



Poznan University of Technology

Faculty of Civil and Environmental Engineering

Learning outcomes

for second-cycle studies, Master of Science Engineering, general academic profile National Qualifications Framework level 7 qualifications

1. Name of the field of study

ENVIRONMENTAL ENGINEERING

2. Placing the field within the area

Environmental Engineering as a field of study belongs to the area of technical studies.

Environmental Engineering as a field of study is especially related to the following fields of study: *Architecture and Urban Planning, Power Engineering, Civil Engineering, Management*. Relationships with them, even if they are not explicitly defined in the learning outcomes or in the program of studies for the field of Environmental Engineering, are essential complements of the description of study. Training is provided on the general academic profile, as a long university tradition of construction faculty at Poznan University of Technology, created from the very beginning of technical higher education, which since 1950 has been teaching on specialties related to sanitary engineering, and since 1972 it has been Environmental Engineering.

3. Reference to international standards

The preparation of these descriptions of learning outcomes was based on international standards formulated by the following organizations: American ABET (Accreditation Board for Engineering and Technology), Japanese JABEE (Japan Accreditation Board for Engineering Education), IEA (International Engineering Alliance), FEANI (Fédération Internationale d'Associations Nationales d'Ingénieurs), EUR-ACE (European Accredited Engineer Project) and CDIO (Conceive Operate Implemented Design Initiative). Most attention was given to the requirements of FEANI, through accreditation requirements formulated by the EUR-ACE.

4. Area descriptors taken into account in the field of study description

The description takes into account the learning outcomes for the general academic profile for education in the area of technical sciences, originating from Annex No. 5 to the Regulation of the Minister of Science and Higher Education dated 2 November 2011 on the National Qualifications Framework for Higher Education (Dziennik Ustaw No. 253, item 1520), and conditions for conducting studies in a certain fields and levels of education, the Regulation of the Minister of Science and Higher Education dated 5 October 2011 (Journal of Laws No. 243, item 1445).

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5. Educational effects

1. to provide knowledge of analyzing and designing complex technological systems for buildings and constructions and systems supplying heat, gas and water, systems neutralizing and disposing of wastewater and solid waste as well as managing work in this field,
2. to develop the ability to identify and solve essential problems in the field of Environmental Engineering and related fields,
3. to prepare the graduate for independent work in positions related to designing, implementing, managing and supervising both own and team work,
4. to acquire abilities to study new problems independently and solve them by means of research and development.

5. Learning outcomes

On completing second-cycle studies, the graduate of Environmental Engineering with the knowledge acquired while studying is prepared to take decisions for the proper application of installation and construction materials, technological installations for buildings and technical infrastructure related to environmental engineering as well as building initiatives in this field.

The graduate knows current trends in the design and execution of construction works. The graduate abides by safety at work rules and is able to design technological installations for complex buildings as well as systems supplying heat, gas, water and systems neutralizing and disposing of wastewater and solid waste, water treatment installations, sewage treatment installations and solid waste neutralization and disposal plants. The graduate knows the rules of technical thermodynamics, heat and mass exchange and fluid mechanics. The graduate can also formulate, create and then apply correct mathematical models for complex installations, systems used in buildings and constructions, technical infrastructure, verify and apply existing mathematical models for these complex systems. The graduate can also create and read technical drawings, recognize mapping and land surveying documentation and supervise building and construction works in the field of environmental engineering.

The graduate can formulate and solve new engineering, technical and organizational problems related to environmental engineering and uses modern information technology to aid designing technological systems and installations for constructions and buildings. The graduate can select arguments critically to help solve collective decisions concerning installations and technical infrastructure related to environmental engineering. The graduate can develop and optionally publish reports concerning the works being done. The graduate can work in a team, supervise a team and be responsible for safety at work in the team. The graduate is aware of the need to raise professional and personal competences and acts in accordance with the rules of ethics. The graduate knows and applies regulations concerning building and construction.

The graduate is prepared to start doctoral studies in the field of Environmental Engineering.

