Annual Activity Report
Faculty of Chemical Technology
University of Pardubice

2020

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University of Pardubice

2020

Content Page

Introduction

Dear readers, this publication is the Annual Report for 2020 presented to the general public by the Faculty of Chemical Technology, University of Pardubice in compliance with Act No. 111/1998 Coll. on Higher Education Institutions and on amendment to some acts. In this report, the management of the faculty presents significant activities and achievements of the faculty in the context of the University of Pardubice, in the framework of Czech and international education and in terms of scientific and research activities.

1. Structure of the Faculty Bodies

1.1 Faculty Management

Dean:	Prof. Ing. Petr Kalenda, CSc.
Vice-Deans:	Prof. Ing. Petr Němec, Ph.D. *Vice-Dean for Education, First Deputy Dean*
	Prof. Ing. Petr Mošner, Dr. *Vice-Dean for Internal Affairs (until 30 November 2020)* *Vice-Dean for Science and Development (from 1 December 2020)*
	Prof. Ing. Libor Čapek, Ph.D. *Vice-Dean for Science and Creative Activity (until 30 June 2020)*
	Mgr. Lucie Stříbrná, Ph.D. *Vice-Dean for External Relations and Promotion*
Secretary:	Ing. Martin Šprync

1.2 Departments and Institutes of the Faculty

Departments and Institutes

Department of General and Inorganic Chemistry (KOAnCh)
Head of Department: Prof. Ing. Zdeněk Černošek, CSc.

Institute of Organic Chemistry and Technology (ÚOChT)
Head of Institute: Prof. Ing. Miloš Sedlák, DrSc.

Department of Analytical Chemistry (KAlCh)
Head of Department: Prof. Ing. Karel Ventura, CSc.

Department of Biological and Biochemical Sciences (KBBV)
Head of Department: Prof. Mgr. Roman Kanďár, Ph.D.

Department of Physical Chemistry (KFCh)
Head of Department: Prof. Ing. Libor Čapek, Ph.D.

Institute of Chemistry and Technology of Macromolecular Materials (ÚChTML)
Head of Institute: Doc. Ing. David Veselý, Ph.D.

Institute of Environmental and Chemical Engineering (ÚEnviChI)
Head of Institute: Prof. Ing. Petr Mikulášek, CSc.

Department of Economy and Management of Chemical and Food Industry (KEMCh)
Head of Department: Ing. Jan Vávra, Ph.D.

Department of Inorganic Technology (KAnT)
Head of Department: Prof. Ing. Petra Šulcová, Ph.D.

Institute of Applied Physics and Mathematics (ÚAFM)
Head of Institute: Prof. Ing. Čestmír Drašar, Dr.

Department of Graphic Arts and Photophysics (KP)
Head of Department: Prof. Ing. Petr Němec, Ph.D.

Institute of Energetic Materials (ÚEnM)
Head of Institute: Doc. Ing. Miloš Ferjenčík, Ph.D.

Centre of Materials and Nanotechnologies (CEMNAT)
Head of Centre: Prof. Ing. Miroslav Vlček, CSc.

Joint Laboratory of Solid State Chemistry (SLChPL)
Head of Laboratory: Doc. Ing. Eva Černošková, CSc.

Centres

University Environmental Centre
Head of Centre: Prof. Ing. Petr Mikulášek, CSc.

1.3 Academic Senate of FChT

Chairman: Doc. Ing. Martin Adam, Ph.D.

Praesidium: Doc. Ing. Martin Adam, Ph.D.
Ing. Aleš Eisner, Ph.D.
Ing. Lada Dubnová

Members: Doc. Ing. Martin Adam, Ph.D.
Doc. Ing. Marek Bouška, Ph.D.
Prof. Ing. Čestmír Drašar, Dr.
Ing. Lada Dubnová
Ing. Aleš Eisner, Ph.D.
Prof. Ing. Roman Jambor, Ph.D.
Doc. Ing. Alena Komersová, Ph.D.
Bc. Petr Leinweber
Ing. Patrik Pařík, Ph.D.
Bc. Martin Šimek
Ing. Pavel Šimon
Ing. Diego Alejandro Valdés Mitchell
Doc. Ing. David Veselý, Ph.D.
Prof. Ing. Jaromír Vinklárek, Dr.
Doc. Ing. Tomáš Weidlich, Ph.D.

1.4 Scientific Board of FChT

Chairman: Prof. Ing. Petr Kalenda, CSc., Dean of the Faculty of Chemical Technology

Internal Members:
Prof. Ing. Libor Čapek, Ph.D.
Prof. Ing. Zdeněk Černošek, CSc.
Prof. Ing. Čestmír Drašar, Dr.
Prof. Ing. Radim Hrdina, CSc.
Prof. Ing. Jaromíra Chýlková, CSc.
Prof. Ing. Roman Jambor, Ph.D.
Prof. Ing. Pavel Jandera, DrSc.
Prof. Mgr. Roman Kanďár, Ph.D.
Prof. Ing. Jiří Kulhánek, Ph.D.
Prof. Ing. Jiří Málek, DrSc.
Prof. Ing. Petr Mikulášek, CSc.
Prof. Ing. Petr Mošner, Dr.
Prof. Ing. Petr Němec, Ph.D.
Prof. Ing. Aleš Růžička, Ph.D.
Prof. Ing. Miloš Sedlák, DrSc.
Prof. Ing. Petra Šulcová, Ph.D.
Doc. Ing. Liběna Tetřevová, Ph.D.
Prof. Ing. Ladislav Tichý, DrSc.
Prof. Ing. Karel Ventura, CSc.
Prof. Ing. Jaromír Vinklárek, Dr.
Prof. Ing. Svatopluk Zeman, DrSc.

External Members:

Prof. RNDr. Jiří Barek, CSc.	Faculty of Science, CU, Prague
Prof. Ing. Roman Čermák, Ph.D.	Dean, Faculty of Technology, TBU Zlín
Prof. Ing. Anton Gatial, DrSc.	Dean, Faculty of Chemical and Food Technology, SUT Bratislava
Mgr. Karolína Gondková	Director of the Higher Education Department, Ministry of Education Prague
Prof. Ing. Jiří Hanika, DrSc.	Institute of Microbiology of the Czech Academy of Sciences Prague
Prof. Ing. Kamila Kočí, Ph.D.	Faculty of Metallurgy and Material Engineering, Institute of Environmental Technology, VSB-TU Ostrava
Doc. Ing. Zdeňka Kolská, Ph.D.	Faculty of Science, JEPU Ústí nad Labem
Ing. Josef Liška	CEO, Synthesia, a.s., Pardubice
Ing. David Pohl, Ph.D.	Managing Director, Synthos, a.s., Kralupy nad Vltavou
Prof. Ing. Václav Švorčík, DrSc.	Faculty of Chemical Technology, UCT Prague
Prof. Ing. Martin Weiter, Ph.D.	Dean, Faculty of Chemistry, BUT Brno

1.5 Study Programme Board

Chairman: Prof. Ing. Petr Němec, Ph.D.

Deputy Chair: Prof. Ing. Petr Mikulášek, CSc.

Members:
Prof. RNDr. Zuzana Bílková, Ph.D.
Prof. Ing. Libor Čapek, Ph.D.
Doc. Ing. Libor Červenka, Ph.D.
Doc. Ing. Pavel Čičmanec, Ph.D.
Doc. Ing. Jan Fischer, CSc.
Prof. Ing. Jiří Hanusek, Ph.D.
Doc. RNDr. Jana Holubová, Ph.D.
Doc. Ing. Aleš Imramovský, Ph.D.
Doc. Ing. Zdeněk Jalový, Ph.D.
Doc. Ing. Petr Janíček, Ph.D.
Prof. Ing. Petr Kalenda, CSc.
Prof. Ing. Andréa Kalendová, Dr.
Prof. Mgr. Roman Kanďár, Ph.D.
Doc. Ing. Anna Krejčová, Ph.D.
Prof. Ing. Petr Mošner, Dr.
Doc. Ing. Marcela Pejchalová, Ph.D.
Prof. Ing. Aleš Růžička, Ph.D.
Prof. Ing. Petra Šulcová, Ph.D.
Doc. Ing. Liběna Tetřevová, Ph.D.
Doc. Ing. David Veselý, Ph.D.

1.6 Advisory Bodies of the Faculty Management

Disciplinary Commission

Chairman: Prof. Ing. Petr Němec, Ph.D., Vice-Dean for Education

Members: Prof. Ing. Petr Mikulášek, CSc., Head of ÚEnviChI
Doc. Ing. David Veselý, Ph.D., Head of ÚChTML
Ing. Barbora Kamenická, doctoral degree student
Ing. Jakub Šulc, doctoral degree student
Ondřej Kovář, bachelor's degree student

Investment Commission

Chairman: Prof. Ing. Petr Mošner, Dr., Vice-Dean for Science and Development

Members: Representatives of all departments/institutes

Commission for handling surplus and useless property of FChT and for precious metal write-off

Chairman: Ing. Martin Šprync, Secretary

Members: Doc. Ing. Petra Bajerová, Ph.D., KAlCh
Doc. Ing. David Veselý, Ph.D., Head of ÚChTML

Assessment board for the applications for habilitation procedure and professor appointment procedure

Chairman: Prof. Ing. Petr Mikulášek, CSc.

Members: Prof. Ing. Petr Němec, Ph.D.
Prof. Ing. Petr Mošner, Dr.
Prof. Ing. Libor Čapek, Ph.D.
Head of the respective FChT department or another significant professional in the field

2. Study and Educational Activity

2.1 Full-time and Part-time Study Programmes (Fields of Study)

The current study programmes at FChT include 18 bachelor's degree programmes (of which 10 are newly accredited), 20 follow-up master's degree programmes (of which 14 are newly accredited), and 16 doctoral degree programmes (of which 10 are newly accredited); In total, the faculty has 54 forms of study.

In the academic years 2019/2020 and 2020/2021, the following accredited study programmes were available:

Study programme		Field of study	Standard length of study (years)			CBBE Code
			BSc	MSc	PhD	
B3912	Special chemical and biological programmes	Clinical biology and chemistry	3			3901R017
		Laboratory assistant	3			5345R020
B3441	Graphic arts and printing technology	Graphic arts and printing technology	3			3441R001
B2807	Chemical and process engineering	Environmental protection	3			1604R007
		Economy and management of chemical and food industry	3			2807R015
B2802	Chemistry and technical chemistry	Chemistry and technical chemistry	3			2802R011
B2901	Chemistry and technology of foodstuffs	Evaluation and analysis of foodstuffs	3			2901R003
B2829	Inorganic and polymeric materials	Inorganic materials	3			2808R023
		Polymeric materials and composites	3			2808R024
B2830	Pharmacochemistry and medicinal materials	Pharmacochemistry and medicinal materials	3			2801R021
B2831	Surface protection of building and construction materials	Surface protection of building and construction materials	3			2808R025
N3441	Graphic arts and printing technology	Graphic arts and printing technology		2		3441T001
N3912	Special chemical and biological programmes	Bioanalyst		2		1406T011
N2901	Chemistry and technology of foodstuffs	Evaluation and analysis of foodstuffs		2		2901T003
N2807	Chemical and process engineering	Economy and management of chemical and food industry		2		2807T015
		Chemical engineering		2		2807T004
		Environment protection		2		1604T007
N2808	Chemistry and technology of materials	Inorganic technology		2		2801T001
		Chemistry and technology of paper and pulp		2		2808T015
		Material engineering		2		3911T011
		Organic coatings and paints		2		2808T022
		Technology of organic specialities		2		2801T007
		Technology of Polymers Manufacturing and Processing		2		2801T009
		Theory and technology of explosives		2		2801T010
		Fibres and textile chemistry		2		2806T003
N1407	Chemistry	Analytical chemistry		2		1403T001
		Inorganic and bioinorganic chemistry		2		1401T001
		Organic chemistry		2		2802T003
		Technical physical chemistry		2		2802T010

P1418	Inorganic chemistry	Inorganic chemistry			4	1401V002
P1421	Organic chemistry	Organic chemistry			4	1402V001
P1419	Analytical chemistry	Analytical chemistry			4	1403V001
P1420	Physical chemistry	Physical chemistry			4	1404V001
P2832	Chemistry and chemical technology	Inorganic technology			4	2801V001
		Organic technology			4	2801V003
P2833	Chemistry and technology of materials	Surface engineering			4	2808V027
		Chemistry and technology of inorganic materials			4	2808V003
		Engineering of energetic materials			4	2808V035
P2837	Chemical and process engineering	Chemical engineering			4	2807V004
		Environmental engineering			4	3904V005

Newly accredited study programs from academic year 2019/2020

Accredited study programme			**Standard length of study** (years)		
			BSc	**MSc**	**PhD**
B0488A050003	Economy and management of chemical industry enterprises		3		
B0512A130006	Analysis of biological materials		3		
B0531A130012	Pharmacochemistry and medicinal materials		3		
B0531A130013	Surface protection of building and construction materials		3		
B0531A130014	Graphic arts and printing technology		3		
B0588A130001	Chemistry and technology of environment protection		3		
B0531A130017	Polymeric materials and composites		3		
B0531A130013	Inorganic and bioinorganic materials		3		
B0531A130024	Evaluation and analysis of foodstuffs		3		
B0531A130025	Chemistry		3		
N0413A050010	Economy and management of chemical industry enterprises			2	
N0512A130006	Analysis of biological materials			2	
N0531A130013	Graphic arts and printing technology			2	
N0711A130008	Engineering of energetic materials			2	
N0914P360001	Bioanalytical laboratory diagnostics in medicine			2	
N0531A130017	Engineering of energetic materials			2	
N0531A130028	Analytical chemistry			2	
N0531A130029	Inorganic and bioinorganic chemistry			2	
N0531A130030	Evaluation and analysis of foodstuffs			2	
N0531A130031	Material engineering			2	
N0531A130035	Physical chemistry			2	
N711A130013	Chemical and process engineering	Chemical engineering		2	
		Environment protection		2	
N711A130014	Sustainable development in chemistry and technology			2	
N711A130015	Inorganic technology			2	
P0711D130001	Organic technology				4
P0531D130009	Analytical chemistry				4
P0531D130011	Inorganic chemistry				4
P0711D130025	Inorganic technology				4
P0512D130013	Biochemistry				4
P0531D130052	Physical chemistry				4
P711D130027	Chemical and process engineering	Chemical engineering			4
P711D130027		Environmental engineering			4
P0531D130013	Chemistry and technology of inorganic materials				4
P0531D130053	Engineering of energetic materials				4
P0531D130015	Organic chemistry				4

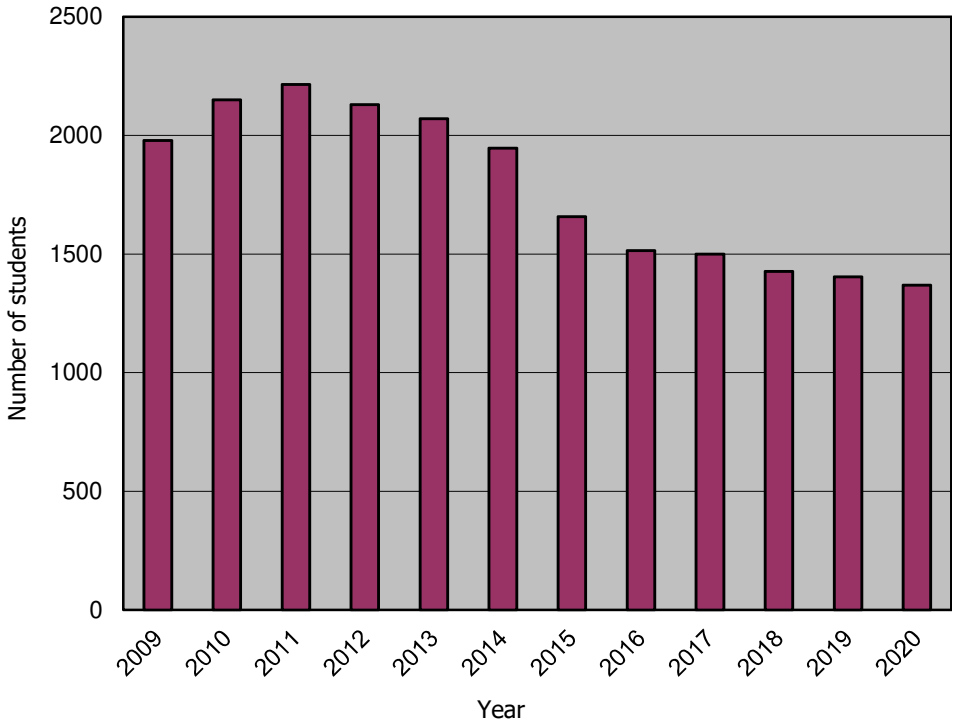
2.2 Numbers of Students in Bachelor's, Master's and Doctoral Degree Programmes

The numbers of students of the faculty (always as of 31 October of the relevant year) are shown in the tables and graphs below. The letter *c* indicates international students.

Development of the overall number of students at FChT

Year	2009	2010	2011	2012	2013	2014
Number of students	1895+83c	2058+91c	2124+91c	2047+82c	1975+95c	1840+106c

Year	2015	2016	2017	2018	2019	2020
Number of students	1542+115c	1377+137c	1353+147c	1276+150c	1262+142c	1236+132c



Development of the overall number of students at FChT between 2009 and *2020*

Numbers of students by type of study

Form and type of study	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21
Czech students	1542	1377	1353	1276	1262	1236
Foreign students	115c	137c	147c	150	142	132
Students total	**1657**	**1514**	**1500**	**1426**	**1404**	**1368**
Full-time study						
Bachelor's degree programmes	1040+80c	875+95c	857+99c	841+99c	866+95c	859+78c
Follow-up master's programmes	315+5c	326+14c	332+22c	278+27c	268+26c	264+25c
Full-time total	**1355+85c**	**1201+109c**	**1189+121c**	**1189+121c**	**1134+121c**	**1123+103c**
Part-time study						
Bachelor's degree programmes	4+0c	2+0c	1+0c	1+0c	-	-
Follow-up master's programmes	0	0	0	0	-	-
Part-time total	**4+0c**	**2+0c**	**1+0c**	**1+0c**	**-**	**-**
Doctoral degree programmes	**183+30c**	**174+28c**	**163+26c**	**156+24c**	**128+21c**	**113+29c**

Number of full-time students by study programmes

Study Programme	2018/2019		2019/2020		2020/2021	
	BSc	MSc	BSc	MSc	BSc	MSc
Chemistry and technical chemistry	116+4c	-	123+7c	-	56+3c	-
Chemistry and technology of foodstuffs	104+14c	24+2c	96+11c	28+4c	56+5c	20+2c
Graphic arts	44+3c	21+5c	14+1c	12+2c	10+1c	2+1c
Special chemical-biological fields	360+44c	65+6c	342+27c	30+2c	340+23c	8+0c
Chemical and process engineering	64+3c	-	29+1c	-	19+1c	-
Pharmacochemistry and medicinal materials	96+30c	-	55+11c	-	32+4c	-
Surface protection of building and construction materials	16+0c	-	10+0c	-	6+0c	-
Inorganic and polymeric materials	41+1c	-	35+3c	-	16+2c	-
Chemical and process engineering - N2807	-	38+2c	-	24+3c	-	7+1c
Chemistry and technology of materials - N2808	-	64+6c	-	57+5c	-	38+6c
Chemistry - N1407	-	66+6c	-	58+7c	-	34+4c
Economy and management of chemical industry enterprises*	-	-	22+2c	7+0c	31+4c	10+0c
Analysis of biological materials	-	-	31+11c	13+2c	40+6c	27+5c
Pharmacochemistry and medicinal materials	-	-	55+17c	-	69+14c	-
Surface protection of building and construction materials	-	-	1+0c	-	11+0c	-
Graphic arts and printing technology*	-	-	16+2c	11+0c	29+1c	13+0c
Chemistry and technology of environment protection*	-	-	26+1c	-	30+3c	-
Polymeric materials and composites*	-	-	11+1c	-	12+4c	-

Engineering of energetic materials*		-	-	-	2+0c	-	2+0c
Bioanalytical laboratory diagnostics in medicine*		-	-	-	26+1c	-	46+2c
Inorganic and bioinorganic materials*		-	-	-	-	17+0c	-
Evaluation and analysis of foodstuffs*		-	-	-	-	35+4c	-
Chemistry*		-	-	-	-	50+3c	-
Engineering of energetic materials*		-	-	-	-	-	4+0c
Analytical chemistry*		-	-	-	-	-	10+1c
Inorganic and bioinorganic chemistry*		-	-	-	-	-	5+0c
Evaluation and analysis of foodstuffs*		-	-	-	-	-	12+3c
Material engineering*		-	-	-	-	-	7+0c
Physical chemistry*		-	-	-	-	-	6+0c
Chemical and process engineering	Chemical engineering	-	-	-	-	-	3+0c
	Environment protection	-	-	-	-	-	3+0c
Sustainable development in chemistry and technology		-	-	-	-	-	4+0c
Inorganic technology		-	-	-	-	-	3+0c
Total		**1119+126c**		**1134+121c**		**1123+103c**	

