science

Education in the chemical technology field of study – legal basis, statistics, dilemmas

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Please cite as: CHEMIK 2015, **69**, 9, 547–556

Introduction

The chemical technology field of study (kTch) is provided by 13 public higher education institutions, by 16 faculties (Tab. 1), only as degree programmes at general academic profile. Most of these faculties are authorised to award doctoral degree (11 faculties) and postdoctoral degree (10 faculties) in the chemical technology field in the sciences in the technology academic discipline as well as in the chemical sciences academic discipline, which ensures autonomy for these bodies in defining programmes of study.

Legal basis of education

The process of education unification for the kTch commenced in 1996 when the Central Council of Higher Education (RGSW) defined minimal curriculum requirements for the kTch long-cycle Master's degree programmes (Tab. 2) in its Act No. 234/96 [1]. The minimal curriculum requirements for the kTch were defined later, two more times. In 2002 the Regulation of the Minister of National Education and Sport (MENiS) [2] legitimised recommendations of the RGSW as the teaching standards and in 2007 the Regulation of the Minister of Science and Higher Education (MNiSW) [3] established education standards for the kTCh two-cycle programmes (Tab. 2).

Since the academic year 2012/2013 Polish higher education institutions have commenced implementation of National Qualifications Frameworks for Higher Education according to the learning outcomes adopted by their senates. The learning outcomes were defined as a body of knowledge, skills and social competences acquired as a result of a learning process in the higher education system [4].

On the ministerial list of areas of academic study [5] the chemical technology field of study in the sciences was placed in the science area of academic study and the chemical science academic discipline as well as in the technological sciences area of academic study and technology science academic discipline.

According to Regulations of the MNiSW [6, 7] description of assumed learning outcomes for the field, level and profile of study considers outcomes selected from the learning outcomes for the area of academic study, from which the field of study was separated. All the Polish higher education institutions (even those that authorisation to grant degrees is limited exclusively to the science area of academic study) provide the kTch programmes in the technological sciences area of academic study.

In case of degree programmes leading upon successful completion to award the engineer's degree or the Master's degree (Master of Science), the description of learning outcomes must also consider the full scope of learning outcomes resulting in receiving engineering competences [6, 7].

Description of learning outcomes for profiles of study in the technological sciences area of academic study (area of academic study learning outcomes) was provided in the Annex No. 5 to the Regulation of the MNiSW of 02.11.2011. The learning outcomes that result in receiving engineering competences were defined in the Annex No. 9 to this Regulation (Tab. 3) [8].

At the higher education institutions description of the field of study learning outcomes for the kTch were formed on the basis of description of the area of academic study learning outcomes. Large generality of description of area of study learning outcomes resulted in very diverse descriptions of field of study learning outcomes (in respect of number of learning outcomes (Tab. 4), and first of all in their substance) at the higher education institutions. At some higher education institutions the particular field of study learning outcomes were referred to the particular learning outcomes in the Regulation, while at other higher education institutions the particular field of study learning outcomes referred to a few learning outcomes in the Regulation. Table 5 presents the examples of the field of study learning outcomes elaborated at higher education institutions referring to a selected area of study learning outcome in respect of skills for first cycle programmes at general academic profile, i.e. the *T1A_U08* learning outcome – *Is able to plan and to realize experiments, including measurements and computer simulations, to interpret obtained results and to draw conclusions* (the list includes field of study learning outcomes, that are related to the T1A_U08 learning outcome only, but not to the combination of the T1A_U08 learning outcome with other learning outcomes).

Statistics

In the academic year 2013/2014 2216 graduates were completed degree programmes in the kTCh (decrease by 13% in comparison with the previous year) and 54% of them are graduates of first cycle programmes. Three out of four graduates of first cycle programmes continue degree programmes at the second level of study of the kTch. Almost half (48%) of the kTch graduates completed degree programmes at the higher education institutions of two voivodeships, i.e. Lesser Poland Voivodeship and Masovian Voivodeship. Part-time programmes are less popular, only 10% of the graduates as well as of the students are participants od this mode of study, provided only by 5 higher education institutions (Tadeusz Kościuszko Krakow University of Technology, Poznan University of Technology, Warsaw University of Technology, Wrocław University of Technology, Kazimierz Pulaski University of Technology and Humanities in Radom) [9, 10].

The number of the kTch students at public higher education institutions is presented in Table 6.

The data concerning education at public higher education institutions in the kTch taking into account the mode and the level of study as well as the number of semesters and the number of offered specializations is shown in Table 1.

The specializations provided by higher education institutions within the kTch are related to analytics, bio-processes, materials science, environmental protection, management and technology of course. The specializations, that are not fall in this thematic area, may include: medical chemistry, technical electrochemistry, industrial catalysis, nanotechnology and business, building material technology, skin technology, anti-corrosion protection technology.