6. Detailed learning outcomes for the field of Environmental Engineering and their reference to the effects for the area of technical sciences

Explanation of signs used in symbols:

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K - directional learning outcomes,
W - category of knowledge,
U - category of skills,
K_ - category of personal and social competence
T1A - area learning outcomes for technical sciences for the first-cycle studies,
general academic profile

Learning outcomes for the field of Environmental Engineering	DESCRIPTION OF FIELD LEARNING OUTCOMES What the graduate can do upon completion of second-cycle studies in the field of Environmental Engineering:	Odniesienie do efektów kształcenia w obszarze nauk technicznych
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KNOWLEDGE

K2_W01	The graduate has a widened and deepened knowledge of mathematics, physics, chemistry, environmental biology and other areas useful in formulating and solving complex problems in the field of environmental engineering.	T2A_W01
K2_W02	The graduate has a knowledge, including theoretical background of the following: - buildings, constructions and structures as well as ways of shaping construction components as far as heat, moisture and air tightness go, - low - energy and passive buildings, - foundations of buildings and constructions as well as placing heat and sanitary networks underground, - installation materials and ways of connecting pipes and networks into systems, - rules of building and construction works in the field of heat and sanitary installations	T2A_W02
K2_W03	The graduate has an organized knowledge with a theoretical background including technical thermodynamics, heat and mass transfer, fluid mechanics, technical microbiology, environmental biology and environmental chemistry.	T2A_W03
K2_W04	The graduate has a detailed knowledge, including theoretical background concerning: - flow mechanics and heat exchange calculation methodology, - methods of calculating heaters, recuperators, underground heat exchangers and heat loss for pipelines, - energy balance of complex buildings and constructions, - selecting elements of heating, ventilation and air conditioning for buildings with various energy characteristics, - regulation and control elements for systems in	T2A_W04

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	buildings and municipal engineering, - rules of energy and exergy efficiency for complex installations and systems used in municipal engineering, - processes of reducing gas and dust contamination of air, - processes of treating wastewater biologically, - microbiological methods of environmental control, - rules of examining physical, chemical and biological composition of sewage and balancing contamination loads;	
K2_W05	The graduate has a knowledge of development trends and recent achievements in the field of environmental engineering including the following: - technical systems for buildings, - systems of automatic control, - conventional and renewable heat and cooling sources, - water treatment systems and wastewater treatment systems, - wastewater disposal systems, - air protection systems, - energy technologies based on conventional and renewable energy sources, - control systems measuring environmental pollution, - air, water and sewage microbiology, - waste disposal systems and land reclamation, - global phenomena which determine and shape housing development;	T2A_W05
K2_W06	The graduate has a detailed knowledge of technical systems, facilities and appliances in environmental engineering, their lifespan including the following: - technical systems and installations for buildings - conventional and renewable heat and cooling sources, - water treatment systems and wastewater treatment systems, - wastewater disposal systems, - air protection systems, - energy technologies based on conventional and renewable energy sources, - methods of environmental auditing;	T2A_W06
K2_W07	The graduate knows basic methods, techniques, tools and materials used in solving complex engineering tasks in the field of environmental engineering, including: - technical systems for buildings, - systems of automatic control, - conventional and renewable heat and cooling sources, - water treatment systems and wastewater treatment systems, - wastewater disposal systems, - air protection systems, - energy technologies based on conventional and	T2A_W07

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K2_W08	renewable energy sources, - air, water and sewage disinfection systems, - waste disposal systems and land reclamation;	T2A_W08		
	The graduate has a knowledge necessary to understand social, economic, legal and other non-technical conditions in engineering business and applying it in practice;			
	K2_W09		The graduate has a basic knowledge of management, including quality management and business activity;	T2A_W09
	K2_W10		The graduate knows and understands the basic concepts and principles of the protection of industrial property as well as the necessity of managing intellectual property and is able to use the resources of patent information;	T2A_W10
	K2_W11		The graduate knows the general principles of creation and development of forms of individual entrepreneurship, using the knowledge of environmental engineering;	T2A_W11

SKILLS

K2_U01	The graduate can get information from literature, databases and from other appropriately selected sources, also in English or in another foreign language recognized as a language of international communication in the field of environmental engineering. The graduate can integrate the information obtained, to make an interpretation, as well as draw conclusions and formulate and justify opinions in detail;	T2A_U01		
	K2_U02		The graduate can communicate using a variety of techniques in a professional environment and other environments, also in English or in another foreign language recognized as a language of international communication in the field of environmental engineering;	T2A_U02
	K2_U03		The graduate can prepare a scientific report in Polish and a short scientific information in English on results of own research;	T2A_U03
	K2_U04		The graduate can prepare and deliver an oral presentation on detailed problems concerning particular problems of environmental engineering in Polish and in a foreign language. The presentation may concern the following: - technical systems for buildings, - systems of automatic control, - conventional and renewable heat and cooling sources, - water treatment systems and wastewater treatment systems, - wastewater disposal systems, - air protection systems, - energy technologies based on conventional and renewable energy sources, - technical microbiology and biochemistry, - disinfection systems,	T2A_U04