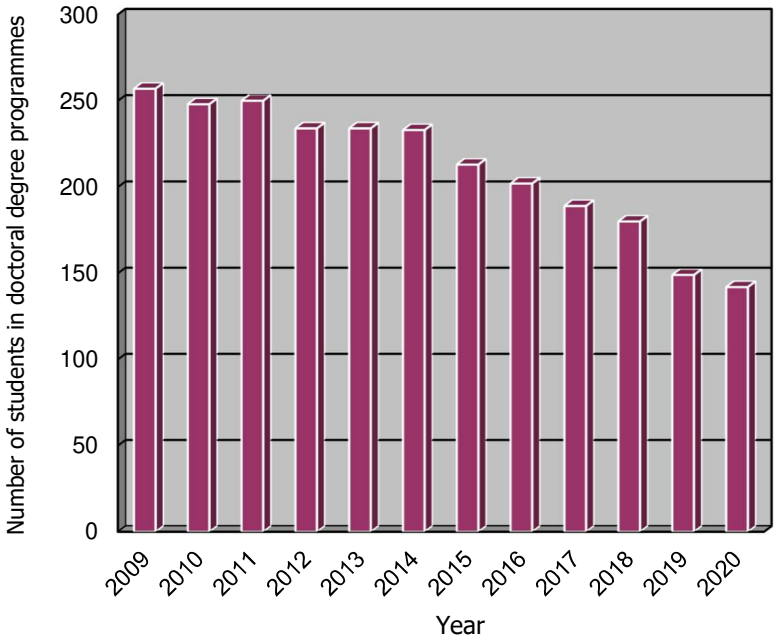
* Newly accredited programmes

Development of the number of students in doctoral degree programmes at FChT

Year	**2009/10**	**2010/11**	**2011/12**	**2012/13**	**2013/14**	**2014/15**
Number of students	260	248	250	234	234	233
Proportion of the overall number of students at (%)	13.1	11.5	11.3	11.0	11.3	11.9

Year	**2015/16**	**2016/17**	**2017/18**	**2018/19**	**2019/20**	**2020/21**
Number of students	213	202	189	180	149	142
Proportion of the overall number of students at (%)	12.8	13.3	12.6	12.6	10.6	10.3

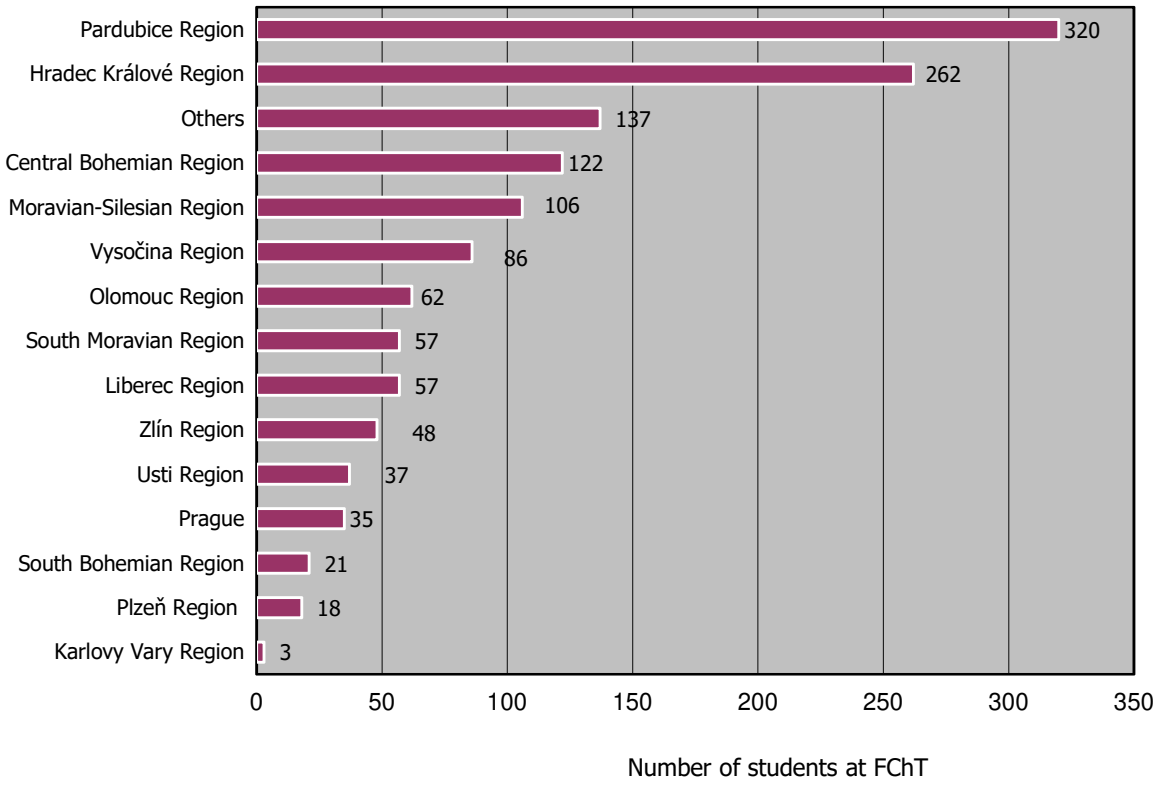
In 2020 the proportion of doctoral degree students was above 10% of the total number of students at FChT. The current proportion is 10.3%.



Development of the number of students in doctoral degree programmes at FChT between 2009 and *2020*

Number of students at FChT by regions

The largest number of students are from the Pardubice and Hradec Králové Regions. A positive fact is that FChT is also chosen by students from the Vysočina and Central Bohemian Regions, in addition to the traditional catchment area of Moravia. A significant proportion of the total number of students is represented by foreigners (column Others). The following figure shows the geographical distribution of students at FChT by regions.



Number of students at FChT by regions (as of 31 October 2020)

2.3 Newly Admitted Students

In 2020 the faculty was active in attracting secondary school students. The faculty addressed the potential applicants at various events, in the radio, press, internet (higher education exhibitions Gaudeamus in Prague, Brno and Bratislava, Open Days, Chemistry Race, advertisements in press, promotion through the radio, information on websites and social networks, presentations in secondary schools, etc.)

As a result of the government's decisions concerning the coronavirus pandemic, a number of traditional events aimed at searching for talented students and applicants were cancelled (for example the Festival of science and technology for children and youth in the Pardubice Region called AMAVET or the national final of the competition Search for the Best Young Chemist of CR). Some activities took part in the online form thanks to modern IT technologies.

Open Days

On 29 January 2020, a total of 124 secondary school students gathered in room C1 in the faculty building in Studentská 573 (61 students from grammar schools and 63 students from other secondary schools). The Vice-Dean provided the applicants with the basic information about the study, study programmes and fields of study offered by the faculty and about the conditions of the admission procedure and opportunities for international study under the ERASMUS+ Programme. Short presentations were also given by the representatives of the departments located outside the main building. After the joint session the students had the opportunity to visit some of the departments and institutes; some of them took the opportunity to talk to the teachers specialized in the fields that they wanted to study at FChT.

The third Open Day took place on 19 February 2020. This Open Day was attended by 48 students from grammar schools and 61 students from other secondary schools.

A special Open Day event was held on 3 February 2020 for our faculty school (SPŠCH Pardubice). This event was attended by 67 students of this vocational secondary school.

Search for talented students

The Faculty has in place a long-term programme aimed at searching for talented students and applicants. Important activities in this area include systematic promotion of the faculty at selected secondary schools (nearly 30 grammar schools and vocational secondary schools), visits of secondary schools students to the faculty, awards at the following competitions: Search for the Best Young Chemist of CR (for elementary schools), Chemistry Race (for secondary schools) and Chemical Olympiad (for secondary schools).

In 2020 the faculty supported the fifth year of the chemical competition **Chemistry Race.** This is a one-day competition for 3 to 5-member teams of secondary school students interested in chemistry. The competition was divided into two categories – category B for younger contestants (secondary school students in grades 1 and 2) and the top category A for secondary school students from all grades. The teams solve a set of theoretical tasks during a specific time period. The team that resolves the highest number of tasks during two hours is the winner. The fifth year of the competition (7 February 2020) involved over 70 teams from secondary schools not only from the Czech Republic but also Slovakia. The winner in category A was the team of students from Gymnázium Na vítězné pláni, Prague 4 (Velká čtyřka), the team of students from Gymnázium Křenová, Brno (Mladí Křeni) was the winner in category B. The winning teams received the Dean's awards including presents and scholarship which will be granted if they enrol for study at the faculty.

In the long-term, the faculty has supported the **Students' Professional Activities (SPA)**. Academic staff and postgraduate students from the faculty have been actively involved in scientific training of secondary school students who work on their competition projects. In this way, young researchers are involved in scientific activities. The interest of secondary school students in developing their projects at FChT is increasing. Last year, the national round and most qualification rounds took place using modern technologies. Despite all the restrictions and changes, the extent of the competition was almost identical with previous years. Although the students did not have the opportunity to consult their work in person, they tried out different forms of online communication.

The Faculty of Chemical Technology together with other faculties of the University of Pardubice organize an educational scientific road-show called **University in Motion**. For several years, employees and students have visited numerous school yards with this extremely popular event. Students are involved in experiential workshops the purpose of which is to show the world of modern technology and present technical and scientific disciplines in a playful and entertaining form and encourage or improve the interest of young people in technical and scientific disciplines. In 2020, the employees of the faculty visited grammar schools in Svitavy and Moravská Třebová.

Instead of the traditional Science and Technology Fair at Pernštýnské Square in the historical centre of Pardubice, in the summer the faculty members visited **summer and day camps** around Pardubice with a popular-scientific programme. The purpose of these events was to raise children's enthusiasm for chemistry, science and technology.

In the week from 24 August to 28 August 2020, children from Pardubice and its surroundings became university students and by means of **Day Camps** took a special holiday programme at selected faculties of the University of Pardubice. The Faculty of Chemical Technology prepared an interesting and entertaining programme for the participants. The children had the opportunity to experience the atmosphere of the laboratories, lecture rooms, try out the work of scientists and experts and learn about a number of interesting tasks and experiments.

The Faculty of Chemical Technology is a traditional participant in the higher education and lifelong learning exhibition **Gaudeamus** in Prague (21 to 23 January 2020) and in Brno (20 to 23 October 2020) and Akadémia Bratislava (6 to 8 October 2020). The purpose of the exhibitions is to provide the maximum possible amount of information about university education to students and

graduates from secondary schools, higher vocational schools, students and graduates from bachelor's degree programmes and those who are interested in lifelong learning.

During the January fair in Prague, the university stand was attended by thousands of secondary school students including their teachers, educational counsellors, and representatives of other universities. The representatives of the faculty at the University of Pardubice stand provided detailed information about the study and admission exams and handed out a number of printed materials relating to the study. In addition to providing information about the study, the University had several interactive stands.

The autumn fairs in Brno and Bratislava were affected by the tightening anti-epidemic measures in both countries and both were conducted online. The organizers prepared a series of online presentation days the purpose of which was to inform secondary school students about the university and faculty and about their potential study after graduation from secondary school.

The faculty significantly supported the 13th year of the **Search for the Best Young Chemist of CR** and is the traditional sponsor of this event. As in previous years, the 2020 competition took place in four categories. The best young chemist was the one with the best results in the test part which consisted of two rounds. The second category was the project part, which was intended for the whole classes. The task for the competitors was to develop a project according to the instructions given by the High School of Chemistry Pardubice. The next category was the best elementary school with the most successful young chemists. The organizer of the competition "Search for the Best Young Chemist" is the High school of Chemistry Pardubice and the Pardubice Region. The general partner of the competition is the Faculty of Chemical Technology, University of Pardubice. Unfortunately, the award ceremony could not take place due to the coronavirus pandemic. Therefore, the prizes were awarded individually under strict hygienic conditions in the premises of Czech Marketing Agency who is the traditional organizer.

In 2020 the faculty was again the partner of **Children's Super Day** which was held on 12 September at the Pardubice Racecourse. The employees of the Faculty prepared a varied and interesting programme with demonstrations of chemical magic.

In 2020, the **Researchers' Night** (25 November 2020) was not a personal meeting of scientists and thousands of science fans directly at the university but an online meeting. The university offered a total of 6 hours of broadcast directly from a special studio in the university auditorium. In addition to live interviews and experiments, the programme included pre-recorded videos which took the virtual visitors directly to the faculty laboratories. The Researchers' Night is one of the biggest Europe-wide projects the purpose of which is to present science and scientific issues to the general public.

The University of Pardubice again enriched the programme of the Sports Park Pardubice (8 to 16 August 2020). The visitors enjoyed the special popular educational programme with attractive and interactive scientific and technical demonstrations. At the experiential **SCIENCE POINT** young scientists and students showed the visitors the world of modern science and through playful and educative demonstrations presented various world curiosities and gave the visitors chemical quizzes.

Students' scientific professional activities at the Faculty of Chemical Technology

Students' scientific professional activities (SSPA) are intended for students in bachelor's and follow-up master's degree programmes at the Faculty of Chemical Technology the purpose of which is to engage students in research and scientific activities beyond their study. SSPA is a significant form of students' preparation through which they learn to present the results of their work, develop scientific and professional skills and improve their argumentation abilities, presentation skills and scientific writing.

The previous year of SSPA was held in a non-standard format. In March 2020, the implementation of this activity was affected by the measures against the global pandemic. Therefore, the rules for the submission of students' projects were changed. Students were allowed to send their projects supported by an experimental part but also, for the first time in the history of SSPA, projects based on literature

search were allowed. Active communication took place between the students and their supervisors using modern communication instrument which at least partially substituted the practical part usually carried out in laboratories.

Normally, the obligation of a student involved in SSPA is participation in a students' scientific conference and publication of an approximately 6-page paper in the conference proceedings. However, the students' scientific conference at which the results of research activities are presented could not be organized.

The seventh year involved a total of 38 students from 12 faculty departments. Most of the projects included an experimental part (29). The quality of the projects did not differ compared with previous years. Despite the specific conditions, students demonstrated their unquestionable qualities for their current and especially future scientific work. Another positive aspect was the involvement of students from nearly all grades.

Admission procedure

The admission procedure for study in bachelor's degree programmes for the academic year 2020/2021 took place in two rounds. The application submission date for the study programmes was 31 March 2020. The deadline was then postponed to 30 June 2020.

Regarding the fact that during the first round of the admission procedure the capacity of some bachelor's degree programmes was not achieved, the second round was announced with the application submission date 21 August 2020. The second round of the admission procedure was based on the evaluation of the applicants academic achievement at secondary school – the applicants were ranked in order and admitted for study according to available capacity of the relevant study programmes.

The application submission date for the follow-up master's degree programmes was 31 July 2020. The admission procedure was performed from 2 to 3 September 2020. The admission exam was carried out by means of an oral interview or written test with the applicants. The application submission date for the doctoral degree programmes was 30 April 2020. The admission exam was carried out by means of an oral interview on 9 June 2020. The deadline for the submission of applications in the second round was 30 June 2020 and the admission procedure took place on 14 September 2020. The results of the admission procedure are summarized in the following table.

Full-time form of study – bachelor's degree programmes

Study Programme	Number of applicants	Accepted 1st round	Accepted 2nd round	Total accepted	Enrolled
Special chemical and biological programmes – laboratory assistant	336	190	26	216	**138**
Graphic arts and printing technology*	40	23	4	27	**22**
Pharmacochemistry and medicinal materials*	196	98	11	109	**48**
Surface protection of building and construction materials*	17	13	1	14	**11**
Economy and management of chemical industry enterprises*	53	30	2	32	**21**
Analysis of biological materials*	124	76	5	81	**29**
Chemistry and technology of environment protection*	37	29		29	**20**
Polymeric materials and composites*	26	12	3	15	**10**
Chemistry*	127	67	9	76	**54**
Evaluation and analysis of foodstuffs*	99	60	9	69	**39**
Inorganic and bioinorganic materials	38	24	3	27	**18**

Total	**1093**	**622**	**73**	**695**	**410**

* Newly accredited programmes

Full-time form of study – follow-up master's degree programmes

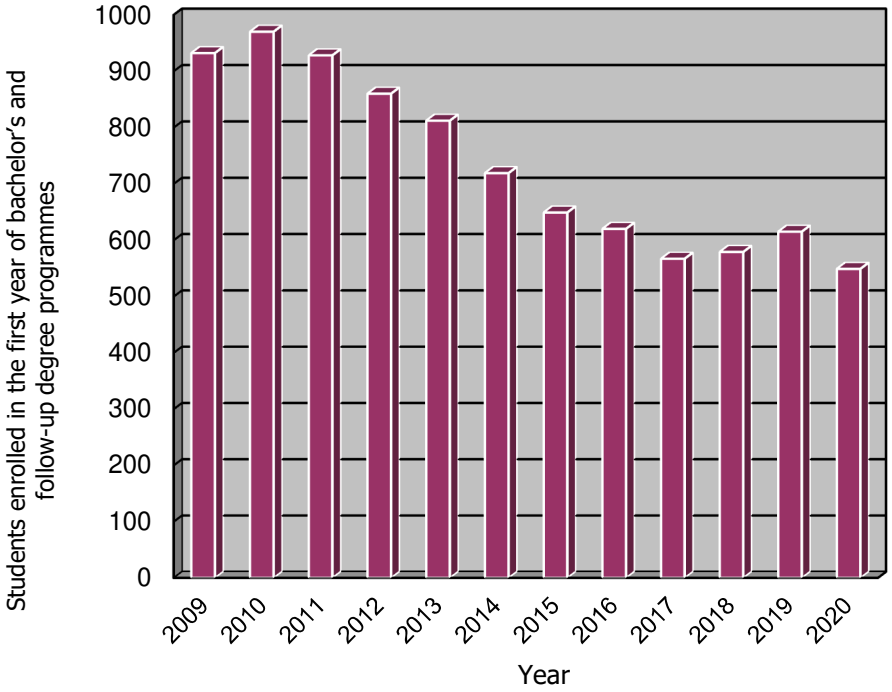
Study Programme		**Number of applicants**	**Accepted without admission exam**	**Accepted with admission exam**	**Total accepted**	**Enrolled**
Chemistry		11	-	10	10	9
Chemistry and technology of materials		26	14	6	20	19
Analysis of biological materials*		41	39	1	40	19
Graphic arts and printing technology*		3	-	3	3	3
Economy and management of chemical industry enterprises*		4	-	3	3	3
Bioanalytical laboratory diagnostics in medicine*		49	-	30	30	25
Engineering of energetic materials*		1	-	-	-	-
Engineering of energetic materials*		7	-	4	4	4
Analytical chemistry*		18	-	13	13	11
Inorganic and bioinorganic chemistry*		6	6	-	6	5
Evaluation and analysis of foodstuffs*		17	-	16	16	15
Material engineering*		8	7	-	7	7
Physical chemistry*		6	5	1	6	6
Chemical and process engineering	Chemical engineering*	4	4	-	4	3
	Environment protection*	10	9	-	9	3
Sustainable development in chemistry and technology*		4	4	-	4	4
Inorganic technology*		4	3	-	3	3
Total		**219**	**91**	**87**	**178**	**139**

* Newly accredited programmes

Development of the number of newly enrolled students in the first year of bachelor's and follow-up master's degree programmes

Year	**2009/10**	**2010/11**	**2011/12**	**2012/13**	**2013/14**	**2014/15**
Applicants	1744+57c	1888+58c	1829+50c	1674+66c	1610+72c	1466+91c
Accepted	1489+53c	1174+11c	1284+29c	1245+49c	1176+55c	1115+64c
Newly enrolled	**897+35c**	**938+32c**	**910+18c**	**830+30c**	**777+35c**	**682+37c**

Year	**2015/16**	**2016/17**	**2017/18**	**2018/19**	**2019/20**	**2020/21**
Applicants	1317+121c	1262+164c	1151+132c	1107+149c	1233+177c	1128+184c
Accepted	1005+89c	916+116c	858+89c	838+110c	898+124c	770+103c
Newly enrolled	**601+48c**	**563+57c**	**516+51c**	**521+58c**	**550+65c**	**493+56c**



Development of the number of newly enrolled students in the first year of bachelor's and follow-up master's degree programmes between 2009 and 2020

Registered and newly enrolled students in full-time doctoral degree programmes

Study Programme	Number of applicants	Total accepted	Enrolled
Chemistry and technology of materials	4	4	4
Chemistry and technology of materials	1	1	-
Analytical chemistry*	2	2	2
Inorganic chemistry*	5	5	5
Inorganic chemistry*	2	2	-
Chemistry and technology of inorganic materials*	3	1	-
Organic chemistry*	3	3	3
Physical chemistry*	2	2	2
Engineering of energetic materials*	2	1	1
Physical chemistry*	1	-	-
Inorganic technology*	1	1	1
Chemical and process engineering*	6	6	5
Total	**32**	**28**	**23**

* Newly accredited programmes

Registered and newly enrolled students in part-time doctoral degree programmes

Study Programme	Number of applicants	Total accepted	Enrolled
Chemistry and technology of materials	1	1	1
Biochemistry*	1	1	1
Physical chemistry*	1	-	-
Engineering of energetic materials*	1	1	1
Chemical and process engineering*	1	1	1
Total	**5**	**4**	**4**

* Newly accredited programmes

695 applicants were admitted in full-time bachelor's degree programmes. 178 applicants (total of 873) were admitted in follow-up master's degree programmes. A total of 32 students were admitted in both full-time and part-time doctoral degree programmes. **In the academic year 2020/2021, a total of 905 students were admitted, of whom 576 enrolled for study.**

Preparatory courses

Before the beginning of regular classes in the winter semester of the first year of the bachelor's degree the Department of General and Inorganic Chemistry organizes the regular "General and inorganic chemistry" course. The course focuses on acquiring and maintaining the basic chemical skills, such as the chemical nomenclature, solution of chemical equations, amount of substances and preparation of solutions with defined concentration. In view of the potential health risks associated with the Covid-19 pandemic, this course was not held in the academic year 2020/21. However, students were provided with online support.

