STUDY MODULE DESCRIPTION FORM

Name of the module/subject	Code
Industrial Water and Wastewater	**1010135231010131095**

Field of study	Profile of study (general academic, practical)	Year /Semester
Enviromental Engineering Extramural Second-	**(brak)**	**2 / 3**
Elective path/specialty	**Subject offered in:**	**Course (compulsory, elective)**
Water Suply, Water Soil Protection	**Polish**	**obligatory**

Cycle of study:	Form of study (full-time,part-time)
Second-cycle studies	**part-time**

No. of hours								No. of credits
Lecture:	**20**	Classes:	**10**	Laboratory:	**10**	Project/seminars:	**16**	**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:

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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 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 exam - after 5 questions from each part. A total of 10 open questions. For each question the maximum number of points 10. Criteria of evaluation depending on the number of points obtained:

Number of points - rating

91 -100 very good (5.0)

81 - 90 good plus (4,5)

71 - 80 good (4.0)

61 - 70 sufficient plus (3,5)

50 - 60 satisfactory (3.0)

Below 50 points - insufficient (2.0)

- Laboratories (effect U1, K1, K2)
- verification of knowledge and skills necessary for the exercise,
- reporting,
- Activity when exercising.

Project (effect W2, U2, K2)

- checking the progress of the project in each activity,
- putting the project (date of donation given on the thematic card,
- verbal defense of the project (verification of independent design work and acquired skills). Evaluation of the project (70% of the defense rating + 30% of the project)

Classes (effect U3, K1, K2)

- reporting,
- final test (at the end of the semester) on water treatment and wastewater treatment in visited industrial plants

Final score (70% test, 30% report)

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. Ion-exchange processes in industry and energy potentials.

Classes

Technical Tours: visiting industrial facilities for water and wastewater treatment

Basic bibliography:

1. Hanna Majcherek: Zmiękczanie i demineralizacja wód przemysłowych. Wydawnictwo Politechniki Poznańskiej, Poznań 2005

2. Apolinary L. Kowal, Maria Świderska - Bróż, Oczyszczanie wody, PWN, Warszawa 2009

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

4. Stańda J., Woda do kotłów parowych i obiegów chłodzących siłowni cieplnych, WNT, Warszawa 1999

5. Danuta Chomicz; Uzdatnianie wody w kotłowniach i ciepłowniach, Arkady 1989

6. Danuta Chomicz. Poradnik. Woda w ciepłownictwie i ogrzewnictwie. Fundacja Rozwoju Ciepłownictwa Unia Ciepłownictwa, Warszawa 1994.

7. Bogusława i Edward Gomółkowie: Technologia wód przemysłowych z ćwiczeniami, Wydawnictwo Politechniki Wrocławskiej, Wrocław 1994

8. Mielcarzewicz E., Gospodarka wodno - ściekowa w zakładach przemysłowych, PWN, Warszawa 1986

9. Bartkowska J., Królikowski A.J.,Orzechowska M., Gospodarka wodno - ściekowa w zakładach przemysłowych, Wydawnictwo Politechniki Białostockiej, Białystok 1991

10. Gospodarka wodno-ściekowa. Przepisy. Normy. Technologie. Metody postępowania; Poradnik; Wydawnictwo Verlag Dashofer 2007

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. AWWA, Technical Editor F. W. Pontius, Water Quality and Treatment, McGraw ? Hill, Inc, New York. 1990

2. 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.

3. Meinck F., Stooff H., Kohlschütter H. Ścieki przemysłowe Arkady, Warszawa 1975

4. Industrial Wastewater Management, Treatment, and Disposal. Water Environment Federation (WEF). Manual of Practice No.FD-3. Third Edition, 2008

5. Majcherek H.: Podstawy hydromechaniki w inżynierii oczyszczania wody, wyd. Politechniki Poznańskiej, Poznań 2006

6. Sozański M.M., Huck P.M.: Badania doświadczalne w rozwoju technologii uzdatniania wody. Monografie Komitetu Inżynierii Środowiska PAN, vol. 42, Lublin 2007

7. Pruss A., Pruss P.: An Attempt at Application of Powdered Activated Carbon and Selective Anionite to Increase Effectiveness of Organic Matter Elimination from Water after Coagulation Process. OCHRONA ŚRODOWISKA Volume: 38 Issue:1 Pages: 25-28 Published: 2016

Result of average student's workload

Activity	Time (working hours)
1. Participation in lectures (contact hours)	20
2. Participation in laboratories (contact hours, practical)	10
3. Participation in project (contact hours, practical)	16
4. Participation in classes (contact hours, practical)	10
5. Design preparation (practical)	40
6. Design evaluation preparation + oral answer (contact hours)	10
7. Laboratory evaluation preparation	6
8. Laboratory results report preparation	4
9. Design, classes and laboratory problems consulting (contact hours)	9
10. Exam preparations	25

Student's workload		
Source of workload	**hours**	**ECTS**
Total workload	150	6
Contact hours	75	3
Practical activities	76	3