STUDY MODULE DESCRIPTION FORM

Name of the module/subject		Code
Industrial Water and Wastewater		**1010102221010131095**
Field of study	Profile of study (general academic, practical)	Year /Semester
Environmental Engineering Second-cycle	**(brak)**	**1 / 2**
Elective path/specialty	Subject offered in:	Course (compulsory, elective)
Water Supply, Water and Soil Protection	**Polish**	**obligatory**
Cycle of study:	Form of study (full-time,part-time)	
Second-cycle studies	**full-time**	
No. of hours		No. of credits
Lecture: **2** Classes: **-** Laboratory: **2** Project/seminars: **2**		**6**
Status of the course in the study program (Basic, major, other)	(university-wide, from another field)	
(brak)	**(brak)**	
Education areas and fields of science and art		ECTS distribution (number and %)
technical sciences		**6 100%**

Responsible for subject / lecturer:

dr inż. Tymoteusz Jaroszyński
email: tymoteusz.jaroszynski@put.poznan.pl
tel. (61) 6652436
Faculty of Civil and Environmental Engineering
60-965 Poznań, street Piotrowo 5

Responsible for subject / lecturer:

dr inż. Alina Pruss
email: alina.pruss@put.poznan.pl
tel. (61) 6653662
Faculty of Civil and Environmental Engineering
60-965 Poznań, street Piotrowo 5

Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	Student should have a basic knowledge about water and waste water technology, mathematics, chemistry, fluid mechanics and general knowledge from environmental engineering.
2	**Skills**	Student should be able to search valuable information and read research articles and reports with understanding. Student should be able to perform mathematical calculations, physical, chemical, mechanics of the fluids and calculation of equipment and facilities of water and wastewater treatment plants.
3	**Social competencies**	Awareness to constantly update and supplement knowledge and skills.

Assumptions and objectives of the course:

The objective of the course is to broaden the knowledge and skills necessary for the selection of technology methods of basic pollutants removal from industrial water and wastewater.

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

Knowledge:

1. Student has structured and theoretically founded knowledge of methods of water treatment and purification of industrial wastewater. - [K2_W03, K2_W04, K2_W07]

2. Student knows the general principle to create technological systems of industrial wastewater treatment depending on the wastewater characterization. - [K2_W04, K2_W07]

3. Student has an ordered knowledge of design methods of basic technological processes used in the industrial water treatment technology. - [K2_W03, K2_W04, K2_W07]

4. Student knows and understand models of water and wastewater management in municipal-industry agglomerations and industrial plants. - [K2_W03, K2_W04, K2_W07]

Skills:

1. Student can describe the industrial water treatment technologies and explain the associated physical, chemical and biological processes. - [K2_U09, K2_U10]

2. Student knows how to design water softening station. - [K2_U01, K2_U12, K2_U18]

3. Student knows how to do the conception of processes for industrial waste water treatment plant. - [K2_U01, K2_U12, K2_U18]

Social competencies:

1. Student understands the need for teamwork in solving theoretical and practical problems. - [K2_K03]
2. Student understands the different roles in teamwork and the need for information and knowledge exchange in a group work. - [K2_K03, K2_K04]
3. Student understands the need for a systematic deepening and broadening his/her competences. - [K2_K01]

Assessment methods of study outcomes

Lecture
? written final exam
? activity
Laboratories:
? review of the knowledge and skills necessary to carry out the exercises,
? reports,
? activity
Project:
? evaluation of the project report
? oral presentation of the project
? activity

Course description

Lectures

-Industrial water

Basic indicators for determining the quality of the water in the heating and boiler (water stability, stability indices, water corrosivity). Processes and equipment used in industrial water treatment. Water softening methods (methods of thermal and chemical), Ion Exchange (range of applications, rules for the operation of equipment for water treatment methods), membrane technology (microfiltration, ultrafiltration, nanofiltration, reverse osmosis, electrodialysis), degassing of water (mechanical, thermal and chemical methods). Water treatment technology for energy purposes. Water quality requirements for energy purposes. Examples of industrial installations: treatment of water for the purposes of district heating, boiler and refrigeration.