2.4 Numbers of Graduates from Bachelor's, Master's and Doctoral Degree Programmes

Numbers of graduates by type of study in previous years

Type of study	2009	2010	2011	2012	2013	2014
BSc	166	191	243	250	260	223
MSc/Mgr.	36	35	34	47	36	30
MSc/Ing.	139	104	103	106	114	149
PhD	28	41	17	21	29	29
Total	**369**	**371**	**397**	**424**	**439**	**431**

Type of study	2015	2016	2017	2018	2019	2020
BSc	209	232	208	176	172	163
MSc/Mgr.	38	23	24	43	36	26
MSc/Ing.	146	116	98	121	89	96
PhD	27	19	26	32	29	28
Total	**420**	**390**	**356**	**372**	**326**	**313**

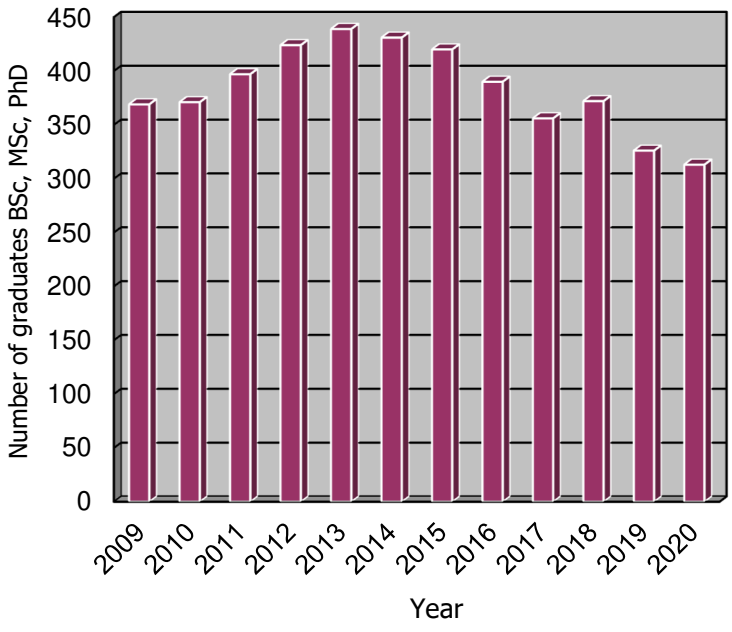
The numbers in the table correspond with the V 12-01 Statement for the period from 1 January to 31 December of the respective year

Numbers of graduates of doctoral degree programmes by year

Doctoral degree graduates	2009	2010	2011	2012	2013	2014
Number	34	37	22	23	26	24

Doctoral degree graduates	2015	2016	2017	2018	2019	2020
Number	31	20	23	35	29	31

The numbers of graduates are specified for the period from 1 November to 31 October of the respective year

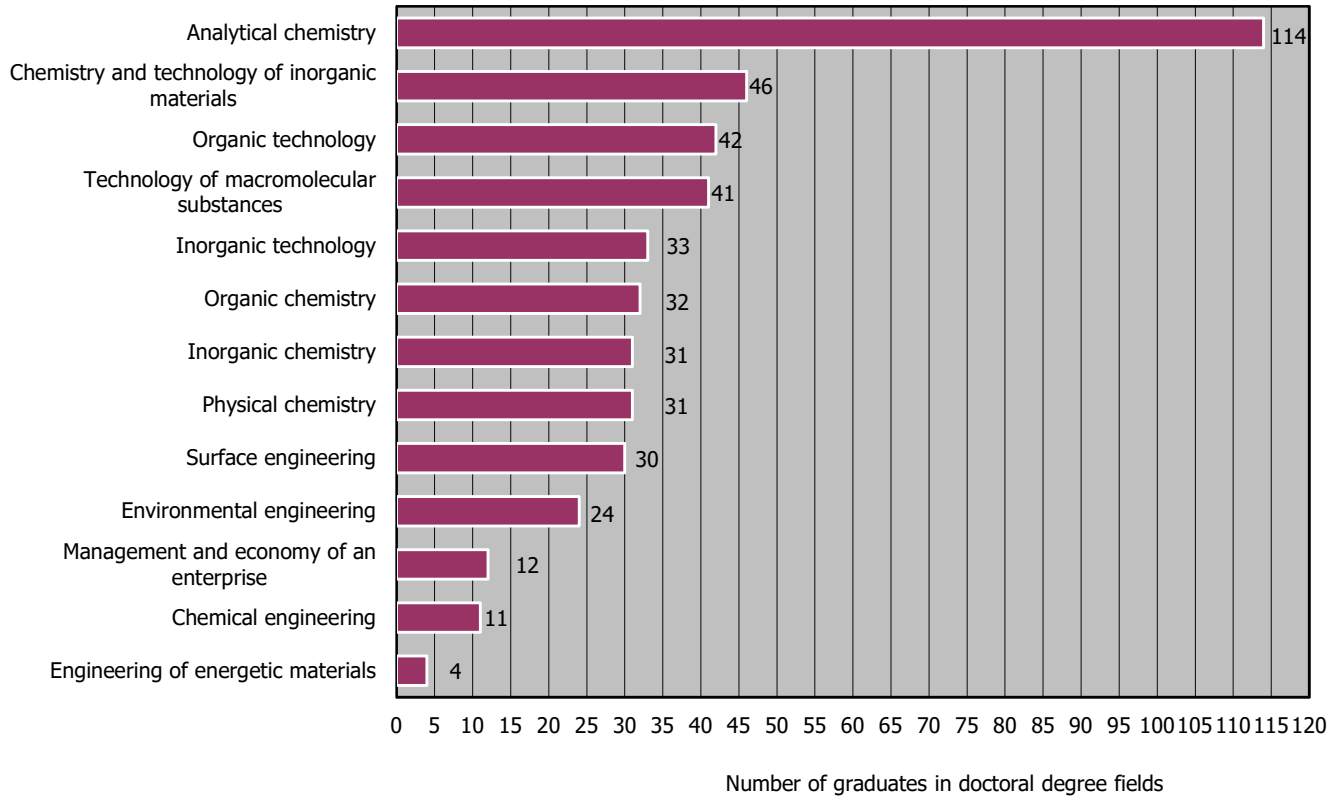


Number of graduates BSc, MSc/Mgr., Ing. and PhD between 2009 and 2020

Graduates of doctoral degree programmes in the period from 1 November to 31 October of the following year

Study Programme	Number of graduates				
	2015/2016	2016/2017	2017/18	2018/19	2019/20
Inorganic chemistry	4	3	1	3	1
Organic chemistry	1	4	2	2	4
Analytical chemistry	7	5	9	3	10
Physical chemistry	-	2	1	3	2
Chemistry and chemical technology	4	3	-	3	4
Chemical and process engineering	2	1	9	7	4
Chemistry and technology of materials	2	5	13	8	6
Total	**20**	**23**	**35**	**29**	**31**

The research projects of the departments and institutes also involved a number of postgraduate students because the topics of their dissertations were based on the issues addressed at these departments and institutes. Postgraduate students are included in research teams and actively contribute to the scientific and research results of the faculty. Between 2005 and 2020, a total of 451 postgraduate students defended their dissertations on issues closely related to the issued addressed at the departments and institutes of the faculty. The following figure shows in which doctoral degree programmes and fields the dissertations were defended.



Overview of doctoral degree fields and number of dissertations between 2005 and 2020 corresponding with the scientific and research focus of FChT departments and institutes

Award-winning papers of FChT students

In 2020 a number of dissertations, master's diploma theses and bachelor's diploma theses were awarded for their outstanding theoretical and experimental level.

Award of the Dean of the Faculty of Chemical Technology, University of Pardubice for outstanding dissertation presented in the academic year 2019/2020

Ing. Michaela Janečková, Ph.D.
Isotachophoretic determination of biologically active compounds – analysis of pharmaceuticals and dietary supplements
Supervisor: prof. Ing. Karel Ventura, CSc.
Department of Analytical Chemistry

Ing. Jitka Klikarová, Ph.D.
Development of modern analytical methods for analysis of biologically active substances
Supervisor: Doc. Ing. Lenka Česlová, Ph.D.
Department of Analytical Chemistry

Ing. Iva Charamzová, Ph.D.
Investigation of vanadium complexes suitable as driers for alkyd-based paints
Supervisor: prof. Ing. Jaromír Vinklárek, Dr.
Institute of Chemistry and Technology of Macromolecular Materials

Ing. Jan Bartáček, Ph.D.
Immobilized catalysts for the enantioselective reactions on activated double bonds
Supervisor: prof. Ing. Miloš Sedlák, DrSc.
Institute of Organic Chemistry and Technology

Level 1 Award of the Rector for master's diploma thesis defended in 2020

Ing. Jan Zechovský
Coordination properties of 2,2´-dipyridylamide and its derivatives in the chemistry of heavier tetrylenes
Supervisor: Doc. Ing. Libor Dostál, Ph.D.
Department of General and Inorganic Chemistry

Level 2 Award of the Rector for master's diploma thesis defended in 2020

Ing. Karolína Feráková
Influence of networking and polymerizable surfactant on the characteristics of latex binders
Supervisor: Ing. Jana Machotová, Ph.D.
Institute of Chemistry and Technology of Macromolecular Materials

Ing. Jakub Halamek
Study CO_2 and CH_4 adsorption on heterosubstituted CHA zeolites
Supervisor: Prof. Ing. Roman Bulánek, Ph.D.
Department of Physical Chemistry

Ing. Kamil Rak
Viologen and its structural analogues as active redox systems for organic flow batteries
Supervisor: Ing. Milan Klikar, Ph.D.
Institute of Organic Chemistry and Technology

Award of the Dean of the Faculty of Chemical Technology, University of Pardubice for outstanding level and defence of master's diploma thesis

Ing. Petr Roudný
Current possibilities and use of prepress automation
Supervisor: Ing. Markéta Držková, Ph.D.
Department of Graphic Arts and Photophysics

Ing. Vít Nýdrle
Research focused on the reductive degradation of organic chemical specialties based on m-trifluoromethylaniline
Supervisor: Doc. Ing. Tomáš Weidlich, Ph.D.
Institute of Environmental and Chemical Engineering

Mgr. Eva Masná
Effects of bee product extracts on the survival and Biofilm Formation of Arcobacter spp.
Supervisor: Ing. David Šilha, Ph.D.
Department of Biological and Biochemical Sciences

Ing. Jiří Kotera
Development of methodology for characterization of acid-base properties of zeolites by probe reaction
Supervisor: Doc. Ing. Pavel Čičmanec, Ph.D.
Department of Physical Chemistry

Ing. Michaela Včeláková
Influence of silver addition on thermal properties of $(GeS_2)_{50}(Sb_2S_3)_{50}$ *glass*
Supervisor: Ing. Petr Košťál, Ph.D.
Department of Inorganic Technology

Ing. Michaela Kamenická
Analysis of fatty acids and tocopherols in oils using GC-MS
Supervisor: Ing. Blanka Švecová, Ph.D.
Department of Analytical Chemistry

Ing. Vít Čábela
Waterborne coating substances based on epoxy resin effect of selected fillers and pigments on adhesion, corrosion resistance and mechanical resistance of applied coating
Supervisor: Doc. Ing. David Veselý, Ph.D.
Institute of Chemistry and Technology of Macromolecular Materials

Ing. Tereza Panchartková
$N \rightarrow M$ *coordinating cations of Group 14th elements: Synthesis and reactivity*
Supervisor: Prof. Ing. Roman Jambor, Ph.D.
Department of General and Inorganic Chemistry

Czech Glass Society Award for the best master's diploma thesis defended in 2020 in the area of glass and amorphous materials

Ing. Jana Petruchová
Potassium phosphate glasses modified with niobium oxide
Supervisor: Prof. Ing. Ladislav Koudelka, DrSc.
Department of General and Inorganic Chemistry

Pfizer, spol. s r.o. Award for the best master's diploma thesis defended in 2020 in the area of pharmacochemistry

Ing. Martin Badošek
Use of 3D printing for the preparation of biodegradable coatings of matrix tablets
Supervisor: Prof. Ing. Petr Mošner, Dr.
Department of General and Inorganic Chemistry

Ing. Martin Vrbický
Synthesis of intermediate of antibiotic Linezolid via asymmetric Henry reaction
Supervisor: Doc. Ing. Pavel Drabina, Ph.D.
Institute of Organic Chemistry and Technology

Award of the Dean of the Faculty of Chemical Technology, University of Pardubice for outstanding level and defence of bachelor's diploma thesis

Bc. Karel Chlumský
Synthesis of imidazolidin-4-ones derived from 2,6-disubstituted pyridines
Supervisor: Doc. Ing. Pavel Drabina, Ph.D.
Institute of Organic Chemistry and Technology

Bc. Simona Kučerová
Synthesis of substituted indenyl molybdenum compounds suitable for biological applications
Supervisor: Prof. Ing. Jaromír Vinklárek, Dr.
Department of General and Inorganic Chemistry

Bc. Nikol Kopecká
The practical application of ischemia modified albumin
Supervisor: Mgr. Pavla Žáková, Ph.D.
Department of Biological and Biochemical Sciences

Bc. Jiří Tlustoš
Development and preparation of capsules using 3D printing
Supervisor: Ing. Václav Lochař, Ph.D.
Department of Physical Chemistry

Bc. Iveta Stýblová
Assessment of the possibility of using wells water for drinking purposes
Supervisor: Prof. Ing. Jaromíra Chýlková, CSc.
Institute of Environmental and Chemical Engineering

Bc. Ondřej Kovář
Preparation and composition of active wound dressing
Supervisor: Doc. Ing. Ladislav Burgert, CSc.
Institute of Chemistry and Technology of Macromolecular Materials

Bc. Barbora Blažíčková
Caffeine – its properties and determination
Supervisor: Doc. Ing. Petra Bajerová, Ph.D.
Department of Analytical Chemistry

Bc. Michaela Bártová
Carbohydrates in diet and their influence to organism
Supervisor: RNDr. Lucie Korecká, Ph.D.
Department of Biological and Biochemical Sciences

Bc. Jakub Venclák
Blue spinel pigments with low cobalt content
Supervisor: Doc. Ing. Žaneta Dohnalová, Ph.D.
Department of Inorganic Technology

Pfizer ČR, spol. s r.o. Award for outstanding bachelor's diploma thesis defended in 2020

Bc. Marie Nevyhoštěná
Dissolution test of poorly soluble drug at different pH
Supervisor: Ing. Václav Lochař, Ph.D.
Department of Physical Chemistry

Awarded students other than from FChT in 2020

Bc. Kateřina Štursová
N,N-Diphenylthiophene-2-amine as a donor unit for push-pull chromophores.
Award of the Rector of the University of Pardubice for the best student poster as part of the Chemistry Congress held on 6–9 September in Prague
Supervisor: prof. Ing. Filip Bureš, Ph.D.
Institute of Organic Chemistry and Technology

2.5 Credit System

The principles of the credit system correspond with the international ECTS system. The use of the credit system for the evaluation of academic achievement at the faculty is defined by the "Study and Examination Code of the University of Pardubice".

2.6 Lifelong Learning

The licence study **Rock disintegration by explosion** is intended for further education and retraining of employees in the area of explosion techniques. Based on the decision ČBÚ 3501/II/08 as of 16 January 2009, the learning content and texts of the licence study are approved as preparation courses for blasting technical managers before a qualification exam. This qualification exam can also be taken by licence study participants who meet other conditions for obtaining the blasting technical manager qualification.

The licence study **Modern technology in graphic arts and printing technology** is intended for further education and retraining of employees who work in the printing industry, are involved in trading of printing products or are suppliers of raw materials for the printing industry. The course participants will gain a broad range of knowledge in all areas of printing production and applications of printing techniques, printing materials and state-of-the-art technologies, quality assessment procedures and the requirements of the applicable ISO standards for printing production.

The licence study **Fundamentals of the technology of the production of fibres, paper, paperboard and their processing** is intended for further education and retraining of employees with a university degree who work in the cellulose-paper processing industry, are involved in trading paper products or are suppliers of raw materials and equipment for the cellulose and paper industry. The purpose of the licence study is to present the basic theoretical principles of the production technology of fibres, paper and paperboard, including ecological aspects and processing aspects.

The licence study **Theory and technology of explosives** is intended for further education and retraining of employees in explosives, ammunition, processing and delaboration plants, including employees who use, store or trade explosives and explosion hazardous substances. This study provides the basic information about the protection of various structures from explosion of gases, vapours or flammable dust dispersions (chemical and food-processing plants, power engineering, etc.) The study

also includes the issue of testing and special analyses of explosives, lectures on the fundamentals of ballistics as well as designing of ammunition and weapons.

Lifelong learning courses at FChT in 2020

Name of lifelong study programme	Number of participants	Length of study	Form of study	Number of sessions
Commenced in 2020				
Fundamentals of the technology of the production of fibres, paper, paperboard and their processing - organized by ÚChTML	21	3 semesters	licence	200
Theory and technology of explosives – organized by ÚEnM	5	4 semesters	licence	345
Ongoing				
Rock disintegration by explosion - organized by ÚEnM	9	4 semesters	licence	400
Modern technology in graphic arts and printing technology - organized by KPF	10	2 semesters	licence	224
Theory and technology of explosives – organized by ÚEnM	11	4 semesters	licence	345

Due to the Covid-19 pandemic and the governmental restrictions, both ongoing and newly launched courses were suspended.

2.7 University Textbooks and Monographs Issued at FChT in 2020

An integral part of educational activity is the preparation of study materials including university textbooks and monographs. In 2020, the following publications were issued at FChT.

Printed textbooks

1. Komers K., Čegan A.: Physical chemistry for clinical-chemical fields, Vol. 2, 1st ed., 113 copies, 216 pages.
2. Drabina P.: Bioorganic chemistry, 1st ed., 114 copies, 242 pages.
3. Hejduk J.: Printing production technology, 1st ed., 114 copies, 276 pages.
4. Čapek L., Hájek M., Lochař V., Shánělová J.: How to calculate your way through bachelor's physical chemistry, 2nd extended ed., 367 copies, 248 pages.
5. Hanusek J., Macháček V., Sedlák M.: Collection of tasks in general and inorganic chemistry, 3rd revised ed., 515 copies, 184 pages.
6. Slováková M., Bílková Z., Korecká L.: Selected laboratory exercises in immunoanalytical methods, 2nd revised ed., 315 copies, 118 pages.
7. Bartoš M., Švancara I., Esner A., Šrámková J.: Laboratory exercises in analytical chemistry, 4th ed., 317 copies, 96 pages.

In total 1,855 copies and 1,380 pages of text.

Electronic textbooks (https://eshop.upce.cz/epub?fakulta=fcht)

1. Sajdlová S., Mistrík J.: Physics - Guideline for laboratory exercises and tasks, 1st ed, 160 pages.
2. Bělina P., Dohnalová Ž, Drobná H., Honcová P., Kalendová P., Košťál P., Luxová J., Svoboda L., Šulcová P.: Guidelines for material synthesis and characterization laboratories; intended for Inorganic technology study programme, 1st ed., 185 pages.
3. Štěpánková Š.: General biochemistry, 1st ed., 114 copies, 213 pages.

In total 558 pages of text.

Digitization of older publications (https://eupce.publi.cz/)

1. Černohorský T., Jandera P.: Atomic spectroscopy, 1st ed., 218 pages
   (ISBN 80-7194-114-X, November 1997).
2. Jarušek J., Kalenda P., Šňupárek J.: Chemistry of film-producing substances, Vol 1., 3rd ed., 166 pages
   (ISBN 80-7194-169-7, December 1998).
3. Macháček V, Panchartek J., Večeřa M.: Organic chemistry, 1st part, 3rd reworked ed., 284 pages (ISBN 80-7194-363-0, June 2001).

In total 668 pages of text.

3. Research and Development

3.1 Scientific and Research Focus of Departments and Institutes

The scientific and research activity of the Faculty focuses primarily on high-quality basic and applied research in accordance with the *Long-term plan of educational, scientific, research, developmental, artistic and other creative activities of the Faculty for 2020*.