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	- air, water and sewage disinfection systems, - waste disposal systems and land reclamation;	
K2_U05	The graduate can determine directions of further learning and implement the process of self-learning;	T2A_U05
K2_U06	The graduate has linguistic skills in the area of science and fields of study related to engineering, which are compliant with requirements listed for level B2+ of the Common European Framework of Reference;	T2A_U06
K2_U07	The graduate has skills enabling him/her to use information technology and communication tools appropriate for doing tasks typical of the engineer's job;	T2A_U07
K2_U08	The graduate can plan and perform experiments, including measurements and computer simulations in the following range: - technical systems for buildings, - conventional and renewable heat and cooling sources, - water treatment systems and wastewater treatment systems, - wastewater disposal systems, - air protection systems, - examination and control processes including biochemical and microbiological processes at various stages of sewage treatment and water production. The graduate can clearly present and interpret the results obtained and draw conclusions;	T2A_U08
K2_U09	The graduate can formulate and solve engineering tasks in the field of environmental engineering using analytical methods, simulation and experimental methods;	T2A_U09
K2_U10	While formulating and solving engineering tasks in the field of environmental engineering, the graduate can integrate the knowledge from science and fields of study related to environmental engineering and apply a systematic approach taking into account non-technical aspects too;	T2A_U10
K2_U11	The graduate can formulate and test hypotheses related to engineering problems and simple research problems concerning environmental engineering including the following: - technical systems for buildings, - conventional and renewable sources of heat and cooling, - water treatment systems and wastewater treatment systems, - wastewater disposal systems, - air protection systems, - energy technologies based on conventional and renewable energy sources, - biological processes used in environmental engineering, - air, water and sewage disinfection systems, - waste disposal systems and land reclamation;	T2A_U11

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K2_ U12	The graduate can assess usefulness and possibility to implement new technical and technological achievements used in environmental technology;	T2A_ U12
K2_ U13	The graduate has necessary background to work in the industrial environment related to environmental engineering and knows safety rules concerning this job;	T2A_ U13
K2_ U14	The graduate can make an initial economical analysis of the engineers' actions taken and related to environmental engineering including the following: <ul style="list-style-type: none"> - technical systems for buildings, - systems of automatic control, - heat and cooling sources, - water treatment systems and wastewater treatment systems, - wastewater disposal systems, - air protection systems, - energy technologies based on conventional and renewable energy sources, - waste disposal systems and land reclamation; 	T2A_ U14
K2_ U15	The graduate can make a critical analysis of the way of functioning and assess existing technical solutions, especially equipment, facilities, systems, processes and services used in environmental engineering;	T2A_ U15
K2_ U16	The graduate can propose innovations and improvements of existing technical solutions used in environmental engineering;	T2A_ U16
K2_ U17	The graduate can identify and formulate a specification of complex engineering tasks in the field of environmental engineering, including tasks which are not typical and taking into account non-technical aspects;	T2A_ U17
K2_ U18	The graduate can assess the usefulness of methods and tools used to solve engineering tasks typical of environmental engineering. The graduate can also notice limitations of these methods and tools as well as solve complex engineering tasks in the field of environmental engineering including tasks which are not typical and those which have research component in them;	T2A_ U18
K2_ U19	The graduate can follow the specification which includes non-technical aspects and design a complex piece of equipment, facility, system or process related to environmental engineering. The graduate can also implement this design at least in part using appropriate existing methods, techniques and tools for it and developing them in progress.	T2A_ U19
SOCIAL COMPETENCES		
K2_ K01	The graduate understands the need of lifelong learning and can inspire other people as well as organize the process of learning for other people.	T2A_ K01
K2_ K02	The graduate is aware of the importance and	T2A_ K02

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	understanding non-technical aspects and results of the engineer's job, including its environmental impact and the resulting responsibility for all decisions made.	
K2_K03	The graduate can cooperate and work in a team accepting various positions.	T2A_K03
K2_K04	The graduate can appropriately set priorities necessary to complete a task specified by other people or a self-prepared task.	T2A_K04
K2_K05	The graduate correctly identifies and solves dilemmas related to doing the job.	T2A_K05
K2_K06	The graduate can think and act in a creative and businesslike way.	T2A_K06
K2_K07	The graduate is aware of the social role of a technical university graduate. The graduate particularly understands the need to formulate information and opinions concerning technological advances and other aspects of the engineer's job and to inform the society about them using mass media. The graduate tries to convey such information and opinions in a way which is generally understandable and taking various points of view into account.	T2A_K07