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One description of the field of study learning outcomes or description with division into common field of study learning outcomes and additional learning outcomes characteristic for the particular specializations were defined at higher education institutions providing more than one specialization at the particular level of study.

It is difficult to estimate exactly how many specializations are offered for the students in the kTch. New specializations are offered during each academic year, some specializations are still provided, but they are not included in the present offer, some of them change their names. It can be estimated that the faculties offer about 80 exceptional specializations. The higher education institutions have different approach to division of classes provided in the kTch into specializations, i.e.: lack of specialization at the first level and division into specializations at the second level of study (AGH University of Science and Technology, Poznan University of Technology, Rzeszow University of Technology, Silesian University of Technology (the macro-field of study), Chemical Faculty of Warsaw University of Technology, Wrocław University of Technology, Kazimierz Pulaski University of Technology and Humanities in Radom); identical or very similar specializations at the first and second level of study (Gdańsk University of Technology, Tadeusz Kościuszko Krakow University of Technology, Lodz University of Technology, Silesian University of Technology, Faculty of Civil Engineering, Mechanics and Petrochemistry of Warsaw University of Technology, University of Science and Technology in Bydgoszcz); a few specializations on the first and a dozen specializations at the second level of study (West Pomeranian University of Technology Szczecin). The faculties providing specializations in the kTch offer from 2 to 7 of them at each level of study, except for the record holder, which has 17 specializations in its second level of study offer (with 55 students – the state on 30.11.2014). Some higher education institutions, from the group educating larger numbers of students, offer education in English at specializations of the second level of study.

Table 1

The characteristics of the kTch education at the public higher education institutions (in alphabetical order, on the basis of the data available on the higher education institutions websites, the state on 23.05.2015)

University	Faculty, city	Mode of study	First cycle programmes		Second cycle programmes	
			number of semesters	number of offered specializations	number of semesters	number of offered specializations
AGH University of Science and Technology (AGH)	Faculty of Energy and Fuels (WEiP), Kraków	S[1]	7	1[3]	3	7
	Faculty of Materials Science and Ceramics (WIMiC), Kraków	S	7	1	3	4
Gdańsk University of Technology (PG)	Faculty of Chemistry (WCh), Gdańsk	S	7	3	3	3
Lodz University of Technology (PŁ)	Faculty of Chemistry (WCh), Łódź	S	7	5	3	5
Tadeusz Kościuszko Krakow University of Technology (PK)	Faculty of Chemical Engineering and Technology (WIiTCh), Kraków	S	7	6	3	6
		N[2]	-	-	3/4[4]	3/2
Poznan University of Technology (PP)	Faculty of Chemical Technology (WTCh), Poznań	S	7	1	3	4
		N	8	1	4	1
Rzeszow University of Technology (PR)	Faculty of Chemistry (WCh), Rzeszów	S	7	4	3	3
Silesian University of Technology (PŚ)	Faculty of Chemistry (WCh), Gliwice	S	7	5	3	5
	WCh Educational Centre, Dąbrowa Górnicza	S	7	1	-	-
	WCh, Gliwice Industrial and engineering chemistry macro-field of study	S	7	1	-	-
Warsaw University of Technology (PW)	Faculty of Civil Engineering, Mechanics and Petrochemistry (WBMiP), Płock	S	7	2	3	2
		N	7	1	3	1
	Faculty of Chemistry (WCh), Warsaw	S	7	1	3	5
Wrocław University of Technology (PWr)	Faculty of Chemistry (WCh), Wrocław	S	7	1	3/4	2
		N	8	1	-	-
University of Silesia in Katowice (UŚ)	Faculty of Mathematics, Physics and Chemistry (WMFiCh), Katowice	S	7	2	-	-
Kazimierz Pulaski University of Technology and Humanities in Radom (UTH)	Faculty of Materials Science, Technology and Design (WMTiW), Radom	S	7	1	3	7
		N	7	1	3	7
UTP University of Science and Technology in Bydgoszcz (UTP)	Faculty of Chemical Technology and Engineering (WTiICh), Bydgoszcz	S	7	3	3	4
West Pomeranian University of Technology Szczecin (ZUT)	Faculty of Chemical Technology and Engineering (WTiICh), Szczecin	S	7	3	3	17

[1] full-time programmes
[2] part-time programmes
[3] value 1 means that the university does not specify the name of specialization in for the particular mode and level of study
[4] education offer in two dimensions of semesters

Table 2

Principal requirements for education in the kTch according to the RGSW (1996) and standards (2002 and 2007)