Research, experimental development and innovation (referred to as "RDI") is based on specific chemical sciences and fields that the faculty has developed in the long term and in which the faculty has achieved significant outcomes in a national as well as international context. FChT focuses on RDI in the following fields: FORD 1 Natural Sciences, 2 Engineering and Technology and 3 Medical and Health Sciences.

The scientific and research activities are performed by working groups established at the faculty's departments and institutes, which are actively involved in projects supported especially by the Czech Science Foundation, Technology Agency of the Czech Republic or departmental support providers. An important aspect in the development of scientific and research activities of the faculty are the resources acquired as a result of collaboration with industrial entities and as a result of international cooperation. This is also related to the extensive publication activity including papers in scientific impacted periodicals, monographs, patents, etc. In terms of finance, the funding of creative activity focusing on science, research and innovation represented a significant part of FChT's budget in 2020.

Dominant focus of FChT in basic and applied research:

- Inorganic pigments for ceramics and paints,
- Analyses and separations of bio-analytical and food compounds,
- Analyses of diagnostically relevant substances for the study of metabolism and oxidative stress in patients with various types of diseases,
- Biologically active compounds for human and veterinary medicine applications,
- Detection of microorganisms by culturing and molecular biological methods,
- Electrochemistry, interphase chemistry and methods of preparation and subsequent element analysis of samples with a focus on the development and application of separation, analytical, detection and diagnostic techniques, instrumentation and sensors in the area of human protection, environmental protection and material analysis,
- Energetic materials for applications in the automotive, aerospace, mining, construction and defence sectors,
- Photonics, optics and optoelectronics,
- Environmental processes (e.g., technologies in the pre-treatment and treatment of process, waste and municipal water),
- Chemical processes with high added value; this particularly applies to the research of new and highly selective adsorbents, catalysts (homogeneous and heterogeneous catalysis) and photocatalysts,
- Identification/detection of biomarkers in patients with neurodegenerative and neoplastic diseases, including early detection of cancer,
- Volume glass and amorphous thin layers,
- Organic dyes for colouring and printing,
- Organic materials for optoelectronics,
- Organic pigments for the automotive industry and construction,
- Organic coatings and paints,
- Organometallic and coordination compounds with subsequent applications in catalytic processes as precursors of advanced materials or compounds with biological effects,
- Advanced low-dimensional nanomaterials (nanoparticles, nanotubes, nanofibres, nanofilms) using modern synthesis methods including applications (e.g., batteries, catalysts, water degradation, solar cells, etc.),
- Nanobiomedical technologies,
- Semiconductors and materials for thermoelectric applications,
- Polymeric materials, fibres, composites and organic coatings,

- Material printing,
- Membrane separation processes,
- Safety engineering methods and risk analyses in the chemical industry,
- Glass producing materials (amorphous/crystalline form, bulk materials/thin layers), advanced viscous and kinetic phenomena and physical-chemical processes associated with the use of these materials,
- Determination of the sensitivity of different cell types to genotoxic agents;
- Fibres based on new polysaccharides with biological properties.

Below is an overview of the scientific and research focus of the departments and institutes of the faculty and their basic activities in 2020.

Department of Analytical Chemistry (KAlCh)

The scientific and research activities of the Department of Analytical Chemistry focus on both basic and applied research. The department focuses on analyses of organic and inorganic compounds using modern approaches. Special-purpose instrumentation allows the application of analytical procedures suitable for materials of different origin (biological and vegetable matrices, samples of food, water, soil air, etc.), not only in terms of the content of usual components but also in terms of trace analysis or toxicological analysis.

The Liquid Phase Separation Methods Group focused on the development of liquid chromatography and capillary electrophoresis methods for the separation of natural antioxidants, porphyrin dyes, surfactants and other substances as well as the development of methods for two-dimensional chromatographic separation. In the field of two-dimensional liquid chromatography, the group continued the development of the interface with active focusing of transmission fractions using electromigration principles. The group tested the so-called three-loop modulator arrangement linking both separation columns that helped increase the sensitivity of the developed 2D methods by electromigration focusing on the transmitted zones of the substances analysed. Monolithic columns for rapid separation in the second dimension were prepared. A method was developed for the analysis of N-acyl amino acid surfactants after derivatization by means of 2,4'-dibromoacetophenone. The resulting derivatives were separated in the reversed-phase system and detected by UV and mass spectrometry. A method was developed for the characterization of oxyethylenated acylglycerols using light scattering detection and mass spectrometry. In the area of electrophoretic separation techniques, natural antioxidants with on-line concentration were analysed as promising substances in two-dimensional liquid phase separations.

The group studied the effect of the mobile phase on polar columns simultaneously showing a dual mechanism – lipophilic and hydrophilic interactions. The group also tested the definition of the phase system allowing the use of a uniform stationary phase volume for the prevailing areas of both retention mechanisms, thus enabling the refinement of experimental retention data for columns with a mixed separating mechanism that have recently been of increased interest in liquid chromatography.

In the area of application outcomes, attention was on the analysis of natural antioxidants in different types of matrices. The HPLC/MS/MS method was optimized for monitoring of the content of biologically active substances in amaranth grain. Focus was also on the optimization of the extraction of free phenolic substances from amaranth flour and the influence of acidic and alkaline hydrolysis on the release of bound phenolic substances. Cooperation with Synthesia, a.s. continued in the analysis of dyes, pigments, intermediate products and impurities. A study was conducted using HPLC to assess the presence of selected classified primary aromatic amines in the final products (pigments) as well as in pigments after degradation simulating the real conditions of their use; attention was also on the evaluation of these amines during the processing (dyeing) of textile materials (wool, cotton) by these pigments. The presence of these amines was also investigated in commercial textile products.

Finally, the group tested various stationary phases for the separation of positional isomers of dinitrotoluene and nitrotoluene in soil samples taken after trinitrotoluene explosion.

The Mass Spectrometry Group continued the development of new methods for lipidomic analysis using UHPLC/MS, UHPSFC/MS and shotgun MS techniques. A study was completed for the early detection of pancreatic cancer based on a lipidomic analysis of the human serum and statistical evaluation of the differences in the concentrations of dysregulated lipids, particularly sphingomyelins, ceramides and (lyso)phosphatidylcholines. The study is currently under review in Nature Communications. In October 2020 the European patent EP 3514545 "A method of diagnosing pancreatic cancer based on lipidomic analysis of a body fluid" was granted. A study was completed on the plasma of patients with renal, breast and prostate carcinoma, which is currently being prepared for submission for publication. The conclusion of both studies is that all types of carcinoma studied show very similar types of lipid dysregulation. In addition, a new UHPLC/MS method for the identification of glycosphingolipids in body fluid samples was developed and optimized. A publication is being prepared on the development of LipidQuant lipidomic software and a new generation of LipidQuant 2.0 is now being tested. Several publications are being finalized on the analysis of plasma, urine and tissue for renal and lung carcinoma. These will be submitted for publication in the next year. A new method was optimized for the separation of lipids in inverted phase systems, which allows better distribution of positional isomers and more detailed lipidome characterization.

The Extraction Methods Group continued the research on the characterization of beer ingredients, particularly malt, using vacuum assisted HS-SPME in conjunction with GC-FID and GC-MS. Attention was especially on volatile organic compounds present in various types of malt (light, dark, caramel, wheat, etc.). Various plant materials after treatment were analysed and their antimicrobial activity was studied. The group also focused on the study of volatile compound emitted from spruce wood in order to distinguish between two sites of Městské lesy Hradec Králové. At the same time, volatile substances were studies that characterize various types of wine and balsamic vinegar. The analysis also included the effect of another reaction gas during negative chemical ionization in order to increase the sensitivity of nitrocompound determination.

The Food Analysis Group in cooperation with Tomas Bata University in Zlín produced a new type of cream cheese enriched with grapevine press cake to increase the consumption of substances with biologically active substances, while at the same time using waste from the production of white wines. Dried carob pod powder was analysed in order to determine the optimum grinding procedure with respect to the biological availability of phenolic substances. In addition, an optimal procedure for obtaining aronia powder was determined using a combination of osmotic dehydration and ultrasound with an emphasis on the maximum yield of substances with antioxidant effects. In a vitamin B12 retention study the researchers focused on the effects of various culinary treatments and different types of meat using immunoaffinity extraction and liquid chromatography.

The Atomic Spectrometry Group in collaboration with the University of Parma worked on the development of new methods and instrumental procedures for the assessment of the authenticity of real fish and cephalopod samples and the possibilities for falsification detection. The determination of the element profile by mass spectrometry with ionization in inductively coupled plasma and its evaluation using sophisticated machine learning tools appears to be one of the most promising strategies that can be used in the near future to comprehensively assess the quality and chemical safety of fish and seafood. The general features of the proposed methods which are key to routine use include particularly the high analytical performance, flexibility, precision, robustness and sensitivity in a wide range of measurements, cost-effective analyses or matrix interference elimination efficiency.

The Electroanalytical Group tested the methods of extractive voltammetry on carbon pastes for the monitoring of milk and cream quality through the determination of fat content. The continuing doctoral studies focused on the analysis of the electrochemical behaviour of the substances responsible for vanilla flavour, including their structural analogues. Moreover, the procedures for the voltammetric determination of lipophilic vitamins and their esters were tested. Attention was also on the method for the determination of drugs on a carbon paste electrode modified in situ by a surfactant, this time adapted to flufenamic acid. This substance was subsequently included in adsorption and kinetics efficiency studies using specific substrates such as Biochar (biocoal). For the purposes of electrochemical detection of As(III), carbon printed electrodes with a film of gold separated from the solution and deposited on the surface of the electrode by various deposition techniques were tested. The gold film was also produced by applying a suspension of gold nanoparticles directly on the working electrode. In

addition to electrode modification, the group analysed the effect of deposition and cathodic stripping voltammetry on the arsenic oxidation signal. Other studies focused on nonionic and amphoteric surfactants in terms of their possible determination by means of an automatic titrator. New artificial enzymes (based on copper complexes) were also examined for the analysis of neurotransmitters (dopamine, serotonin).

In cooperation with the University of Lodz, the group tested various carbon electrode materials for the electrochemical detection of the fungicide fenhexamid. A rapid and simple electroanalytic technique was developed for the determination of this fungicide in blueberries and grapevine. Together with colleagues from the University of Pristina, the group developed electrochemical methods for the simultaneous determination of the lipophilic vitamins E and K and esters of vitamins E and A using the glass carbon electrode in food supplements and cosmetic products, which allows time-saving sample preparation compared with traditional separation techniques. Moreover, a rapid electrochemical method was developed for the direct determination of beta-carotene on the gold electrode for the analysis of its contents in vegetables and pharmaceutical preparations.

In the area of isotachophoretic analysis the group completed the research on the determination of group B vitamins and continued in the research on the determination of different antidepressant and antiepileptic groups and conducted the first tests concerning the determination of ethanol and denatonium benzoate.

The Chemometric Group studied enthalpy, entropy and thermodynamic dissociation constants of Bedaquiline, Baricitinib and Valsartan by means of UV/VIS spectrometric and potentiometric data analysis.

Department of General and Inorganic Chemistry (KOAnCh)

The scientific and research activity of the department focuses on the chemistry of inorganic, organometallic and coordination compounds, catalyses, non-crystalline oxidic and chalcogenide glasses, thin layers and nanomaterials as well as thermoelectric materials.

The Organometallic and Coordination Compounds Group studied the compounds of metals from almost the whole periodic table with a special focus on chelating, bulky or other modern ligands in order to understand their structure, bond properties and applications as molecular precursors of new materials, catalysts and markers or therapeutic substances in medicine. The group studied the reactivity of borane, thiaborane and carborane compounds with *N*-heterocyclic carbenes. In this class of compounds, a new reactivity in the ten-vertex series of compounds was discovered. These compounds can be protonated to form the first cationic boranes and carboranes. *O*- and *m*-carboranes were used in the activation of small molecules (e.g. CO) and stabilization of elements in unconventional oxidation states including $N(I)^+$, Si(0), $Si(I)^+$, Ge(0) etc. As part of the ongoing study of coordination compounds, the group synthesised compounds with multidental ligands with *N*-donors such as amides, imides, amidinates and guanidinates. The reactivity of the most voluminous anilines was examined. In the area of applied research, the group continued to study the preparation, properties and use of lactyl lactates as surfactants and cosmetic ingredients, synthesis of polyglycerines or pigments for security printing. The research also focused on the reactivity of unconventional monomers of organogermanium hydrides coordinated on a CuX (X = Cl, I) substrate. Focus was also on the study of the chemistry of bidental P,Ge(II) a P,Sn(II) ligands. The prepared P,Ge(II) and P,Sn(II) ligands were studied as suitable chelates for the coordination of transition metals. The prepared Ru(II) complexes containing bidentate P,Ge(II) and P,Sn(II) ligands were studied as potential catalysts in aerobic oxidation of alcohol and amines. N,N-chelated cations of Group 14 elements were prepared. These ion compounds were investigated together with organogermanium hydrides coordinated on CuX as precatalysts in ring-opening polymerization reactions. The group also prepared a comprehensive series of new unsymmetrical substituted monovalent compounds of Group 15 elements containing a secondary amine function in their structure. Its presence has a major impact on their reactivity, for example in their oxidation by air which is controlled by a tautomer conversion involving this group. Moreover, the researchers studied the mechanism and limitations of the hydrogenation of C=C bonds using the above-mentioned compounds of selected pentels. Last but not least, the group focused on the synthesis of high-Lewis acid tellurium

cations which are capable of activating B-H bonds in carborane frameworks. The researchers also prepared diazapnictol (P and As) cymantrene derivatives and synthesised larger aromatic systems containing CC-annelated 1,2,3-diazaphospholides. These compounds were studied by spectroscopic techniques and cyclic voltammetry. Focus was also on the preparation of the cyclopentadienide proligand with a side link with a thioether functional group, preparation of the allyl cyclopentadienyl complex $[(\eta^3\text{-}C_3H_5)(\eta^5\text{-}C_5H_4(CH_2)_2SC_6H_5)Mo(CO)_2]$ and its protonation using tetrafluoroboric acid in MeCN which led to the formation of the cation complex $[(MeCN)_2(\eta^5\text{-}C_5H_4(CH_2)_2SC_6H_5)Mo(CO)_2][BF_4]$. By substituting coordinated MeCN with *N,N´*-bidentate ligands, a series of complexes with a potential cytostatic activity was prepared.

In the area of oxidic non-crystalline materials, potassium phosphate glasses modified by niobium oxide were prepared and the changes in the structure of selected physical and chemical properties of these ternary glasses with an increasing content of niobium oxide were studied. Focus was also on the process of crystallization of glass-forming melts of these glasses and on the identification of crystalline products. The structure of all prepared glass materials was studied using Raman spectroscopy and ^{31}P MAS NMR. The study showed a positive effect of the addition of Nb_2O_5 to these glasses, resulting in increased temperature of glass transformation and higher chemical resistance. Glass making capability was observed in the ternary system $K_2O\text{-}Nb_2O_5\text{-}P_2O_5$ and three compositional rows of glasses were studied to detect their content-based structural changes. Cooperation with the Ruđer Bošković Institute in Zagreb continued on materials with ion-polaron conductivity on glasses and crystalline material of the $WO_3\text{-}P_2O_5$ binary system. The study showed that in controlled crystallization of these glasses at temperatures of 700 to 935°C the electrical conductivity of the samples increased by four orders as a results of the formation of electrically conductive phases $W_2O_3(PO_4)_2$ and WO_3 and that these materials appeared promising for possible applications in solid-state batteries.

The group continued to study the effect of transition metals on some physical characteristics and especially the structure of phosphate glasses. The study is based on ^{31}P MAS and static NMR, Raman spectroscopy, detailed analysis of electron spin resonance spectra and electron spectroscopy, possibly supplemented with information from X-ray diffraction. In addition to traditional procedures, the results were processed by means of the theory of point group symmetries. The group completed the study of $Na_2O\text{-}ZnO\text{-}TiO_2\text{-}P_2O_5$ glasses as well as the analysis of bonding of copper, zinc and calcium in metaphosphate glasses. A study was initiated on phosphate glasses with molybdenum. In addition to the determination of thermoanalytical characteristics, the work focused on obtaining the basic information concerning the structure of the glass network by using ^{31}P MAS NMR, Raman scattering and electron spin resonance. In cooperation with Alexander Dubček University in Trenčín, Slovakia, the group continued on the thermodynamic modelling of the chemical composition of phosphate glasses with niobium and analysed the results of the measurement of dielectric spectroscopy of glass zinc-ferric metaphosphate. Cooperation also continued with the Department of Physics at Pavol Jozef Šafárik University, Košice, Slovakia on the study of the magnetic properties of phosphate glasses at very low temperatures.

$(PbO)_{50-x}(TeO_2)_x(P_2O_5)_{50}$ glasses doped with 0.1 at.% ER^{3+} were studied in order to achieve up-conversion photoluminescence which is relatively rare in phosphate glasses due to the high photon energy values. The structure of the prepared glasses was studied by Raman scattering and ^{31}P MAS NMR, while the thermoanalytical properties were analysed by DSC calorimetry. The disadvantage of these high-TeO_2 glasses is their high sensitivity to hydrolysis. This significantly affects their optical properties manifested for example by reducing the time of photoluminescence fade out due to the non-radiant recombination associated with the presence of -OH groups.

In the area of chalcogenide glasses, in collaboration with the Joint Laboratory of Solid State Chemistry of the Faculty of Chemical Technology and the Institute of Optical Materials and Technologies of Acad. Jordan Malinowski of the Bulgarian Academy of Sciences, works were successfully completed on volume glasses as well as thin layers of the $Ge_{30}As_xSe_{70-x}$ system.

Moreover, in the area of amorphous and crystalline chalcogenides, research focused on the structure of chalcogenide glasses of the Ag-Ge-Sb-S system using mass spectrometry (MS) and Raman spectroscopy. The structural units or their fragments detected by mass spectrometry can be correlated with the structural units determined by Raman spectroscopy. Regarding the fact that for the purposes

of MS the material is ionized by laser desorption, the results are also valuable for the preparation of thin glass layers by laser deposition including the mechanism of thin layer synthesis.

In collaboration with Harbin Engineering University (Harbin, China) the group studied broad-spectrum photoluminescent emissions in the mid-infrared band (2.5-4.5 mm) from Co^{2+} ions in the glass ceramic of the Ge-As-S –Zn(Cd)Se(S) system containing nanocrystals of the binary compounds ZnS, ZnSe, CdS or ternary compounds ZnCdS, ZnSSe. The nanocrystals can be used to tune the energy and width of the luminescent bands. These materials are intended to be used for gas detection or as sources of excitation radiation.

The study also focused on the electric properties of the phase-change thin layers of $Ge_2Sb_2Te_5$ by measuring temperature dependencies of direct and THz conductivity. These materials were further tested for preparation in the form of 2D nanolayers. It was demonstrated that layers of 10-60 nm in thickness can be achieved by magnetron sputtering of thin multilayers with subsequent exfoliation. A very interesting area is the preparation of 2D nanolayers of metals or their oxides. Tungsten multilayers were prepared by means of magnetron sputtering. These layers were separated by both dry and wet exfoliation. These metal layers and their oxidized forms were characterized by HRTEM, HERE and conductive AFM methods. 2D W nanolayers are electrically conductive. They can be oxidized in a controlled manner as indicated by the XPS measurement. After controlled oxidation, WO_3/W/WO_3 layers were observed for example.

The study of thin layers of chalcogenide glasses also focused on their deposition from solutions in volatile organic basic substances by means of spin coating. Special focus was on the effect of the length of the aliphatic chain of the amine applied on the structure and the physical-chemical properties of the prepared layers. The study also focused on the possibilities of doping of chalcogenide glass solutions by organometallic compounds. In the area of thin layer structuring, focus was on the hot-embossing method including the preparation of initial matrices, their replication and particularly the applicability of this method in the structuring of thin layers of solution-based chalcogenide glasses.

The group successfully optimized the preparation of nanocrystalline oxides based on perovskites $LaAlO_3$, $LaGaO_3$ and $LaInO_3$ doped with 1 at.% Er^{3+} and garnets $Yb_3Ga_5O_{12}$:x (x = 0.01–2 at.% Er^{3+}) by the combustion technique using various fuels (ethylenediaminetetraacetic acid, citric acid, glycine) and the NH_4NO_3 oxidizer. The prepared powder materials were subsequently annealed at different temperatures, which in combination with the oxidizer/fuel ratio can be used to control the size of the crystallites roughly between 1 and 10 nm. Intensive $\lambda \approx 1.5$ μm emission was observed for all samples. Moreover, intensive green up-conversion emission was observed for the $LaGaO_3$:Er and $LaInO_3$:Er perovskites while the $Yb_3Ga_5O_{12}$:Er garnets were dominated by red up-conversion emission. During the study of up-conversion dynamics the process of thermal quenching was observed, probably due to the heating of the sample during 977 nm laser excitation. The effect of thermal processes on up-conversion dynamics depending on the size of crystalline grains is the subject of a follow-up study.

