# COURSE DESCRIPTION CARD - SYLLABUS

Course name

Water supply

## Course

Field of study

Environmental Engineering

Year/Semester

2 / 4

Area of study (specialization)

Profile of study

general academic

Level of study

First-cycle studies

Course offered in

Polish

Form of study

full-time

Requirements

compulsory

## Number of hours

Lecture

15

Laboratory classes

Other (e.g. online)

Tutorials

0

Projects/seminars

30

## Number of credit points

3

## Lecturers

Responsible for the course/lecturer:

dr inż. Agnieszka Szuster-Janiaczyk

email: agnieszka.szuster-janiaczyk@put.poznan.pl

tel. 61 665 24 36

Faculty of Environmental Engineering and Energy

ul. Berdychowo 4, 61-131 Poznań

Responsible for the course/lecturer:

## Prerequisites

Fluid mechanics: knowledge of physical quantities characterising liquids; units; the basic notions and principles describing the flow of water in conduits; knowledge of the methods used to measure such quantities. Knowledge of equations describing the phenomena; understanding the causes of water hummer and cavitation and knowledge of the principles used to describe them.

Mathematics: knowledge of the formulation basics and the methods of solving of systems of algebraic linear and non-linear equations. Knowledge of the basics of mathematical optimization.

Determining extreme values of functions. Solving problems with hydraulic calculations for pipelines connected with reservoirs and pumps; solving algebraic, linear and non-linear equations and systems of equations; measurements of hydraulic parameters; selection of measuring devices.

Awareness of the need to continuously update and upgrade the knowledge and skills.

## Course objective

Conveying the basic knowledge and skills in planning, designing and operation of process equipment and technological operations associated with water abstraction, storage and transport from the intakes to water treatment plants and from water treatment plants to service lines supplying household water distribution systems.

## Course-related learning outcomes

### Knowledge

1. The student has knowledge of the structure of water intake and distribution systems in water supply systems, knows the functions, types and features of devices constituting technological systems in the system. [KIS2_W01, KIS2_W03]

2. The student knows the basic techniques and tools needed to solve engineering tasks in the field of construction and maintenance of equipment in water intake and distribution systems. The student knows the principles of designing vertical wells. Pump and siphon systems transporting water from vertical wells to the treatment station, principles of selection and dimensioning of devices for these systems [KIS2_W01, KIS2_W05, KIS2_W07].

3. The student knows the methods of programming the development, design and operation of water supply systems and the devices that are their elements. The student knows the standards characterizing the level of service, level of equipment maintenance. The student knows the next phases in the process of planning, design and construction of water supply systems and the requirements for the necessary project documentation. KIS2_W01, KIS2_W05].

4. The student has knowledge about the complexity of the issues of operation of water supply systems. Monitoring of hydaraululative and quality parameters. Knows what the WHO Water Safety Plan is. He knows the concept of critical points in the system and knows the tools for estimating the risk of adverse events in SZwW. [KIS2_W01, KIS2_W09.

### Skills

1. Student is able to identify features, analyze working conditions and assess the technical condition of exploited technological systems used for water intake and distribution [KIS2_U05, KIS2_U09, KIS2_U10].

2. Student is able to formulate and solve tasks of selection and dimensioning of system components as part of their planning, design, construction, modernization and maintenance [KIS2_U05, KIS2_U09, KIS2_U10].

3. Student is able to plan and conduct experiments, including simulations, of working conditions of pipelines transporting water on intakes and in water supply networks, their cooperation with other systems constituting the water supply system. [KIS2_U01, KIS2_U05, KIS2_U07, KIS2_U08.]

4. Student, formulating and solving engineering tasks, is able to see systemic aspects, economic and legal conditions of planning, designing and maintenance of devices [KIS2_U01, KIS2_U08, K2_U10, K2_U15].

Social competences

1. The student understands the need for teamwork in solving theoretical and practical problems [KIS2_K01].

2. Student realizes the importance of tasks related to optimal water management.

3. Student is able to identify socio-political conditions that may affect decisions taken in the management of water supply systems [KIS2_K01, KIS2_K03, KIS2_K04].

4. Student recognizes the need for systematic deepening of knowledge and extension of their competences [KIS2_K02, KIS2_K05].

## Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture:

Written exam, consisting of 25 questions, which are a combination of open, closed and test questions. Duration: 60 minutes. Maximum number of points to get: 100 points.Grading scale:

0 ÷ 49.5 - (2.0)

50 ÷ 60 - (3.0)

60,5 ÷ 70 -(3,5)

70,5 - 80 -(4,0)

80,5 - 90 - (4,5)

90,5 ÷ 100 - (5,0)

Learning effects: [ W01, W02, W03, W5, W06, W07]

Project excercises:

Checking progress in class, which is documented by entries in the consultation card.

Completion based on the completed post-project exercise - maximum number of points: 60 points

and a written defense of the project, consisting of two calculation tasks and two open questions. Duration 90 minutes. Maximum number of points to get: 40 points.

Completion of project exercises is carried out with a total number of points from the project and a written defense equal to 50 points, whereby the student must receive not less than 30 points from the project and not less than 20 points from the colloquium.

Grading scale:

0 ÷ 49.5 - (2,0)

50 ÷ 60 - (3.0)

60.5 ÷ 70 - (3.5)

70.5 ÷ 80 - (4.0)

80.5 ÷ 90 - (4.5)

90.5 ÷ 100 - (5.0)

Learning outcomes: [U01, U02, U03, U04, U05, KIS1, KIS2, KIS3, KIS4]

Learning methods:

Lecture: Lecture using multimedia presentations, combined with discussion with the listeners.