Requirements	Minimal curriculum requirements according to the RGSW (1996) and teaching standards (2002) for long-cycle Master's degree programmes [1, 2]	Education standards (2007) [3]	
		first cycle programmes	second cycle programmes
Duration of programmes	10 semesters	≥ 7 semesters	≥ 3 semesters
Number of class hours	~ 3400	≥ 2500	≥ 900
Number of ECTS credits	-	≥ 210	≥ 90
Minimal number of hours	1575 including: general education subjects 360 basic subjects 555 field of study subjects 660	975 including: group of basic curriculum content 450 group of field of study curriculum content 525	group of field of study curriculum content 180
Share of hours of the schedule of degree programmes defined and detailed in the standards	46%	39%	20%
Student placement	The obligatory student placement form is not determined for this field of study. The programme of study should provide from 8 to 12 weeks of student placement, including the field of study placement and the diploma placement.	The student placement should last no less than 6 weeks. The principles and form of doing student placement are defined by the faculty of the higher education institution offering education.	-

Table 3

Type and number of learning outcomes for the degree programmes at general academic profile in the technological sciences area of academic study and learning outcomes resulting in receiving engineering competences [8]

Learning outcomes	Type and number of learning outcomes		
	first cycle programmes	second cycle programmes	for the first and second cycle qualifications resulting in receiving engineering competences
Knowledge	11	11	5
Skills including:	16	19	8
general skills (not related to the area of engineering education)	6	6	
basic engineering skills	6	8	
skills related directly to solving engineering tasks	4	5	
Social competences	7	7	2

Table 4

Number of learning outcomes defined at higher education institutions for the kTch (on the basis of the data available on the higher education institutions websites – state on 23.05.2015.)

University, faculty	Number of learning outcomes					
	first cycle programmes			second cycle programmes		
	knowledge	skills	social competences	knowledge	skills	social competences
AGH, WIMiC	14	18	12	17	23	8
AGH, WEiP	21	30	7	17	24	7
PG, WCh	24	20	6	20	20	7
PŁ, WCh	18	14	13	12	16	12
PK, WIiTCh	20	27	11	13	20	2
PP, WTCh	19	33	7	14	23	7
PR, WCh	19	22	7	12	16	3
PŚ, WCh	19	25	7	12	20	6
PW, WBMiP	26	32	10	24	31	10
PW, WCh	16	26	8	14	16	3
PWr, WCh	26	42	5	3 semesters: 14/16 4 semesters: 21/23	3 semesters: 14/19 4 semesters: 22/24	2
UŚ, WMFiCh	43	59	16	-	-	-
UTH, WMTiW	21	20	6	14	17	7
UTP, WTiICh	24/27/25 [1)]	22/26/25	7	13/14/13/13	19/19/18/18	6
ZUT, WTiICh	21	24	11	15	20	4

[1)] different number of learning outcomes for specializations

Table 5

Exemplary, field of study learning outcomes related to the T1A_U08 area of study learning outcome (on the basis of the data available on the higher education institutions websites – the state on 23.05.2015)

University, faculty	Symbol of the field of study learning outcome	Description of the field of study learning outcome
PK, WIiTCh	K_U08	Is able to plan chemical experiments, interpret obtained results and draw correct conclusions.
	K_U09	Is able to use simulators helping in engineering design processes and chemical technology (ChemCAD).
PR WCh	K_U009	Is able to use IT technology for designing, simulations and characterization of simple unit operations and technical processes.
	K_U010	Is able to plan and realize experiments, including chemical ones, calculate, interpret obtained results and draw correct conclusions.
	K_U011	Uses the basic laboratory techniques in synthesis, separation and purification of chemical compounds.
PŚ, WCh	K1A_U07	Is able to carry out simple physical and chemical measurements and elaborate as well as present in comprehensive way their results, especially: to put together a simple measuring system using standard measuring devices according to the required diagram and specification, determine results and their direct as well as indirect measurement uncertainty and record them in a relevant form; assess reliability of obtained measurement results and interpret them on the basis of possessed physical and chemical knowledge.
	K1A_U10	Is able to use the basic laboratory techniques in synthesis, separation and purification of chemical compounds.
	K1A_U11	Is able to select analytic methods for qualitative and quantitative determination of chemical compounds.
	K1A_U12	Is able to determine physical, chemical, mechanical and thermal properties of materials.
	K1A_U13	Is able to foresee reactivity of chemical compounds on the basis of their structures, is able to estimate heat effects of chemical processes.
PW, WBMiP	C1A_U08_01	Is able to plan and realize measurements of basic properties characterizing materials, especially crude oil processing products and polymer materials; is able to realize simulations of production processes.
	C1A_U08_02	Is able to present obtained results in numerical and graphical form, interpret them and draw conclusions.
PW, WCh	K_U09	Is able to plan and realize experimental studies independently.
	K_U10	Is able to interpret and discuss results of realized studies critically and draw conclusions in order to modify earlier assumptions.
UŚ, WMFiCh	TCh_Ui21	Is able to use compounds and materials of high and special purity in chemical engineering and outside it.
UTP, WMTiW	K_U06	Realizes chemical experiments, studies the course of chemical processes and interprets obtained results.
	K_U09	Is able to characterize different states of the matter and distinguishes types of chemical reactions and is able to select them for realized chemical processes.
	K_U20	Realizes isolation of micro-organism and realizes experiments using them (outcome for the industrial biotechnology field of study).
	K_U23	Realizes quantitative analyses of inorganic compounds (outcome for the industrial biotechnology field of study).