Institute of Organic Chemistry and Technology (ÚOChT)

The research and development activities of the employees and students of the institute focused on the synthesis and characterization of new catalysts, biologically active compounds, compounds with defined electronic properties, study of organic reaction mechanisms as well as new technologies of organic intermediates and dyes.

A new strategy was proposed and successfully tested for the preparation of different inhibitors of kinases with an oxindole skeleton using the Eschenmoser reaction as the key step. By using the reaction of substituted 3-bromoxindol with substituted thioamides in dimethylformamide, the range of newly prepared aryl(amino)methylidene oxindoles that contain in their molecule the primary, secondary and tertiary amino group was substantially expanded. Moreover, a synthetic approach was used for the preparation of sphingoid bases of Clavaminol A and Xestoaminol C and their non-natural stereoisomers with enantiomer purity above 95% e.e. These compounds were further tested for cancerostatic activity with respect to four different lines of cancer cells. The key precursor of Linezolid antibiotic was prepared

in an optically pure form using the asymmetric Henry reaction catalysed by our own highly efficient chiral imidazolinone based catalysts. Ligands with an oxazoline skeleton were immobilized on a polystyrene carrier. The palladium complexes of these polymer catalysts showed significant enantiocatalytic activity in the asymmetric 1,4-adition of arylboronic acids to cyclic enones. Further study focused on the verification of the suitability of repeated use of these catalysts (recycling). In cooperation with Cayman Pharma Ltd. the synthesis of the key 'ynol' intermediate product was developed and optimized, which can be used for the preparation of clinically used prostaglandin analogues. The original synthesis is based on Corey-lactone, which was converted by the Corey-Fuchs reaction to dibromovinyl derivative which was subsequently subjected to dehydrobromination and alkylation using transmetalation. The researchers also synthesised a series of new modified dipeptides derived from leucine and phenylalanine which effectively modulate the viability of cancer cells and completed the synthesis of potential proteasome inhibitors based on salicylamides that have in their molecule an aldehydic, arylsulfonyl hydrazide or vinyl sulfone functional group. Following the previous research in the area of synthesis, characterization and study of the biological properties of 6-fluoro-1,3-benzothiazolylalkylamines and related heterocyclic compounds, a series of new derivatives was prepared. (*S*)-1-(6-fluoro-1,3-benzothiazol-2-yl)-2-methylpropane-1-amine hydrochloride and two methoxyacetic acid and cyclobutanecarboxylic acid chlorides were used as the initial compounds for the preparation of 14 new amides that had so far not been described. New procedures suitable for the synthesis of baseline 2- and 4-(morpholin-4-ylmethyl)anilines and their sulfonamide derivatives were developed. This procedure was used to prepare and characterize a series of 16 new sulfonamide derivatives of 2- and 4-(morpholin-4-ylmethyl)aniline. The laboratory procedure for the preparation of new staple microfibres based on hyaluronan and modified starches was verified.

In the field of basic material research, functionalized organic compounds with significant photophysical and photochemical (or photocatalytic) properties were prepared and characterized. New D-A and D-A-D' luminophores with an oxazaborine acceptor were synthesized and characterized. Many of the compounds prepared showed a significant AIE effect and luminescence in the solid phase. New organic materials with (non)linear optical (NLO) properties based primarily on the pyrimidine molecule were prepared and characterized. These organic materials have a high potential in OLED technology. Focus was also on monomers for the so-called "smart" polymers. A comprehensive range of fluorinated aromatic diamines was synthesised and subsequently used in the synthesis of polyimides with modular characteristics. New indolinospiropirane pigments that show photochromic properties in the solid phase were prepared and characterized. When exposed to sunlight, these pigments showed a temporal change in their colour in the course of a few seconds. When the pigments are no longer exposed to sunlight and are heated, they fade in the course of tens of seconds. Research in the field of organic electronics focused on the issue of organic compounds intended as electrolytes of redox flow batteries. 4,4'-bipyridyl derivatives and its structural analogues were systematically studied. In particular, the electrochemical properties of these molecules and their chemical stability or solubility in aqueous electrolytes were thoroughly studied. The experimental results showed that some of the derivatives met the primary requirements for organic electrolytes. In the field of material organic chemistry the researchers continued to study volatile organic compounds of selenium applicable as precursors for atomic layer deposition. A series of primarily cyclic silylselenides was prepared as selenium precursors with balanced stability and reactivity suitable for atomic layer deposition. These organic volatile selenium compounds were further used for the preparation of the $MoSe_2$ nanolayers that have a number of subsequent applications. Organic push-pull molecules were applied in light-induced organic reactions. In the area of photoredox catalysis, oxidative annulations and cross-coupling reactions were studied.

Department of Physical Chemistry (KFCh)

The scientific and research activities at the Department of Physical Chemistry are conducted in the following four areas: (a) Surface chemistry and catalysis; (b) Kinetic phenomena in glass forming systems; (c) Conversion of oils into valuable products; and (d) Applied chemical kinetics and pharmacokinetics.

In 2020, research on advanced porous materials and fundamental adsorption studies focused on the localization of extra-matrix cations of alkali metals and zeolite MOR matrix as well as the interaction of these cations with carbon monoxide as the test molecule. It was demonstrated that the diffusion of small molecules such as CO was significantly affected by the Si/Al ratio and cation type. This "gate effect" causes strong stabilization of dispersion bonded CO in the deformed by-channel. It was also demonstrated that IR spectroscopy could be used to distinguish between cations localized in the main channel and side pocket. The results of this in-depth study published in Microporous Mesoporous Materials corrected the frequently misinterpreted IR spectra. In collaboration with colleagues from CEMNAT and ICPF CAS, the adsorption and separation of α-pinene optical isomers from racemic mixtures on Al_2O_3 modified polycarbonate membranes were studied. The results of the study were published in Langmuir.

In 2020, part of the research activity of the Surface Chemistry and Catalysis Group also focused on the study of the acidity of Brønsted acid centres on the external surface of the hierarchic MFI zeolite and the comparison of their acidity with the acidity of intrazeolitic centres using the measurement of the kinetics of H/D isotopic exchange between deuterated zeolitic material and ethane at temperatures around 400°C monitored by means of time-differentiated IR spectroscopy. A methodology for selective deuteration of only external or only intrazeolitis Al-O(H)-Si was developed. Significant differences in the H/D exchange rate of different types of acid centres were observed, which suggests that the primary activation of the C-H bonds in the hydrocarbon molecule was sensitive to the geometry around the acid active centre. A publication on this subject is in preparation and will be published in 2021.

In the area of heterogeneously catalysed oxidation reactions, attention was on influencing the catalytic activity of catalysts based on BEA zeolites modified by cobalt using appropriate promotors. A very significant effect of lanthanum and manganese was observed to increase the catalytic activity by more than 200% while maintaining the very high selectivity of ethane ammoxidation to acetonitrile (selectivity greater than 90%). The effect of promotor presence on the properties of cobalt which forms active centres for ammoxidation was studied using a combination of spectroscopic techniques (IR, Raman, UV-vis, XPS) and temperature-programmed techniques. These results will be published in 2021. The study also focused on the possibility of using alkaline activated zeolite foams developed in the framework of the dissertation by Z. Tišler as active phase carriers for the preparation of industrial catalysts. Catalysts based on cobalt applied on zeolite foams were prepared and successfully tested in N_2O catalytic decomposition. The results of the study were published in Catalysts.

In the area of photocatalysis, focus was on hydrogen generation as part of photocatalytic degradation of methanol-water solution. The main part of the research focused on the modification of the batch photoreactor and the construction of a new type of flow photoreactor.

Research in the area of basic heterogeneous catalysis focused on layered double hydroxides (LDH) of different compositions (Ca^{2+}, Mg^{2+}, Zn^{2+} and Al^{3+}, Fe^{3+}), mixed oxides formed by LDH heat treatment and the so-called "reconstructed" LDH and their use in aldol condensation of furfural, Guerbet reaction (conversion of ethanol to butanol) and transesterification of vegetable oil. Attention was on (a) acid-base properties of the materials studied and (b) analysis of the relationship between their structure/composition/basicity and activity/selectivity of the reactions. The research was conducted in cooperation the ORLEN UniCRE (transesterification of vegetable oil and Guerbet reaction) and Technopark in Kraupy of the University of Chemical Technology (aldol condensation of furfural).

In the field of oil chemistry, focus was on the epoxidation of vegetable oils and products from these oils (esters and fatty acids). In particular, the study focused on the conditions of epoxidation under which the epoxy achieves the required properties and the analytical methods for the determination of the

quality and quantity of the final epoxy product. The process of epoxidation produces substances with higher oxidation stability usable as a replacement for petroleum-based lubricants or as plasticizers. Other applications of epoxy products are in polymer chemistry.

In the field of non-crystalline materials, the group continued to study the physical properties (viscosity, surface diffusion, thermal capacity, surface tension, etc.) and kinetic processes (crystallization, structural relaxation) that take place not only in chalcogenide glass-forming materials. During 2020, focus was mainly on the differences in the crystal growth rates concerning the volume and surface of the materials prepared and their relation to viscosity and surface self-diffusion. For this purpose, a number of direct (VIS, IR and SE microscopy, AFM) and indirect (DSC, TMA, STA, nanoindentation) methods were used. A combination of these methods can lead to a better understanding and prediction of these complex nuclear growth processes. The study of surface diffusion and its effect on crystal growth in the different materials provides essential information that will clarify the differences in growth rates between bulk and surface crystals which are comparable with the measurements in molecular glass-forming systems, thus allowing the generalization of the findings. Focus was also on the research of the theory of kinetic analysis of solid phase processes including the study of the effect of the methodologies used, extent of measurement and the quality of the data obtained to determine the activation energy of complex processes. Subsequently, a new methodology for simultaneous use of differential and integral isoconversional methods was developed. In collaboration with AV, Italy, a new open-source software was developed for the purposes of modelling and analysis of kinetic data. The connection between theoretical and experimental research was realized in a model study on the effect of particle size on the kinetic analysis of complex kinetic data, which led to the development of a new methodology for accurate prediction of kinetic behaviour with significant extrapolation of experimental conditions and wide distribution of powder material particle size. The methodology was successfully validated for a wide range of material types involving inorganic glasses, hydrated crystalline substances, functional nanomaterials or pharmaceutical substances. In cooperation with TnUni (Trenčín, SR) a study was performed on the structural relaxation, viscosity, crystallizing behaviour, corrosive properties and surface tension of several series of oxidic glasses.

In 2020, research on solid pharmaceuticals focused primarily on the preparation and development of mixed fibres for 3D printing of matrix tablets and the development of a method for matrix tablet coating using 3D print. In the process of fibre development, focus was on optimizing the extrusion process which is the key step in FDM 3D printing. Both synthetic (Kollidon, PVA, hypromellose) and natural (chitosan, alginate) fibres were used in the process of fibre preparation. The new fibres were characterized by EDX, SEM and FTIR. Fibre disintegration was studied in various media that simulate the GIT environment. On the basis of these results, a 3D printing method for matrix tablet coating was developed and optimized to minimize the risk of 'alcohol-induced dose dumping' effect in tablets with a prolonged release of the active substance. Research also continued in the area of dissolution kinetics of lipophilic matrix tablets. In the area of lipophilic matrix tablets the group focused on the study of the kinetic and thermodynamic aspects of the release of the active substance and the degradation of these tablets with ionizing and non-ionizing active substances. The research studies were implemented in cooperation with SOTAX Pharmaceutical Testing, s.r.o.

Institute of Environmental and Chemical Engineering (ÚEnviChI)

In the area of membrane processes, the activity of the institute focused on acquiring further experimental and theoretical knowledge in order to extend its application potential. In this context, the use of pressure membrane processes focused on the disposal of contaminated waste water and treatment of technological water including drinking water. The main activity in the area of nanofiltration was the study of the effect of significant parameters on the separation of heavy metals, such as the their concentration in solutions, pressure difference above and below the membrane, membrane type, etc. on the selected characteristics of this pressure membrane process (intensity of permeate flow and system component rejection). The method of separation of the selected organic substances from water-based solutions using reverse osmosis was tested. Aqueous solutions of ethanol, propanol and maltose were tested in order to assess the effect of the pressure difference and substance concentration on the rejection and intensity of permeate flow.

The Diffusion Dialysis Group focused on experimental measurement of continuous diffusion dialysis of mixtures of inorganic acids and salts ($HCl+FeCl_3$, $HNO_3+Fe(NO_3)_3$ a $HF+Fe(NO_3)_3$) the composition of which corresponded to real depleted mordant solutions. The tests included the anion-exchange membranes Neosepta-AFN, Neosepta-AHA and Fumasep FAD.

In cooperation with MEGA, a.s. and Membrain, s.r.o. the following project funded by the Ministry of Trade continued: FV 40062 *Zero liquid discharge of industrial waste water using electrodialysis*. A master's diploma thesis was produced focusing on the study of the effect of high concentrations of other salts on the solubility of scaling salts ($CaSO_4$). SSPA projects and bachelor's diploma theses focused on the use of electrodialysis with polarity reversion in the implementation of ZLD technologies.

In collaboration with VÚOS, a.s. an analytical method (HPLC-UV) for the determination of the amount of benzoic acid in the acceptor liquid was developed, optimized and validated. The tests focused on the penetration of benzoic acid into the acceptor liquid using *in vitro* skin penetration tests on pig skin and artificial Strat-M membrane with commercial static diffusion cells according to Franz under different test conditions (mixing rate, cells used, method of application, temperature effect).

In cooperation with Synpo, a.s. the Rheology Group continued the measurement of the rheological properties of the samples of commercial and newly developed polyurethane adhesives intended for the automotive industry and their components and mechanical properties in the process of curing at a temperature range of 25–80 °C. The rheological measurements focused on the determination of flow and viscosity curves, possible sample thixotropy, viscoelastic behaviour and adhesive power by means of the so-called tack tests. The results of these measurements were used in the description of the rheological behaviour of the test substances.

The activity of the Chemical Technology Group, which was included in the excellent research group thanks to the results achieved under the leadership of Doc. Ing. Tomáš Weidlich, Ph.D. (project VA390013), focused on the ecological aspects of chemical processes. The group focused on the removal of industrially significant chlorinated and fluorinated aromatic compounds (Diclofenac, flufenamic acid, herbicides, azo dyes and azo pigment production by-products) from model and/or real technological and waste water using the best available techniques such as sorption, ion exchange and coagulation and flocculation. In cooperation with VÚOS, a.s. and Synthesia, a.s. the group performed an applied research study and experimental development funded by the TA CR under the project GAMA 2-01/005: *Removal of dangerous compounds from contaminated waste applicable for recycling according to the circular economy* and Zeta project *Removal of polar polyfluorinated compounds from contaminated materials*. The removal of halogenated derivatives from water was tested using the application of ion liquids on a suitable carrier, for example on saturated adsorption charge of activated carbon in adsorption columns in order to increase the sorption capacity of the column without replacing the charge according to a modified patent of the University of Pardubice (Weidlich T.: CZ307282 (B6)); the procedure was finalized by means of a verified technology. The procedure allows the concentration of halogenated organic acids and regeneration of the sorption charge using suitable surfactants. The developed ion exchange technology using ionic liquids applied to a saturated sorbent carrier for AOX capture and subsequent regeneration of ionic liquids by reductive dehalogenation was patented (Weidlich T., Kamenická B., Bartoš M., Čermák J.: Method of removal of halogenated organic acids from water. CZ308220 (B6) 2020-03-04). In addition, the utility model application PUV 2020-38319 "Decontamination device" was submitted to the Industrial Property Office. The technology of decontamination of water polluted by polyfluorinated compounds was validated. By means of a licence, the know-how patented by the University of Pardubice was used (Weidlich T.: CZ 305586 (PV 2014-367)). To address the issue of the treatment of the concentrates of separated contaminants, the process of degradation of halogenated derivatives in waste water using chemical reduction (hydrodehalogenation) was analysed. Based on the results of this research, the patent application PV 2020-246 "Method of hydrodefluorination of aromatic trifluoromethyl derivatives" was submitted to the Industrial Property Office.
In addition to the activities described above, the following project was launched: TA CR GAMA 2-02/003 *Increasing of resistivity of textile face covers by impregnation using virucidal preparation*. The project resulted in the production of a functional sample of this impregnation and validation of its virucidal activity.

Cooperation continued with the Institute of Electronics and Photonics FEI STU Bratislava in order to test and use new electrode materials, especially BDD electrodes. In this context, a higher-life BDD flow cell is being developed and will be tested on model and real waste water. This was the third year of operation of a house waste water treatment unit, for which an electrochemical final cleaning module was prepared. Cooperation was established by means of contract research with Glanzstoff Bohemia, s.r.o. in the area of zinc separation and regeneration in waste and industrial water using electrodeposition. The cooperation also included the use of AOP processes in the oxidation of organic pollution in waste water. Emphasis was on increasing the effectiveness of using new cathode materials based on Pt, Au or Pd plated titanium. Focus was also on the application of these electrodes in suppressing AOX produced during the electro-oxidation of organic compounds in the chloride ion environment in comparison with BDD electrodes.

Together with the Forest and Game Management Research Institute and TERAMED, s.r.o. the following project continued under the 2nd public competition of the Epsilon scheme announced by the Technology Agency of the Czech Republic: TH02030823 *Development of methodological-technical procedures minimizing the impacts of forest management on the quality of groundwater as a result of the migration of excess reactive nitrogen and phosphorus.* The activity focused on further monitoring of rainwater, subsurface water and groundwater and forest soils of Městské lesy Hradec Králové in Běleč nad Orlicí in order to clarify the biological processes after a clear-cut of forest growth in a real forest environment.

Under the Epsilon scheme of the Technology Agency of the Czech Republic the group cooperated with TERAMED, s.r.o. and the Potato Research Institute Havlíčkův Brod on the following project: *Biocomposite component for slow release of active minerals in soil for plant nutrition* aimed at semi-operational monitoring of phosphorus and nitrogen activity in soil under the presence of biologically treated zeolites. For Ecocoal s.r.o. Ostrava the group implemented the so-called Innovative Voucher (OP EIC) *Development of new technological processes to obtain usable substances from dust leaches from metallurgical production.*

As part of contract research for EOP Opatovice, a.s. the group examined the possibility of improving the properties of lime fly ash after the introduction of denitrification in the power plant to prevent the deterioration of its strength characteristics and the working environment due to the release of ammonia. For AHV ekologický servis, s.r.o. the group assessed the process of regeneration of printing solvents with a focus on ethanol quality.

Together with EPS Biotechnology, s.r.o. and Tomas Bata University in Zlín a project was started under the 4th TA CR Zeta applied research public competition. The project dealt with the removal of chloroacetanilide pesticides from contaminated water and soil.

In the context of monitoring of the effects of products and technologies on the environment, a study was initiated on the assessment of the life cycle of the preparation of non-compostable biomass for conversion to biofuels. Attention was also on the environmental effect of fast fashion, particularly textile processing.

A study was carried out on the transport of nutrients and other selected elements from soil to grapevine. Focus was especially on the transport of anthropogenic gadolinium to the plant, grapes and the final product. A positive gadolinium anomaly was observed in the sample of soils, plants and wines. Due to the increasing use of gadolinium-based contrast agents, their spread in the aquatic environment and the potential for contamination of food chains, plant monitors and basic agricultural products in which gadolinium of anthropogenic origin is detected were identified. At the same time, the specific chemical forms of gadolinium and their individual effects on gadolinium anomaly in the green algae were monitored under laboratory conditions.

In collaboration with CEMNAT, the method of cryogenic grinding of polyacrylonitrile nanofibres in order to prepare nanoparticles suitable for subsequent toxicity tests on selected cell cultures. The Ecotoxicology Group also focused on the study of the toxicity of chlorinated pesticides for soil annelids under the TA CR project *Combined procedure of elimination of chloroacetanilide pesticides from contaminated water and soil*. In collaboration with the Institute of Hydrobiology of the Czech Academy of Sciences and University of Vienna, the group implemented a project addressing the effect of

periphyton on the movement of phosphorus in oligotrophic lakes formed as part of brown coal mine reclamation. The previously developed methods for the determination of phosphorus using scintillation detection were used for the analysis of real samples from several sampling campaigns and the effects of a number of parameters on the uptake of phosphorus by periphyton were analysed under laboratory conditions. A methodology for the determination of the selected pigments in the samples of periphyton using HPLC was developed. The research of the group also focused on the use of the immunochemical response of annelids in the screening evaluation of the safety of tattoo inks.

In the study of the galvanostatic deposition of zinc on the copper electrode it was observed that in real samples the dependencies of the deposited amount m and decrease in concentration c_{Zn} on time t had lower efficiency by 30% at i=10-20 mA·cm^{-2} compared with model waters, while log c vs. t showed narrow steepness values as well as m vs. c. The deposition of unstable Zn coatings at i>20 μA·cm^{-2} resulted in significant deviations of the dependencies from their otherwise linear course (at lower i values).