Project exercises: a design method using multimedia presentations

## Programme content

Lecture:

1. Computer aided design of water transporting systems. Database. Spatial information systems. Computer modeling of water distribution systems. Mathematical foundations of modeling of hydraulic and quality parameters. Stages of building hydraulic models of water supply networks. Modeling of individual hydraulic devices. Ways to verify and calibrate hydraulic models.

2. Operation of water distribution systems. Basic principles of exploitation of intakes, water networks and pumping stations. Network failure. Water supply reliability indicators. Hydraulic impacts and methods of its suppression. Organization and tasks of the operational service. Economic basics of exploitation.

3. Monitoring of hydraulic parameters of network operation - measuring instruments. Data collection and archiving. Remote data reading and analysis systems. SCADA. Flushing of the water supply network - types of flushing, required hydraulic parameters.

4. Supervision over water quality. Types of water quality monitoring. Remote monitoring and water withdrawal from the network. Measuring instruments. Range, frequency and location of water quality monitoring points. IT support for the water supply network operation process.

5. Management of processes shaping water quality in water supply systems. Water safety plans. Factors affecting water quality in SZwW. Secondary water pollution processes in water supply systems. Prevention of secondary water pollution processes. Determination of critical points in the system. Estimating the risk of adverse events in water demand systems. Water Safety Plans according to WHO (Water Safety Plans).

6. Computer support for the operation of water intake and transport systems. The use of a computer model for analysis and evaluation of the water supply system. Assessment methods, reliability indicators of water supply systems. Neural networks.

7. Modeling of water quality using IT tools. Basic equations describing changes in water quality during its distribution. Exergy and energy analysis of water supply systems. Multi-criteria analysis in the decision-making process. Types of decision support tools. Decision criteria. Giving weight to criteria. Mathematical analysis. Benchmarking in water supply companies. Benchmarking platforms.Tutorials exercises: Calculating the performance of wells with a free and pressure water table - calculating exercises.

Project exercises: Water supply network project for a city with balanced functions.

1. Drawing of a well with a free and pressure water table.

2. The issue of thematic cards. Discussion of how to develop a spatial development plan. Data acceptance for the project.

3. Calculation of water demand. Hourly distribution of water demand.

4. Dimensioning of water tanks - completion of Stage I

5. Routing the water supply network.

6. Determination of nodal partitions.

7. Development of calculation schemes.

8. Diameter selection. Reduction of nodes using the Krot method - passing Phase II.

9. Hydraulic calculations of the water supply network by the Cross-Łobaczew method. Correction of pre-selected diameters.

10. Development of the pressure line graph.

11. Selection of pumps - passing Stage III.

12. Creating a hydraulic model of a water supply network.

13. Creating a hydraulic model of a water supply network.

14. Final test

15. Improvement of the final test.

## Teaching methods

Lecture: Lecture using multimedia presentations, combined with discussion with the listeners.

Project exercises: practice method using multimedia presentation.

## Bibliography

Basic

1. Gabryszewski T., Wodociągi, Arkady, Warszawa, 1983

2. Suligowski Z., Zaopatrzenie w wodę, Wydawnictwo Seidel-Przywecki sp. z o.o., 2014

3. Mielcarzewicz E., Obliczanie systemów zaopatrzenia w wodę, Arkady, Warszawa 2001.

4. Knapik K., Bajer J., Wodociągi, Politechnika Krakowska, 2011

Additional

1. Clark R., Grayman W., Modeling Water Quality in Drinking Water Distribution Systems, AWWA, 1998

2. Guidlines for Drinking-water Quality, wydanie 4, WHO 2011

3. Lyp B., Strefy ochrony ujęć wód podziemnych, Wydawnictwo Seidel-Przywecki sp. z o.o., 2018

4. Kwietniewski M. i inni, Projektowanie elementów systemu zaopatrzenia w wodę, Wydawnictwo Politechniki Warszawskiej, Warszawa 1998

5. Pociask-Karteczka J., Zlewnia, właściwości i procesy, Wydawnictwo Uniwersytetu Jagiellońskiego, 2006

6. Rak J., Tchórzewska-Cieślak B., Ryzyko w eksploatacji systemów zbiorowego zaopatrzenia w wodę, Wydawnictwo Seidel-Przywecki sp. z o.o., 2013

7. Kowalski D., Nowe metody opisu struktur sieci wodociągowych do rozwiązywaqnia problemów ich projektowania i eksploatacji, Monografia PAN, Lublin 2011

8. Szuster-Janiaczyk Agnieszka, Zarządzanie jakością wody w systemach wodociągowych, XIX Krajowa, VII międzynarodowa konferencja naukowo-techniczna: zaopatrzenie w wodę, jakość i ochrona wód,

Zakopane, 18-21 czerwca 2006 r.,red. Andrzej Królikowski, Marek M. Sozański / PZIiTS Oddz. Wielkopolski [i in.] [org.]. - Poznań : PZIiTS Oddz. Wielkopolski. - T. 1, 2006. - S. 863-883

## Breakdown of average student's workload

| | Hours | ECTS |
|---|---|---|
| Total workload | 75 | 3,0 |
| Classes requiring direct contact with the teacher | 45 | 1,0 |
| Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation) [1] | 30 | 2,0 |

[1] delete or add other activities as appropriate