Industrial wastewater

Models of water and wastewater management in municipal-industry agglomerations and industrial plants. Criteria and standards of industrial wastewater treatment. General principle to create technological systems of industrial wastewater treatment depending on the wastewater characterization. Processes used in industrial wastewater treatment (physical-chemical processes: neutralization, oxidation, reduction, chemical precipitation and coagulation; flotation; biological processes: anaerobic, aerobic). Characterization of quantity and quality industrial wastewater in different industrial plants (slaughter-house and meal industry, dairy industry, plants treatment of metals) .

Project

Technological design of water softening station to power boilers.

Laboratories

1. Water softening ? chemical precipitation.
2. The coagulation process applied to the clarification and separation of suspended solids in waters for industry, processes and industrial wastewater.
3. Wastewater neutralization.
4. Ion-exchange processes in industry and energy potentials.
5. Potential of sorption processes and chemical oxidation in the removal of synthetic and natural dyes.
6. Technical Tours: visiting industrial facilities for water and wastewater treatment

Basic bibliography:

1. Majcherek H.: Zmiękczanie i demineralizacja wód przemysłowych. Wydawnictwo Politechniki Poznańskiej, Poznań 2005
2. Kowal A. L. , Świderska-Bróż M.: Oczyszczanie wody. Wydawnictwo Naukowe PWN, Warszawa- Wrocław 1996
3. Stańda J.: Woda do kotłów parowych i obiegów chłodzących siłowni cieplnych, WNT, Warszawa 1999
4. Chomicz D.: Uzdatnianie wody w kotłowniach i ciepłowniach, Arkady 1989
5. Chomicz D.: Poradnik. Woda w ciepłownictwie i ogrzewnictwie. Fundacja Rozwoju Ciepłownictwa Unia Ciepłownictwa, Warszawa 1994
6. Gomółka B., Gomółka E.: Technologia wód przemysłowych z ćwiczeniami, Wydawnictwo Politechniki Wrocławskiej, Wrocław 1994
7. Mielcarzewicz E.: Gospodarka wodno - ściekowa w zakładach przemysłowych, PWN, Warszawa 1986
8. Bartkowska J., Królikowski A.J., Orzechowska M.: Gospodarka wodno - ściekowa w zakładach przemysłowych, Wydawnictwo Politechniki Białostockiej, Białystok 1991
9. Gospodarka wodno-ściekowa. Przepisy ? Normy ? Technologie ? Metody postępowania; Poradnik; Wydawnictwo Verlag Dashofer, 2007
10. Bartkiewicz B., Umiejewska K.: Oczyszczanie ścieków przemysłowych, PWN Warszawa 2010
11. Bartkiewicz B.: Oczyszczanie ścieków przemysłowych, PWN Warszawa 2002
12. Koziorowski B.: Oczyszczanie ścieków przemysłowych, Wydawnictwa Naukowo-Techniczne Warszawa 1975
13. Rűffer H., Rosenwinkel K-H.: Oczyszczanie ścieków przemysłowych. Poradnik. Projprzem-EKO. Bydgoszcz 1998

Additional bibliography:

1. MWH, Water Treatment Principles and Design (Secondo Edition, Revised by J. C. Crittenden, R. R. Trussell, D. W. Hanol, K. J. Howe and G. Tchobanoglous), John Wilej & Sous, Inc., Hoboken, 2005.
2. AWWA, Technical Editor F. W. Pontius, Water Quality and Treatment, McGraw ? Hill, Inc, New York. 1990
3. Majcherek H.: Podstawy hydromechaniki w inżynierii oczyszczania wody, wyd. Politechniki Poznańskiej, Poznań 2006
4. Sozański M.M., Huck P. M.: Badania doświadczalne w rozwoju technologii uzdatniania wody, Monografie Komitetu Inżynierii Środowiska PAN, vol. 42, Lublin 2007
5. Meinck F., Stooff H., Kohlschütter H.: Ścieki przemysłowe, Arkady, Warszawa 1975
6. Industrial Wastewater Management, Treatment, and Disposal. Water Environment Federation (WEF). Manual of Practice No.FD-3. Third Edition, 2008

Result of average student's workload

Activity	Time (working hours)
1. Participation in lectures :	30
2. Participation in laboratories	30
3. Participation in project	30

Student's workload

Source of workload	hours	ECTS
Total workload	170	6
Contact hours	96	3
Practical activities	60	2