The testing of the indication of the process of cleaning power plant waters using the potentiometric response of silver amalgam electrode AgAE suggested that in water solutions with ions Ag^+ of c=10^{-3} mol·L^{-1} mixed potentials E_s were observed in cured as well as freshly prepared electrodes within approximately 180 s. The time shapes of immediate potentials E-t from the submersion of AgSAE had an increasing, stable or decreasing tendency at different c Ag^+ at different AgSAE. Their shapes were filtered for example by means of Gaussian or Boltzmann distributions.

Research also focused on the development of new voltammetric methods for the determination of the selected bioactive substances important to human health and the environment by using prospective electrode materials. The group completed and evaluated studies focused on the voltammetric behaviour of anti-inflammatory drugs of the oxicam group, specifically piroxicam and tenoxicam, and developed methods of their determination using the boron doped diamond electrode (BDDE). At the same time, experiments were carried out to clarify the oxidation mechanism of oxicam drugs. Another group of substances includes azole fungicides. Methods for the determination of difenoconazole and tebuconazole were produced as well as the mechanisms of ongoing oxidation reactions. The group continued the study of voltammetric behaviour and the development of a method for the determination of triticonazole. At the same time, research was initiated on the pre-treatment/activation of BDDE surface in order to improve its electrochemical properties.

In the area of development of voltammetric methods for the determination of plant stimulators a sensitive method for the determination of paclobutrazol was developed. This is a substance that is used to slow down plant growth (reduces the effect of the plant hormone gibberellin) and is also used as a fungicide. Its use in a mixture with difenoconazole prevents the development of interferences and allows a simultaneous determination of both substances.

In the area of remote sensing and monitoring of surface water, further samples were taken (using the developed floating sampling device) to expand the data base of water quality parameter models based on the remote monitoring approach. Focus was also on continued development of models and optimization of satellite data processing.

Institute of Chemistry and Technology of Macromolecular Materials (ÚChTML)

The Institute of Chemistry and Technology of Macromolecular Materials performed research in areas that are unique in the Czech Republic. The institute has three departments with a long-term scientific-research focus: Department of paints and organic coatings, Department of synthetic polymers, fibres and textile chemistry and Department of wood, pulp and paper.

Scientific activity in the area of organic coatings and paints includes comprehensive research of these materials with an emphasis on binders as well as chemically or physically active coating components, i.e. pigments, fillers and numerous functional additives. Research focuses on the development of polymeric and composite coatings, nanomaterials and special polymers. Attention is on cross-linking

reactions on polycondensation and polyaddition resins, binders made of renewable sources and environmentally friendly materials. At present, strict focus is on ecological and toxicological safety of paint and organic surface components. Therefore, attention is on organometals potentially applicable in the area of paints. Detailed focus is on organometallic derivatives for oxopolymerization drying of alkyd paints, whose Cp ligand carries electron acceptor substituents. The mechanism of their effect in autooxidation reactions is studied by means of spectroscopic methods. Focus was on searching and studying new antioxidants for paints and optimization of their application. Another research area was the synthesis of ecological and highly efficient anti-corrosion pigments and corrosion inhibitors as well as the study of the mechanisms of their effect in the protection of metal materials. A promising solution seems to be the use of the synergic effect of the compounds that limit the speed of corrosion reactions (corrosion inhibitors) with other components of protective organic or inorganic coatings. The institute focused on synthesising oxide nanoparticles and morphologically interesting pigment particles intended for efficient interconnection of the polymer network of protective films. Core-shell particles with an active nanolayer inhibiting the course of a certain corrosion reaction were developed. Conductive polymers and carbon nanomaterials as active inhibitors of corrosion reactions were studied. Focus was also on the formulation of organic coatings containing conductive polymers, where a very promising alternative seems to be the composite particles of conductive polymers and their suitable carriers. For the preparation of nanodispersions with zinc oxide in organic solvents, dispersion techniques including appropriate conditions and additives that facilitate these technologies were developed. The prepared nanosuspensions are used as anti-corrosive and anti-microbial agents in paints.

In the area of anti-corrosion coatings for heavy corrosion protection, focus was on investigating the properties of paints with a high zinc content and the aim was to decrease the content of this metal using other electrically and electrochemically conductive materials. Research was carried out in the area of syntheses and application of anti-corrosion pigments with various chemical structures and particle morphologies. Pigment modification by conductive polymers was performed to increase the anti-corrosion efficiency of anti-corrosion pigments or corrosion inhibitors, reduce the amount in paints and improve the mechanical properties of binders. Focus was also on the formulation of thermally and chemically stable coatings and layers containing metal particles or nanoparticles of ferritic pigments.

In the area of polymeric and textile chemistry, research focused on chemical technology, automotive industry, textile chemistry, design and composite materials and processing industry, medicinal materials, energy materials, etc. Scientific activity included the study of polymerization and polycondensation reactions. Material research was performed in the area of composite materials and construction adhesives for the automotive industry. Focus was also on the study of biodegradable polymers on the basis of polymerable sugars and biodegradable auxiliaries in the textile chemistry. In the area of reactoplastic materials, research focused on the modification of epoxy resins, adhesives and sealants. Important thermoplastic polymers include polyethylene and resilient polystyrene, whose macromolecules contain polymeric-bound light stabilisers and antioxidants. The purpose of these polymeric carriers is to improve UV stabilisation and decrease oxidative degradation of for example polyurethanes and other polymers. Research also focused on other additives (antistatics, flame retardants and fluorescent markers), covalent-bound to plasma-treated polymer carriers. Emphasis was on the development of environmentally acceptable flame retardants based on lignin nanoparticles. Further research focused on the synthesis of reactive structured polymer parts using the technique of emulsion polymerization, their properties and applications, particularly in the area of surface treatment. The purpose of these research activities was to develop antimicrobial protective polymer coatings based on hybrid polymer dispersions which contain inorganic nanoparticles of metal oxides. Focus was also on the study of increasing water resistance of latex films. Another area of study included heterogeneous ion-exchange membranes on the basis of emulsion polyelectrolytes as polymer carriers and functionalized styrene-divinylbenzene resin. The institute also focused on the synthesis and study of hyper-branched polymers as precursors of organic coatings. Textile dyes were developed including microencapsulation. In the context of final textile treatment, the processes of anti-shrink and antimicrobial treatment including the development of new products were optimized. In the area of wound covering research, a new method was proposed that uses a stable iodine complex in the covering made of suitable polymers in order to achieve antiseptic wound covering. The researchers also focused on the development of covers for chronic wounds (varicose ulcers, pressure sores). For the purposes of the textile industry, new types of hydrogen peroxide stabilizers were developed to optimize the bleaching processes.

Scientific and research activity in the field of wood, pulp and paper focused on biomaterials, both on the theoretical and practical level. Attention was on environmental issues related to the production and use of these materials, including combinations of paper and paper materials with other biomaterials and synthetic polymers. Special attention was on technological and waste waters and their recirculation. Traditional focus was on the study of the principles of paper processing technology and the properties and behaviour of paper-based materials. Research focused on the development of pulp production, especially from annual plants and biowaste. Another important programme in the upcoming period is research on the properties of pulp-based fibres in the process of their ageing with respect to their life, recycling and protection of written heritage. Research also focused on surface treatment in paper refining and use of paper as a bioremediative and bioactive foil for the purposes of intensification of plant activity in agriculture. Explorational activity focused especially on better characterization of the epimolecular structure of lignocellulosic mass and other materials, particularly at their hypermolecular level, which is the key aspect in all molecular-surface, chemical and biochemical processes, as it is the first when molecules from the surrounding environment enter its core. The area of separation of wood, pulp and paper currently focuses on circular economy based on renewable sources with a closed product lifecycle and on the reduction of non-renewable materials in fast-moving packaging materials.

Institute of Energetic Materials (ÚEnM)

The scientific and research activities of the Institute of Energetic Materials focused on several traditional areas:

Research and development focused on energy composition based on plastic-bound explosive mixtures (in collaboration with Egypt) and co-crystals high energy volume (in collaboration with Poland). Research continued in the area of initiation reactivity of energetic materials and its correlation with the energy content in these materials.

Research focused on the properties of various coordination compounds containing the cyanide group as an alternative non-metallic fuel applicable in pyrotechnic compounds. Research continued in the area of reactivity of selected explosive compounds to electrostatic discharge and influencing ESD sensitivity using various additives.

Another joint project funded by TA CR continued with Explosia, a.s. focusing on the development and characterization of heterogeneous rocket fuels. Another project with Explosia, a.s. was implemented by means of contract research focusing on waste water treatment in the production of nitro compounds and on new substances applicable as additives in nitrocellulose propellant materials. Applied research in the area of chemistry of energetic materials focused on the processing of post-production waste acids and on the preparation and testing of selected substances for specific explosive applications.

Research activity continued in the area of improvised explosives in order to obtain further information on the possibilities of abuse by "home synthesis" using available materials for the purposes of criminal activity, their detection and description of their risk properties.

Attention was also on the research of the structure and properties of tetrazene, an explosive used in initiators. New interesting facts were revealed concerning the chemical structure and sensitivity of this explosive which had been used over a hundred years. The results will be published.

In the area of explosion physics, direct and indirect measurement was performed to monitor detonation and its effects on the near environment using both traditional pressure sensors and prospective optical methods. Part of the experiments was numerically simulated using the LS-DYNA software. The project MPO FV40140 – TRIO examined the possibilities of measurement of the parameters of emulsion explosives.

In collaboration with OZM Research, s.r.o., a new methodology was developed for statistical evaluation of sensitivity tests – FEST.

Applied research in the area of safety engineering and risk analysis focused on improving the ability to analyse hazardous situations associated with exothermic reactions.

Department of Inorganic Technology (KAnT)

The scientific and research activities of the Department of Inorganic Technology focused on the following three principle areas: inorganic pigments, industrial fertilizers and soil improvers (special agrochemicals) and the study of the properties of chalcogenide materials by calorimetric methods.

In the area of inorganic pigments, attention was on the synthesis of new oxide materials of ecological composition, high thermal stability and appropriate optical properties which can be used as inorganic pigments and applied in commercial ceramic glazes and also organic binding systems. Research focused on compounds, especially those of a pyrochlore, perovskite, cassiterite and spinel structure and phosphates. The composition of these oxide materials is affected by rare earth elements and transitional elements, which can have a positive effect, especially on the optical properties of the synthesised compounds. The prepared substances were characterized in terms of their phase composition, optical and physical-chemical properties, thermal and chemical resistance, light stability as well as their applicability in various binders. In the case of perovskite compounds, focus was also on their capability of reflection in the near-infrared region depending on the composition and type of perovskite structure. In the area of phosphates, attention was on the preparation of LISICON type compounds (Lithium Super Ionic Conductor) the structure of which consists of shared PO_4 and ZrO_6 groups while the compensating element is located inside the structure cavities. Particularly, the study focused on the study of the composition of $LiZr_2(PO_4)_3$ and the verification of the effect of lanthanides and the degree of substitution on the colouring, phase composition and structure as well as thermal stability. Specifically, the study focused on the $Li_{1-3x}LnZr_2(PO_4)_3$ and $Li_{1+x}Zr_{2-x}Ln_x(PO_4)_3$ composition which are new types of compounds that provide a varied colour scale and at the same time are thermally stable. The objective was to test the possibilities of various optical properties of these materials in both the visible and near-infrared regions. The focus of further research was on the testing of various conditions of hydroxyapatite precipitation in terms of its corrosive-inhibitory effects with applications in various binders and subsequent evaluation of corrosion tests. The synthesis of new oxide materials was based on solid phase reactions, precipitation, sol-gel method, suspension mixing of raw materials and also mechanoactivation. Focus was also on testing of various input materials in order to achieve a positive effect on reactivity. In the process of synthesis, focus was on the application of various types of mineralizers and defined atmosphere in order to achieve a positive effect on the course of synthesis.

The research on special agrochemicals focused on further optimization of the conditions for the synthesis of hydrogels based on the copolymer of acrylic acid and acrylamide graft on starch from different natural resources. The objective was to prepare materials that could be used as biodegradable superabsorbents that act as soil moisture regulators and nutrient carriers and that could at least partially replace fully synthetic soil improvers that leave undesirable residues. The study focused on the effect of the amount of acrylamide on the swelling capacity of the resulting hydrogel in water and in fertilizer solutions. Another objective was to assess hydrogel solubility in water, characterization and comparison of the properties of hydrogels prepared under the presence of the crosslinking agent N,N'-methylen-bis-acrylamide with non-crosslinked hydrogels. The results obtained are ready for publishing in an impacted journal. Another research study focused on the synthesis of hydrogel which included starch obtained from the fruit of *Aesculus hippocastanum*. The researchers optimized the conditions for the isolation and purification of this starch and subsequently used it to synthesise hydrogel using the procedure identical to that of previous starch types. All of the prepared hydrogels as well as the initial materials were characterized by thermogravimetric analysis and scanning electron microscopy. The results confirmed that starch copolymer hydrogels may be a suitable ecological alternative to commercial fully synthetic polyacrylamide products.

Research on chalcogenide materials focused on the study of the thermal capacity of these materials. In this area, a methodology was developed for experiments performed in an inert atmosphere applied to specific basic chalcogenide materials, both in the glass and crystalline form. Focus was also on the viscosity behaviour of chalcogenides. In addition to acquiring further experimental data, the research also focused on the study of the possibilities of combining experimental data with suitable theoretical

models. The researchers also focused on the possibility of estimating the viscosity behaviour in supercooled melt where direct detection of experimental data is compromised by the process of cold crystallization of the supercooled melt. The kinetics of cold crystallization was studied for pseudobinary $GeSe_2$-Sb_2Se_3 glasses and the determined kinetic parameters were compared with direct monitoring of crystal growth. In the area of testing substances suitable for heat accumulation, research continued on the effect of doping of inorganic substances on the suppression of supercooling in cobaltous and nickel nitrate hexahydrate and calcium nitrate hexahydrate. Moreover, the tests focused on the effect of the addition of inorganic fibres to these salts to suppress phase separation. The prepared mixtures were characterized by means of TG/DSC or DSC and the values of thermal capacity, density as well as thermal conductivity at room temperature were determined.

Department of Graphic Arts and Photophysics (KP)

The scientific and research activity of the Department of Graphic Arts and Photophysics focused on several different areas.

The first area of research focused on chalcogenide glasses and their thin layers with special attention on the study of some systems based on tellurium (Ge(Ga)-Sb-Te, (Ge)-As-Te), selenium (Ge(Ga)-Sb-Se) but also other elements. The department also studied the preparation of thin chalcogenide layers from organometallic precursors. The research of amorphous chalcogenides is largely based on broad cooperation with foreign as well as domestic institutes. A significant stimulus supporting developmental and research activities in this area was broadening of the spectral area of ellipsometric measurements which now includes the UV-VIS-NIR part of the spectrum as well as the acquisition of spectrophotometers covering the UV-VIS-NIR-MIR-FIR parts of the spectrum.

The second area is the research of UV curable paints and varnishes. The study primarily focused on two areas: hybrid polymerization systems (radical and cation polymerization) and UV curable systems using UV LED. One of the promising areas in the area of curing of paints and varnishes using UV radiation is the possibility of substituting medium-pressure mercury lamps with UV LED (longer lifetime, lower electricity consumption, environmental aspects, etc.) The project TP01010012 (GAMA2-01/007) focused on the development of UV curable varnish for digital varnishing machines which will allow surface as well as partial varnishing including special effects. The varnish is cured by UV LED technology.

In the area of material printing and printed electronics, where attention was on smart packaging, smart labels for autonomous temperature and a relative humidity monitoring system were developed on a semi-operational level. Smart labels were tested by end users in the field of food processing, healthcare, museum administration, logistics, etc. In the area of material printing, the researchers focused on the issue of printing large-scale sensors for warehouse management using IoT data transfer. The technology of sensor production was successfully transferred to the production level for the specific types of sensors and the first series of sensors were manufactured and deployed. In the third year of the OrgBat project, research focused on printed accumulators based on organic compounds. This involved accumulators with electrolytes based on lithium salts as well as sodium salts. Research continued on the SmartField project which focused on printed sensors for the detection of soil moisture and temperature in various depths. The technology of sensor printing on a bidegradable (wooden) substrate was developed. This technology was patented. Data collection from the sensors was performed by means of IoT with transition via networks such as LoRa, SigFox, etc. using a module developed as part of the project.

In collaboration with OP papírna, s.r.o. research continued on the evaluation of print-through on thin print papers. Attention was on the application of different types of paper fillers. In addition to the commonly used kaolin and precipitated calcium carbonate, a special filler based on precipitated magnesium aluminium silicate was tested. The effect of different contents and filler combinations on print-through was analysed.

In the research of thermochromic system, the following project supported by the Ministry of Trade continued: FV30048 *New additives for multifunctional modification of polymer surfaces*. Based on the previous results, the Department of Graphic Arts and Photophysics focused on the different temperature

and time stress conditions applied to the selected points with perylene-embedded pigment. A functional sample of thermochromic paints was prepared.

The department also performed research aimed at the development of new printing forms for flexo printing. Flexo printing is currently a very promising printing technique used primarily for the development of a broad range of packaging. Research focused on two directions. The main focus was on the development of new rubber printing forms, improvement of their printing properties and methods of direct burning using various types of lasers (in cooperation with Ligum, spol. s r.o., Gravitech, s.r.o.). The department was also involved in the implementation of new flexo printing forms in practice (Obchodní tiskárny, a.s., OTK GROUP, a.s.). The results of this activity included practical applications in the polygraphic industry. The other direction was the application of the know-how of the Department of Graphic Arts and Photophysics in providing technical support in the development of printed electronics and UV curable systems.

Department of Economy and Management of Chemical and Food Industry (KEMCh)

Research performed by the Department of Economy and Management of Chemical and Food Industry focused on seven main areas.

In the field of marketing management, a primary quantitative research was carried out to identify the current use of various public relations tools in chemical enterprises in the CR and to evaluate their perceived effectiveness in influencing public opinion. A comparison of the use and perceived efficiency of PR tools was performed and suitable strategies for their development in chemical enterprises in the CR were recommended.

In the area of shared economy, a quantitative research study analysing the attitudes of generations M, Y and X towards the phenomenon of sharing was performed as part of the COST (CA16121) project. Attention was also on alternative forms of B2B sharing, particularly from the perspective of chemical enterprises. A comprehensive analysis was performed on the economic, social and environmental benefits and risks of the principles of shared economy, taking into account the specifics of the Czech Republic.

In the area of social responsibility, research continued on web-based communication of socially responsible activities carried out by chemical enterprises abroad, specifically in Norway. The assessment focused on economic, environmental, ethical, social and philanthropic activities.
In the field of in-house process management and supply chain management, research studies focused on improving the sustainability of packaging for consumer chemistry products. Innovative sustainable packaging activities in chemical enterprises were analysed and the importance of the requirements of consumer chemistry customers for environmental packaging was identified. Focus was on possible ways of identifying the readiness of enterprises for servitization and the specification of the conditions and procedures for its successful implementation with respect to changes in the supply chain and possible causes of its failure. The findings were confronted with the state of servitization in Lučební závody Draslovka, a.s., Kolín.

As far as the introduction of Industry 4.0 in the chemical industry is concerned, a qualitative and quantitative research study was conducted on the economic and social aspects of the implementation of the elements of Industry 4.0 in chemical enterprises. The study focused on the possibilities for strategic approaches of manufacturing enterprises to servitization with respect to its great potential to positively influence the achievement of sustainable development in the context of the entire supply chain. A survey was carried out among enterprises in the CR focusing on the services provided in terms of their extent and products including the so-called smart services. On the basis of these results, the effect and servitization opportunities were identified in order to achieve sustainable development.

In the area of HR management, the concept of gig economy was examined as part of shared economy. The research focused on agency employment, freelancers and cooperation. New forms of employment are becoming increasingly popular among both workers and employers. This is also reflected in the

amendment to the Labour Code valid since 2021, which provides for the possibility of creating shared jobs.

In the area of management accounting, the KEMCH Group as part of the NANOBIO project performed analyses and calculations of costing procedures relating to the research and development stages of product/process life cycle. The costs of selected newly developed methods for the determination of the toxicity of nanomaterials was determined and cost calculation procedures in the context of these approaches were recommended.

Department of Biological and Biochemical Sciences (KBBV)

The department has a total of four research groups which achieved considerable success. The results included papers in impacted journals, collaboration with national and international research or academic institutions and commercial entities. A significant OP RDE funded project called NanoBio is under way. A project entitled *Strengthening of interdisciplinary cooperation in the research of nanomaterials and their effects on living organisms* allowed to establish long-term cooperation with partners from the Hradec Králové and Pardubice Regions, specifically the Faculty of Medicine, Charles University in Hradec Králové and University Hospital Hradec Králové. The project team also includes members from the Centre of Materials and Nanotechnologies, FChT. The overall funding of the 4-year project is over 115 million CZK (4,5 million EUR) and the employees of the department are the principal investigators of this significant investment project.