Table 6

Number of the kTch students [9, 10]

Mode of study	Academic year 2012/2013			Academic year 2013/2014		
	first cycle programmes	second cycle programmes	total	first cycle programmes	second cycle programmes	total
Full-time programmes	5694	1304	6998	5429	1364	6793
Part-time programmes	607	188	795	491	211	702
Total	6301	1492	7793[1)]	5920	1575	7495[2)]

[1)] of which females: 5312 (68%)
[2)] of which females: 5185 (69%)

Dilemmas – instead of summary

The analysis of the legal basis and the reality of providing degree programmes inspire to pose many questions concerning the issues of education in the kTch.

1. Who is a chemical technology engineer, exactly? What conditions must fulfill someone who can be called a chemical technology engineer? Is an engineer defined by his education or by fulfilled professional tasks?
2. Is it enough to be graduated in the field of study called „chemical technology" by the senate of higher education institution and achieve the approved learning outcomes to become a chemical technology engineer?
3. Is there any canon of minimal field of study requirements concerning the knowledge and skills allowing to call a graduate an engineer or a Master in Science in chemical technology?
4. Should there be standard learning outcomes for the kTch?

5. Should there be frame or field of study learning outcomes for the kTch? Should there be frame or field of study curriculum contents for the kTch?
6. Are there any requirements for the kTch necessary, such as for example: minimal number of class hours for the particular modules?
7. Should the programmes be provided as two-cycle programmes or long-cycle Master's degree programmes?
8. What is the objective of providing specializations? Is it the fulfilment of the requirement of module selection? Are the class hours within the specialization used to include an academic teacher in the minimum staffing requirement?
9. Should division into specializations be already at the first level or only at the second level of study?
10. Does the graduating in a definite specialization help the graduate to find a job?
11. Is education at the part-time programmes advisable?
12. Should there be any regulations and what would be their use concerning the profession of a chemical technology engineer?
13. Would defining of professional task not be accomplishing the equilibrium between the profession regulation and preserving the academic diversity?
14. Can integrated qualification system help in defining the requirements for a chemical technology engineer? How should the sectoral qualification framework be formed? Does the broadly defined academic community participate in its elaboration?
15. Should the academic community not strengthen the pursuit objected to acknowledge equal value of the chemical technology field of study in sciences regardless of the area of study, to which this field of study in sciences was allocated?

References

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„Studiujesz? Praktykuj!"

Rusza kolejna odsłona „Uczelni Przyszłości" – programu Ministerstwa Nauki i Szkolnictwa Wyższego. Tym razem to ogłoszony przez Narodowe Centrum Badań i Rozwoju konkurs „Studiujesz? Praktykuj!", na organizację którego przeznaczono aż 550 mln PLN.

Celem konkursu jest umożliwienie polskim uczelniom przygotowania swoich studentów do wejścia na rynek pracy. Programy będą ustalane pomiędzy uczelnią a pracodawcą. Minimalny czas trwania stażu, to jeden miesiąc. Możliwe jest jednak przygotowanie programów dłuższych, np. trzymiesięcznych, i te zostaną odpowiednio wyżej ocenione. Oferty kierowane będą przede wszystkim do studentów ostatnich lat studiów, co ułatwi im wejście na rynek pracy. Studenci otrzymają m.in. stypendia stażowe, pokryte zostaną również koszty ewentualnych dojazdów, zakwaterowania i utrzymania oraz inne – np. ubezpieczenia czy badania lekarskie.

W konkursie będą mogły wziąć udział uczelnie publiczne i niepubliczne, które kształcą co najmniej 100 studentów na kierunkach stacjonarnych. Państwowe wyższe szkoły zawodowe, podobnie jak ich niepubliczne odpowiedniki, będą mogły ubiegać się o wsparcie w ramach odrębnego projektu: „Programu praktyk zawodowych w Państwowych Wyższych Szkołach Zawodowych". *(kk)*

(http://www.nauka.gov.pl, 11.08.2015)

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