how to do the conception of analytical control for treatment system, as well as prepear the operating nstructions [[[K2_U08, K2_U09]]]	 Linz_000, nz_009, nz_010JJJ Student knows how to design the processes of water treatment based on pre-design research. III K2_101, K2_108, K2_111JJJ 							
	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]]]							
 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

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.

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2. Zbigniew Heidich i inni, Urządzenia do uzdatniania wody, zasady projektowania i przykłady obliczeń, Arkady, Warszawa 1987

 Hanna Majcherek, Podstawy hydromechaniki w inżynierii oczyszczania wody, wyd. Politechniki Poznańskiej, Poznań 2006
 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	30
2. Laboratory	30
3. Project	30
4. Design consulting	5
5. Laboratory report consulting	5
6. Design preparation	40
7. Design evaluation preparation	20
8. Laboratory evaluation preparation	20
9. Exam preparation	20

Student's workload					
Source of workload	hours	ECTS			
Total workload	200	6			
Contact hours	55	3			
Practical activities	0	3			