The Immunochemistry and Immunology Group, specifically its academic employees and doctoral degree students, were involved in several projects in 2020. One of them is the already mentioned NanoBio project, where the group focused on the surface modification and biofunctionalization of the developed nanomaterials. The results of the project included valuable publications in renowned journals aimed at the application of nanomaterials in biomedicine. The group also continued its cooperation with the University Hospital Hradec Králové, specifically with the department led by Prof. MUDr. V. Maisnar, Ph.D. and Doc. MUDr. Jakub Radoch, Ph.D. from the 4th Department of Internal Medicine – Hematology. The project focused on the involvement of the immune system in the detection and elimination of myeloma cells in patients with multiple myeloma. Another important research was the development of immunosensors with quantum dot electrochemical detection (Qdots) for various biomedical applications. Currently, the group led by Prof. Bílková and Dr. Korecká works on the development of a multiplex immunosensor to detect biomarkers in the amniotic fluid in pregnant women with premature membrane rupture in the framework of the PersonMed project coordinated by the Faculty of Medicine, Charles University in Hradec Králové and University Hospital Hradec Králové.

In 2020, a project funded by IQ Structures was implemented in which the research team led by Prof. Bílková contributed to the development of a microconcentrator for the isolation and extraction of viral RNA, specifically SARS-CoV 2. Another important collaborative project on the development of polymeric materials for the preparation of an antiviral vaccine was commenced with the Faculty of Military Health Sciences, University of Defence in Hradec Králové.

Research of both general and clinical biochemistry focused on the area of clinical diagnosis of cardiovascular diseases, type 2 diabetes and adrenoleukodystrophy. A research study was carried out in cooperation with the Clinical and Biochemical Laboratory, Faculty of Medicine, University of Tübingen (Germany). The outcome was an innovated diagnostic procedure based on an analysis of plasma lipoproteins. This methodology was also used for the determination of the clinical cut-off values of the concentrations of linear fatty acids C:20-C:26 that cause X-adrenoleukodystrophy. This study has been carried out since 2008 and has so far included 1953 patients from the Department of Medical Genetics. In cooperation with the Department of Cardiology, Internal Clinic, Pardubice Regional Hospital a study was conducted on the parameters that affect systemic inflammation and the associations with the selected indicators of the onset of the disease, degree of severity and overall short-term and long-term prognosis in patients with cardiovascular disease, especially in patients after percutaneous coronary intervention with coronary stent implantation. Methods were introduced for the identification of selected aminoacids, oxoacids and fatty acids in breast milk. Cooperation was established with the Department of Obstetrics and Gynaecology of the Pardubice Hospital which provides samples of colostrum and breast

milk. In these samples obtained by the dry spot technique, the levels of amino acids, oxoacids, fatty acids and vitamins were analysed in order to analyse the nutritional value of breast milk. The indicators of oxidative stress in humans were determined. The dry blood spot technique was used because taking a drop of blood from the finger is less invasive compared with conventional blood sampling. Moreover, the transport and storage of these samples is easier. The tests also included acetylcholinesterase biosensors. A new methodology was implemented for the determination of the inhibitory effect of selected cholinesterase biosensors and the process of immobilization of acetylcholinesterase on the surface of a three-electrode sensor was tested. In this area, collaboration is established with the Department of Molecular Pathology and Biology, Faculty of Military Health Sciences in Hradec Králové. In cooperation with the Department of Pharmaceutical Botany and Ecology, Faculty of Pharmacy in Hradec Králové, the researchers tested the inhibitory effect of selected alkaloids in monocotyledonous plants against cholinesterase. In cooperation with the Department of Organic and Bioorganic Chemistry of the Faculty of Pharmacy in Hradec Králové, salicylanilide derivatives with a carbamic group, hydrazine-carboxamides and hydrazide-hydrazones are primarily tested as potential cholinesterase inhibitors. Newly synthesized substances as potential cholinesterase inhibitors were also tested in collaboration with the Regional Centre of Advanced Technologies and Materials and the Laboratory of Growth Regulators of the Faculty of Science, Palacký University Olomouc. In cooperation with all of the above mentioned departments, cholinesterase inhibitors were tested for inhibitory activity expressed as IC_{50}, type of inhibition, bonding mechanism between the inhibitor and the bonding location of the enzyme as well as their lipophilic properties. Methods were introduced for the determination of cholinesterase activity and the most appropriate reaction conditions were tested. In addition, the method for the determination of acetylcholinesterase activity using indoxyl acetate substrate was introduced. Methods were introduced for the identification of selected aminoacids, oxoacids and fatty acids in a dry spot of blood, sweat and breast milk. Cooperation also continued with the 2nd Department of Internal Medicine – Gastroenterology, University Hospital Hradec Králové concerning research on the effect of oxidative stress and lipid peroxidation on the development of Crohn's disease and colon cancer. In these patients, measurements focused on the levels of selected antioxidants and oxidative stress markers in whole blood, plasma and colon tissue. In these samples, the concentrations of selected aminoacids and fatty acids were determined in order to identify the indicators of these diseases.

The staff of the Microbiology Group focused on several research directions. Research continued in the area of potentially pathogenic *Arcobacter*-like bacteria. This research is quite exceptional in the Czech Republic and Central Europe. Recent research focused on the monitoring the resistance of both plankton and biofilm forms of these bacteria against clinical ATB but also against numerous natural substances. Moreover, the inhibitory potential of bee products was tested (honey, Manuka honey, propolis, royal jelly) including their possible use for these purposes. In cooperation with the Department of Analytical Chemistry of the Faculty of Chemical Technology, University of Pardubice, the analysis of the biological effects of the prepared natural essential oils and hydrolates with many interesting experimental and publication outcomes continued. The KBBV department also implemented a TA CR ZETA project in cooperation with other departments of the Faculty of Chemical Technology, University of Pardubice and Výzkumný ústav organických syntéz, a.s. This project addressed the issue of possible chemical and biological decontamination of polyfluorinated compounds from contaminated materials. One of the objectives of the project was to monitor the absorption of flufenamic acid and efavirenz from contaminated water by plants. In May 2020, another ZETA project entitled *Combined procedure of elimination of chloroacetanilide pesticides from contaminated water and soil* was launched. The objective was ecotoxicological evaluation of the degradation products of chloroacetanilide pesticides including alachlor, metolachlor and acetochlor. The cooperation with the Institute of Environmental and Chemical Engineering, Faculty of Chemical Technology, University of Pardubice, K2Pharm Opava and Výzkumný ústav organických syntéz, a.s. under a TA CR EPSILON project resulted in the research and development of new food supplements the purpose of which was to positively influence the human microbiome as well as monolaurin-based cosmetic products combined with natural substances. In September, a TA CR GAMA project was started in collaboration with the Department of General and Inorganic Chemistry, Faculty of Chemical Technology, University of Pardubice on the development and testing of new biodegradable oligomer compounds for health-care disinfection applications. Another project funded by the Ministry of Trade was implemented with SYNPO, a.s. on the evaluation of the applicability and safety of new preservatives for writing fluids.

In the analysis of waste and surface water, research focused on isolating the selected bacterial genera and identifying the degree of their resistance to antibiotics. In cooperation with the Institute of Animal Science in Kostelec nad Orlicí, a long-term research is carried out on the microbial contamination of samples of sperm of breeding boars intended for sow insemination. Research also focused on the selected natural substances and inorganic compounds and their effect on the propagation of undesirable micro-organisms that contaminate sperm samples from breeding boars. In collaboration with the Department of Analytical Chemistry of the Faculty of Chemical Technology, the researchers returned to the detection of toxinogenic moulds (*Fusarium*) by means of traditional molecular biological methods. Multiplex PCR was introduced for rapid identification of toxinogenic moulds in food and raw materials. The HPLC/MS method was applied to determine and identify the basic toxins produced by the *Fusarium* genus moulds. The research will continue in order to monitor the presence of moulds in food including possible ways of toxin biodegradation. In the context of a TA CR GAMA project, cooperation was established with the Department of Synthetic Polymers, Fibres and Textile Chemistry, Institute of Chemistry and Technology of Macromolecular Materials, Faculty of Chemical Technology, University of Pardubice. The cooperation focused on the development of new textile materials with microbicidal and virucidal effects. In the area of clinical microbiology, focus was on the changes in the vaginal microbiome in healthy women and women included in the assisted reproduction programme. The objective of the research was to clarify the effect of vaginal microflora on conception. An integral part of microbiological diagnostics was the detection of the sensitivity of microorganisms to antibacterial drugs, including the testing of the effect of synthesised sulphonamides.

The Cytology and Physiology Group focused on a number of separate research tasks. In the Tissue Culture Laboratory, which is equipped with new instrumentation and modern accessories thanks to involvement in many R&D projects, the group worked on the cultivation of new cancer cell lines, allowing a detailed *in vitro* study of the nephrotoxic, neurotoxic and hepatotoxic effects of the substances tested. In addition to *in vitro* study of cytotoxicity of acetanilide compounds in renal cell lines, where focus was on the monitoring of redox and kidney specific functional changes by means intracellular fluorescent probes and immunochemical methods, another important research task was the study of the nephrotoxic effect of cadmium. At the same time, a detailed study of the mechanisms of the neurotoxic/neuroprotective effect of synthetic melanin was launched in 2020 as part of international cooperation. Another study focused on the mitochondrial activity of the neuroblastoma cell line and renal cell lines affected by various test substances by respirometry and fluorescence microscopy using advanced bioanalytical methods, including an analysis of protein expression. In the Cell Culture Laboratory, further experiments were performed that focused on the evaluation of the cytotoxicity and the effect of selected newly developed nanomaterials on the proliferation and viability of primary and tumour cell lines. Other experiments focused on the evaluation of the cytotoxicity of new and potentially anticancer substances isolated from plants from the *Amaryllidaceae* and *Berberidaceae* families. These substances were analysed for their effect on cell behaviour (growth kinetics, adherence ability, proliferation, etc.) immediately after the effect took place and in real time. Other partial R&D objectives of the Cytology Group included the evaluation of the biological effects of new potentially neuroprotective drugs, stereoisomers of aminoalcoholic compounds or the development of entirely new unique methods for the evaluation of cellular damage at cellular or subcellular level.

Institute of Applied Physics and Mathematics (ÚAFM)

The Institute of Applied Physics and Mathematics consists of several research groups with different focus.

Ellipsometric characterization of physical changes in chalcogenide GST layers induced by pulse laser exposure and other materials prepared by co-sputtering in order to better understand the processes in phase change memory media. Ellipsometric characterization of thin layers of MoS_2 dichalcogenide topological insulators prepared by various deposition methods in the amorphous and crystalline phases. Cooperation with TOSEDA, s.r.o. concerning the determination of optical constants of selected co-polymers for space applications in the Earth's orbit. Cooperation with the University of Southampton (UK) on optic fibres permeable in the IR spectrum. Cooperation with Yeungnam University (Republic of Korea) on the research of materials usable for the storage of energy prepared by atomic-layer deposition

and on the research of In-Sn-Zn-O-thin layers deposited by sputtering. The group started diffraction modelling on laser-created optical structures using SW Comsol.

Preparation and characterization of semiconductors with thermoelectric, magnetic and topological properties. This for example included the optimization of thermoelectric systems SnSe and SnS, Bi_2O_2Se by means of doping and modification of natural compound stoichiometry. A great emphasis was on the association between the conveyor properties and the defective structure. Using positron anihilation the number of vacancies in SnSe and their interaction with dopants were identified. In this context, the researchers also focused on examining the possibilities of increasing the efficiency of thermoelectric conversion on the basis of optimizing crystal growth (defect concentration). The model systems primarily included doped SnSe and Bi_2Se_2 monocrystals.

Examination of the development of polymeric nanoparticles, networks and brush structures using x-ray and synchrotron radiation. In the first case, focus was especially on the characterization and classification of nanoparticles by their size and shape depending on the method of preparation. The purpose was to study the use of multi-layer micellar nanoparticles to transport drugs in the organism. In the area of polymeric networks, focus was particularly on the study of the local arrangement of interpenetrating networks and its correlation with relevant macroscopic and especially mechanical properties. In the area of brush structures, research studies focused on the density and length of the chains on wafer surfaces and their effect on the ability to prevent blood coagulation. A new direction was the study of the correlation between the phase transitions of semiconducting polymers and their electrochemical properties. It appears that these systems (e.g. PANI) have suitable properties for the development of supercondensators.

Examination of the additive properties of the units in real sub-bodies of weakly branched circular bodies. The following hypothesis was tested: in the p-th circular body, where p is a prime, there is a maximum of 4 subsequent units x, x+1, x+2, x+3. For p greater than 3, there are always 4 subsequent units. It was also examined which natural numbers can be expressed as the sum of two units in the p-th circular body.

Joint Laboratory of Solid State Chemistry (SLChPL)

SLChPL has existed as one of the FChT's departments since 2018. It was transformed from the joint department shared by the University of Pardubice and the Institute of Macromolecular Chemistry of the Czech Academy of Sciences. The scientific and research activity of SLChPL remains divided into three areas – non-crystalline materials, crystalline materials – thermoelectrics and intercalates. The major part of the activities is based on cooperation with FChT departments and institutes and other workplaces.

As far as non-crystalline materials are concerned, the researchers continued to study the photoinduced changes in the multi-layer GeSe-AsS system by analysing the effect of temperature ((-80°C)–(+200°C)) on the speed and extent of solid phase reactions. Using focused CW lasers (λ = 405; 532 and 785 nm), micro lenses, lines and craters were formed in the glasses with a high refractive index (Ge-Sb-S and $PbO\text{-}Bi_2O_3\text{-}Ga_2O_3$ system). The study focused on the effect of penetration depth of the radiation applied, thermal properties and bond energy on the development and parameters of the structures formed. The study of chalcogenides is just at the beginning. The main conclusion of the research on oxide glasses so far was that adding Bi_2O_3 significantly reduced the threshold radiation intensity for the development of micro lenses, thereby increasing their height in a multiple manner.

The experimental results were subsequently evaluated by the Institute of Applied Physics and Mathematics, resulting in the development of a temperature model for the description of the behaviour of the surface parts of the oxide glasses subject to point laser radiation (micro lenses, craters).

The Institute of Optical Materials and Technologies BAV, Sofia, Bulgaria continued variable angle ellipsometry measurement and the study of solid phase reactions of two steamed chalcogenide thin films $As_{40}S_{60}$ and $Ge_{30}Se_{70}$. The order of their steaming and thickness were experimentally altered. Heat treatment and/or exposition were used to produce a new quaternary Ge-As-S-S interlayer which was subsequently characterized.

Using a modified thermal mechanical analyser (TMA – indenter made of optical-quality silica glass), viscosity flow changes were studied in some chalcogenide and oxide glasses. A comparison was made concerning the changes between viscosity flow without exposure and photon induced viscosity flow. The radiation sources introduced in TMA were lasers (λ = 532 and 655 nm). The changes in the viscosity flow were measured at different material temperatures (below the glass transition temperature). The following materials were used as model glasses: chalcogenide glass As_2S_3 and phosphate glass of the PbO-ZnO-P_2O_5 system doped by CoO. It was observed that the effect of radiation on the viscosity flow decreased with increasing temperature. It was also found that the speed of penetration increased as a result of the effect of photons. In the measuring cycle no exposure – exposure – no exposure, the same direction (speed) as in the first step was observed after the laser had been turned off. We assume that the information obtained could contribute to the clarification and understanding of the mechanism of the formation of micro lenses.

In the area of thermoelectric applications, cooperation with the Institute of Applied Physics and Mathematics and the Institute of Macromolecular Chemistry of the Czech Academy of Sciences related to the so-called metal-organic frameworks studied for possible use in lithium batteries. Solid-phase multinuclear NMR spectroscopy was used to investigate the mechanism of ion conductivity at atomic level and to clarify the interaction of the so-called order-disorder processes, including the interaction of the basic structure with ions and structural changes due to the incorporation of Li^+CoD- with Li^+ ion transfer. Li^+ ions exist in two states (free and bound) that exhibit large movements. Both types of Li^+ ions make mutually communicating chains which are large enough to allow effective charge transfer over long distances resulting in macroscopic conductivity.

The preparation of intercalates started in collaboration with SYNPO, a.s., including the preparation of intercalates based on double hydroxide ZnAl with 2-phenyl-5-benzimidazolesulfonic acid (PBISA), which is a commercially used UV absorber. Depending on the method of preparation (reaction of carbonate form of ZnAl with PBISA, reaction of ZnO with aluminium nitrate solution and PBISA, reaction of exfoliated carbonate form of ZnAl with PBISA), three intercalates were prepared with interlayer distance of approximately 21.7 Å which slightly differ in the Zn/Al ratio and the amount of intercalated acid. In the intercalate UV spectrum, an intense absorption band is visible at about 320 nm. A double hydroxide modified with intercalated UV absorber was tested in the LV CC 220 polyurethane-acrylate paint system. Scanning electron microscopy was used to confirm that unlike PBISA alone which forms relatively large particles in thin film, the prepared intercalate was almost homogeneously dispersed in the film. Intercalate modified films showed a significant decrease in optical permeability in the 300-400 nm region compared with both non-absorber films and films modified by PBISA alone.

A study was performed in collaboration with CEMNAT on the thermal properties of quantum dots and materials based on polymeric nanocomposites using various thermoanalytical methods. The newly synthesized materials were observed for the effect of the method of preparation on their thermal stability, especially temperature and degradation rate. The study included the description of the substituents (aliphatic, aromatic and heterocyclic fragments) in substituted thioureas on the kinetics of synthesis and the properties of the resulting nanomaterials. It was confirmed that in the process of synthesis, toxic and expensive sulphur precursors (such as trioctyl- and tributylphosphinsulphide) could be well substituted with low-cost substituted thiourea with high conversion of the desired product.

In cooperation with the Institute of Chemistry and Technology of Macromolecular Materials, research on the surface properties of acrylate latex paints continued. This time, focus was on increasing the hydrophobic properties of latex films using the following strategies: (1) Application of the traditional non-polymerized and progressive polymerized emulsifier in latex synthesis by emulsion polymerization; (2) Introduction of covalent crosslinking into latex film (intra-particle vs. inter-particle); (3) Application of inorganic ZnO nanoparticles to introduce ionic latex film crosslinking. In the tensiometric measurements, emphasis was particularly on the determination of contact angles for water. The results increased the existing knowledge of the issue, especially in terms of influencing the hydrophobic properties of latex films and their sensitivity to the effects of water.

Cooperation continued with the Institute of Rock Structure and Mechanics of the Czech Academy of Sciences on the study of photoactivity (UV lamp, 360 nm, 10 W/cm) of geopolymers modified by three different forms of TiO_2 (CG100, CG300 and P25). This TiO_2 differs in particle size: P25 20 nm, CG100

18 nm, CG300 approximately 6 nm and modifications (small amount of rutile in P25, only anatase in both CGs). In the degradation of Rhodamine B it was confirmed that the rate of degradation was more influenced by the type of TiO_2 used to modify the geopolymer than its quantity. The highest conversion was achieved using a geopolymer sample with TiO_2 in the form of P25.

New cooperation was established with the Faculty of Mathematics and Physics, Charles University, Laboratory of General Physics Education. The cooperation concerned the study of precipitation in steel alloys based on Mg and/or Al. A number of alloys with different methods of preparation were studied (after casting, cold rolling and hot rolling). DSC, AFM and SEM was applied to study the composition and structure of the prepared alloys. It was observed that the conditions of the preparation process caused the formation of precipitates of different compositions and structures at alloy phase interfaces, for example defects similar to vacancies with a high Si content and different concentrations of Zn, Cu, Mn, Sc and Zr. Layered particles with different morphological characteristics such as square and polygon shapes rich in Sc and Zr were also detected.

New cooperation was established with EIS Laboratory, Skjoldenaesvej 17, 4174 Jystrup, Denmark, FunGlass, Alexander Dubček University of Trenčín, Slovakia and KOAnCh, University of Pardubice concerning the study of electric transport and dielectric relaxation in As_2S_3 model chalcogenide glass using electric impedance spectroscopy at various temperatures (300–433 K) and frequencies (0.1 mHz–1 MHz). Using a novel approach to the analysis of experimental data, a different contribution (effect) of the transport of electric charge and a contribution of dielectric relaxation processes to the overall electrical response was observed.

Centre of Materials and Nanotechnologies (CEMNAT)

In 2020 CEMNAT, the youngest FChT department, successfully implemented its research, development and educational activities in material science in all areas of research (photonics, electronics and electrical engineering, renewable energy, chemically active surfaces). In the long term, CEMNAT employees have been known as outstanding experts in the area of physics and chemistry of solid materials, synthesis and deposition techniques of new materials including nanomaterials and metamaterials, and modelling of their structure and properties. In CEMNAT, there are currently four working groups (led by Prof. Miroslav Vlček, Prof. Tomáš Wágner, Prof. Petr Němec, and Dr. Jan Macák).

In 2020 CEMNAT confirmed its status of excellent infrastructure providing outstanding background for various open-access user groups. On the basis of the evaluation performed by the Ministry of Education, Youth and Sports of the Czech Republic, CEMNAT will continue, at least until 2022, to be on the Roadmap of Large Research Infrastructures.

In 2020 CEMNAT carried out a total of five research projects. Probably the most significant *Towards new generation of solid-state photovoltaic cell: Harvesting nanotubular titania and hybrid chromophores* is supported by the European Research Council and aims to develop a new concept of solar cells combining titania nanotubes with suitable inorganic and organic chromophores in order to achieve efficient conversion of solar energy to electrical energy. In 2020, the project *High-sensitivity sensors and low-density materials based on polymeric nanocomposites NANOMAT* continued (supported by MEYS, OP RDE) aiming to develop active and passive innovative materials, specifically high-sensitivity new sensors based on polymeric nanocomposites and new low-density materials based on polymeric nanocomposite materials for the space, aerospace and automotive industries. A research study continued under project *Amorphous to crystal (3D2D) transition in van der Waals bonded chalcogenide materials* (supported by the Czech Science Foundation). New research was started under the following projects: *Polymeric fiber materials for capture and killing of viruses and a methodology for the determination of antiviral properties of the fiber materials* (funded by TA CR, Gama 2, call Covid-19) and a bilateral project *Engineering of glass formation and photoinduced property modification of hybrid amorphous chalcogenides via controlled content of lone-pair electrons* (funded by GA CR). The former project focused on the applications of polymeric fibre systems in order to capture and eliminate viruses and to determine the antiviral properties of fibre materials. The latter project focused on basic research in the area of development of amorphous chalcogenide systems and the modification of their photoinduced properties. CEMNAT staff were also significantly involved in the following two projects: (i)

Strenghtening of interdisciplinary cooperation in the research of nanomaterials and their effects on living organisms (NANOBIO) (supported by MEYS, OP RDE) and (ii) *Selenide-based 2D nanomaterials by atomic layer deposition with exciting properties* (supported by GA CR). The purpose of the former project is to build modern infrastructure for the development and characterization of newly prepared nanomaterials, their surface modification and biofunctionalization as well as testing of the effect of conventional and newly developed nanomaterials on living organisms. The aim of the latter project, as suggested by its title, is to prepare selenide 2D nanomaterials with unique properties by means of atomic layer deposition.

The funding of the above projects together with the funding from the development project *Modernization and upgrade of CEMNAT infrastructure* and from infrastructure funds of FChT, University of Pardubice allowed an upgrade of the instrumentation for the synthesis and characterization of advanced (nano)materials. Several medium-sized laboratory devices were purchased including a microwave hydrothermal reactor, vacuum cryostat and cooled thermostat for anodizing. The fibre fabrication plant was upgraded by adding a fibre guide and winding unit. The electro-chemical workstation and the atomic layer deposition (ALD) device were modernized. The optical laboratory was provided with additional equipment and software was purchased for modelling of material structures at an atomic level.

In cooperation with CEMNAT, a total of 38 original papers were published in international impacted journals and a chapter was published in a foreign scientific book in 2020. Due to the coronavirus pandemic, only 6 active participations (all lectures) took place at international conferences (of which 5 were online), a patent application was submitted (Czech and PCT international) and 3 expert seminars were held.

3.2 Involvement in Research and Development Programmes

Funding received in the framework of creative activity

Year	2013	2014	2015	2016	2017	2018	2019	2020
Institutional support for the development of a research organization (thousand EUR)	4,302	4,343	4,041	4,397	4,730	5,403	5,544	5,755
Research intents (thousand EUR)	-	-	-	-	-	-	-	
Research centres (thousand EUR)	-	-	-	-	-	-	-	
Foreign grants (thousand EUR)	761	236	336	478	523	390	301	193
Domestic grants (thousand EUR)	2,753	2,690	2,552	2,764	3,590	9,955	7,159	5,898
Student grant competition (thousand EUR)	737	754	694	701	712	690	722	484
Additional activity (thousand EUR)	*131	*194	*103	*170	*214	*217	*207	*278

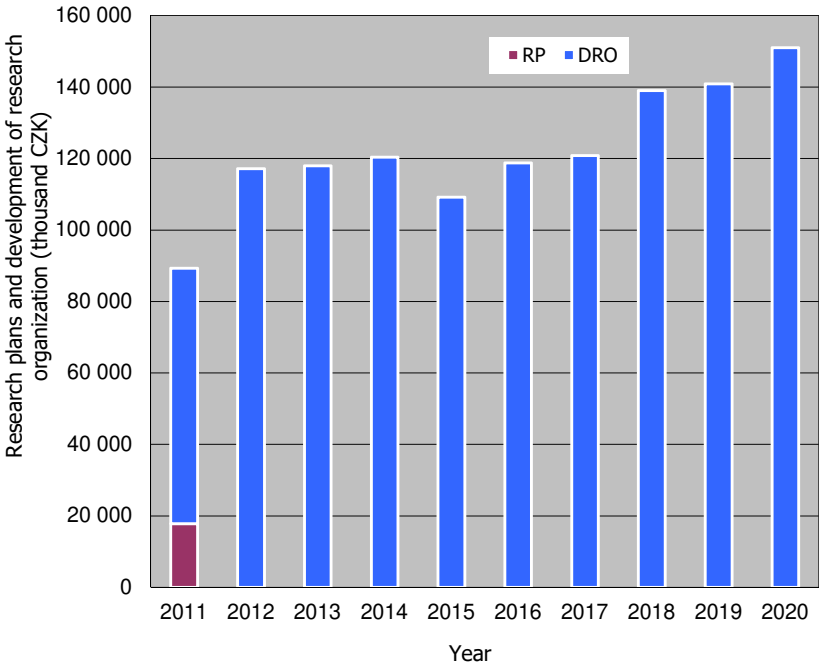
* The amount of additional activity is related to a number of activities in the framework of the main activity.

The amount of 5,898 thousand EUR obtained in the framework of domestic grants and projects in 2020 includes the following:

- National educational grants and projects amounting 31 thousand EUR (IDC);
- National scientific grants and projects amounting to 3,738 thousand EUR (GA CR 2,037 thousand EUR, TA CR 658 thousand EUR, other projects 1,043 thousand EUR);
- OP RDE projects 2,128 thousand EUR.

The amount of 277 thousand EUR obtained in the framework of additional activity include the following incomes:

- Service activity 224 thousand EUR;
- Printing production 3 thousand EUR;
- Contract research above 50 thousand CZK (approx. 1,905 EUR) 39 thousand EUR;
- Licences – inventions 11 thousand EUR.

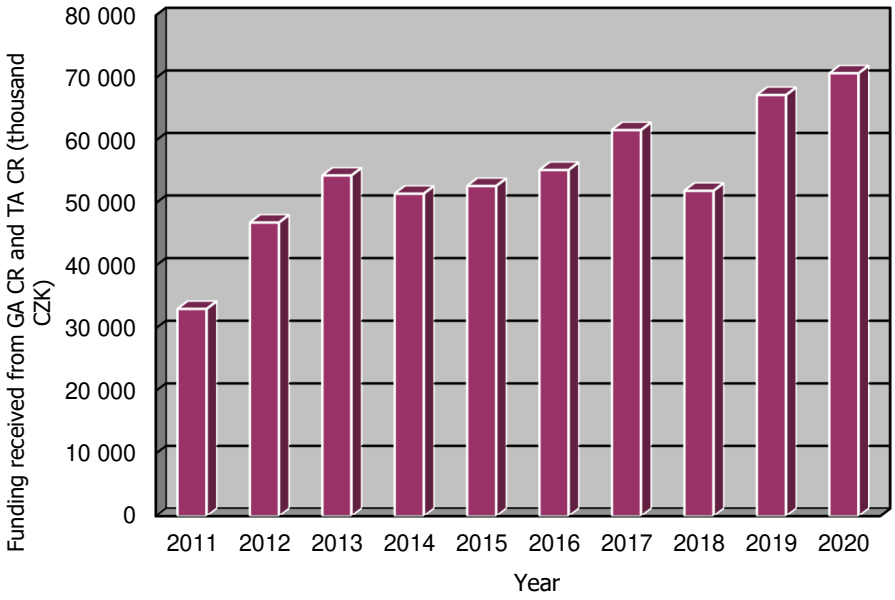


Funding by years of research plans and development of research organization

Grant funds received from GA CR and TA CR in recent years (investigators and participants)

Provider	2015		2016		2017	
	Number of implemented projects	Funding thousand EUR	Number of implemented projects	Funding thousand EUR	Number of implemented projects	Funding thousand EUR
GA CR	20	**1,289**	19	**1,306**	23	**1,466**
TA CR	14	**662**	15	**740**	19	**948**

Provider	2018		2019		2020	
	Number of implemented projects	Funding thousand EUR	Number of implemented projects	Funding thousand EUR	Number of implemented projects	Funding thousand EUR
GA CR	24	**1,491**	29	**1,979**	27	**2,037**
TA CR	17	**528**	19	**668**	19	**658**
				Total in 2020	46	**2,695**

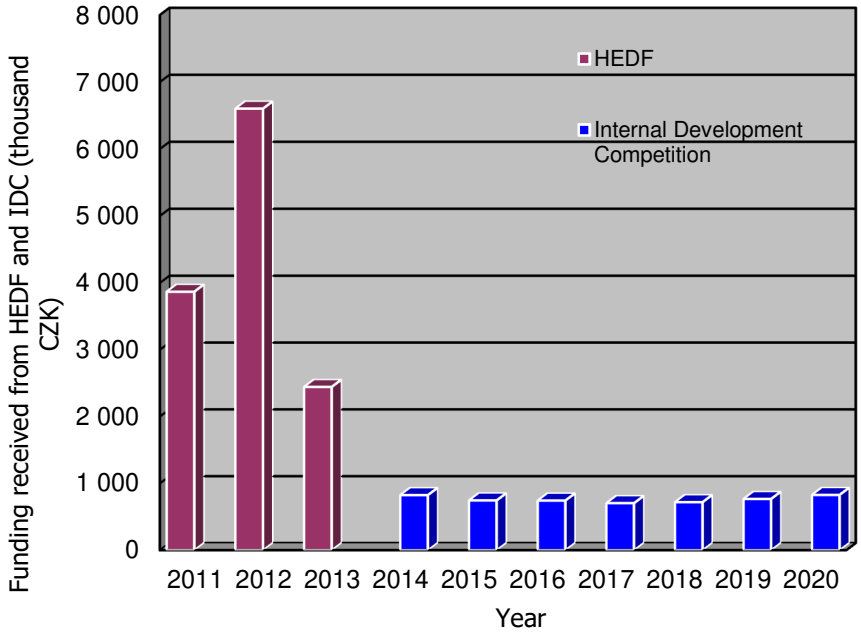


Grant funds received from GA CR and TA CR between 2011 and 2020

Grant funds received in 2020 from the Internal Development Competition

In 2014, Higher Education Development Fund projects were replaced with the Internal Development Competition:

Provider	2020	
	Number of implemented projects	Funding EUR
MEYS – Internal Development Competition	10	**31,473**



Funds received from HEDF between 2011 and 2013 and funds received in the following years from the Internal Development Competition

Involvement in the preparation and implementation of projects under EU Operational Programmes in the area of research and development

In 2020, FChT continued to implement six projects supported by the Operational Programme Research, Development and Education (referred to as OP RDE) launched in the previous years.

In 2020, a total of 4 OP RDE projects were implemented (NANOBIO, NANOMAT, ORGBAT and IT4Neuro) focused on pre-application research. In two cases FChT was the project coordinator. The NANOBIO project focuses on strengthening interdisciplinary cooperation in nanomaterials research and the study of their effect on living organisms. The NANOMAT project focuses on the development of high-sensitivity sensors and low-density materials based on polymeric nanocomposites. Both projects involve partners from the application sphere and their purpose is to find quick use in practice. Another project implemented at FChT in 2020 entitled *Modernization and upgrade of the CEMNAT infrastructure* led to an improvement of the instrumentation for the syntheses and characterization of advanced (nano)materials. FChT continued to implement an ERDF project focused on the modernization of instrumentation in the practical courses of technical study programmes in chemistry and on the modernization of SW in theoretical and practical courses.

The projects implemented at the faculty contributed to the improvement of the quality and modernization of instrumentation of the respective departments. In 2020, the investments associated with OP RDE projects amounted to 14 million CZK (533,435 EUR).

The faculty was also actively involved in the preparation and implementation of university-level OP RDE projects. The project *International mobility of researchers at the University of Pardubice* successfully continued. As a result of the project, selected research groups were joined by 3 foreign post-docs with experience from prestigious international institutions. One UPa researcher undertook a foreign visit. In 2020, the project *International mobility of researchers at the University of Pardubice II* was approved and its activities will be initiated in 2021. An ESF project continued in the area of increasing the quality and modernization of education, including a greater offer of courses in English. In 2020, two additional university-level projects continued with FChT participation focusing on improving the quality and modernization of education under the OP RDE ESF and ERDF for Higher Education Institutions II Calls. FChT also joined the university-level project of HR development strategy at the University of Pardubice (STROP).

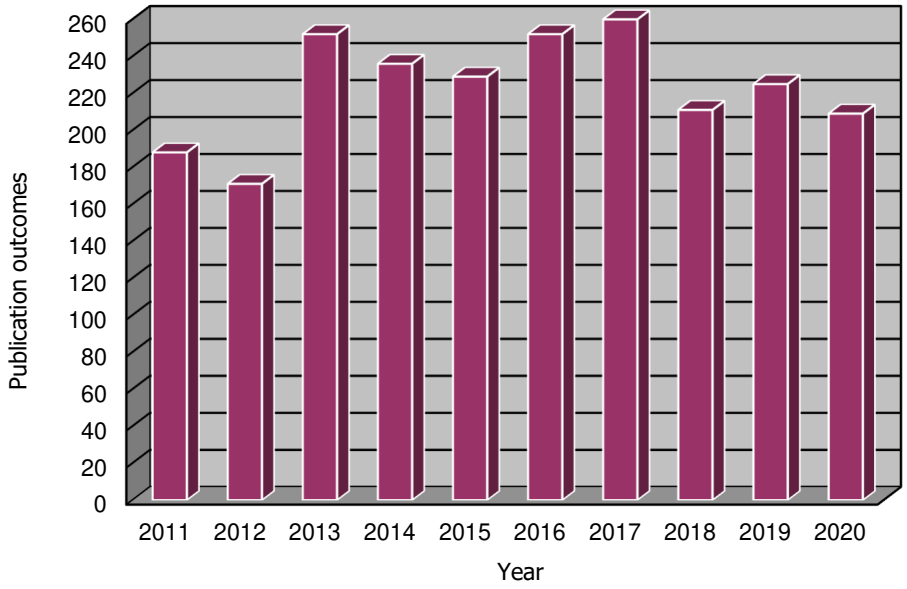
3.3 Publication Activity

The overall data on the publication activity of FChT in impacted journals between 2014 and 2020 and a detailed analysis of all publication activity of the faculty in 2019 are specified in the following tables.

Overview of the number of FChT publications in impacted journals in recent years

Year	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Number of $J_{imp.}$ publications	236	229	252	260	211	225	209

The outcomes of scientific and research activity of the faculty mainly included the publication of original results in scientific and scholarly journals as well as the presentation these results at conferences and symposia. The following graph shows a comparison of the most significant publication outcomes in the past ten years.



Summary of publication outcomes $J_{imp.}$ between 2011 and 2020

Overview of publication and other activity in 2020 by departments/institutes and result groups

Department	A1	A2	A3	A4	B1	B2	C	D	Total number of outcomes
KOAnCh	52	1	3	-	9	3	1	1	70
ÚOChT	27	1	-	-	3	16	-	7	54
KAlCh	30	3	9	2	4	18	2	1	69
KFCh	29	-	1	-	7	1	-	-	38
ÚEnviChI	17	-	4	2	2	6	1	2	34
ÚAFM	5	-	-	-	3	-	-	-	8
SLChPL	17	-	1	-	3	-	-	-	21
KEMCh	4	1	3	1	7	5	-	-	21
KAnT	5	-	2	-	-	12	-	1	20
ÚChTML	16	1	2	-	4	4	1	6	34
KBBV	24	2	1	1	3	9	1	1	42
KPF	14	-	-	-	1	1	1	2	19
ÚEnM	7	1	-	-	5	-	3	-	16
CEMNAT	38	2	1	-	2	4	1	-	48

Legend:

A1 Publication in a scholarly periodical listed in the WoS - J_{imp} database
A2 Publication in a scholarly periodical listed in the SCOPUS - J_{SC} database
A3 Publication in scientific papers proceedings
A4 Other publications Jost
B1 Papers at international scientific conferences
B2 Papers at national scientific conferences
C Monographs, selected chapters, learning texts, university textbooks
D Granted patents, utility models, open technologies

3.4 Scientific Events and Conferences

16th RANK Conference

The conference is a forum for the exchange and transfer of practical knowledge and experience, mainly in the field of routine analysis of both the human and extrahuman genome. It has become a traditional meeting of Czech and Slovak experts in the field of nucleic acids analysis by molecular-biological processes.

Host: Department of Biological and Biochemical Sciences
Date: 5–6 February 2020

21st CSIP-PM: Conference on Special Inorganic Pigments and Powder Materials

This conference focused on the preparation and exchange of new knowledge in the area of powder materials and inorganic pigments, their application, physical and chemical properties and methods for their evaluation, environmental aspects of production as well as the application of inorganic pigments. The results of scientific and research activity in the area of ceramics, ceramic surface treatment and heat-resistant materials were presented.

Host: Department of Inorganic Technology
Date: 24 September 2020

13th CONFERENCE ON PIGMENTS AND BINDERS (online)

The conference focused on pigments and their applications in the construction industry, paints and plastics as well as on organic binders for paints and the construction, inorganic binders for ceramics, construction, high temperature paints, etc. Attention was also on recently developed nanomaterials, special materials and technologies in the area of surface treatment.

Host: Institute of Chemistry and Technology of Macromolecular Materials, Department of Paints and Organic Coatings, CHEMAGAZÍN
Date: 2–3 November 2020

52nd National Colouristic Conference TEXCHEM – RegioTEX (online)

The current situation affected the main theme of the conference which was health protection and issues around Covid-19.

Host: STCHK – Association of Textile Chemists and Colourists Pardubice, Institute of Chemistry and Technology of Macromolecular Materials, Department of Synthetic Polymers, Fibers and Textile Chemistry
Date: 5–6 November 2020

4 Practical Cooperation

4.1 Practical Cooperation in Education

In the long-term, the faculty has been involved in practical cooperation with industrial enterprises through several basic activities. The same continued in 2020.

Practical cooperation in the area of education was achieved through:

- Placement of students of all forms of study in industrial enterprises and research institutions;
- Excursions of students in production enterprises, research institutions, and specialized departments;
- Student internships (mandatory internship defined by the study plan);
- Membership of experts from industry and research in the FChT Scientific Board;
- Membership of experts from industry and research in Doctoral Subject Area Boards;
- Appointment of experts from practice in State Final Examination Boards and Dissertation Committees;
- Lectures given by prominent experts from practice; this applies especially to courses in which students learn about real technological procedures and processes;
- Single lectures given by experts from practice for students of all levels of study.

In 2020, student placements in industrial enterprises took place especially in Synthesia, a.s., Pardubice and Výzkumný ústav organických syntéz, a.s., Pardubice. These placements allowed students to experience a broader spectrum of research and production. Students from the Department of Biological and Biochemical Sciences had their practical training in hospitals and healthcare institutions throughout the Czech Republic.

Completion of placements increases students' chances on the labour market after completion of their study.

4.2 Practical Cooperation in Science and Research

In 2020, the activities of the following joint institutes successfully continued:

- Joint Laboratory of Membrane Processes, MEGA, a.s., Stráž pod Ralskem and University of Pardubice (SLMP);
- Joint Laboratory of Polymer Analysis and Assessment, SYNPO, a.s., Pardubice and University of Pardubice, Faculty of Chemical Technology (SLAP);
- Joint Institution of Applied Medicine, Pardubice Hospital and Faculty of Chemical Technology (SPAM).

Further continuation of active work of these joint institutes remains vital for the development of research and scientific work of the faculty departments. The institutes are systematically involved in the scientific and research activities of the faculty and in the process of education. They are equipped with adequate instrumentations which is gradually renewed and upgraded. The SPAM joint institution successfully continues its activities, which remain focused on increasing the quality of the process of education in the master's degree programmes.

The faculty also cooperated with industrial enterprises, research institutions and hospitals. It would be impossible to list all of the partners involved in various projects of the faculty departments, both in basic or applied research, implemented by means of joint teams of investigators and additional activities. Undoubtedly, this form of collaboration in addressing the current problems in industrial and application practice also contributes to the scientific and research development of the faculty and its students and must be paid due attention.

In 2020, the Faculty of Chemical Technology participated in TA CR projects, projects funded by sectoral providers, and contract projects for a number of enterprises and research institutions. The following table presents an overview of joint applied research projects.

Cooperation of the faculty with enterprises and research institutions on joint projects

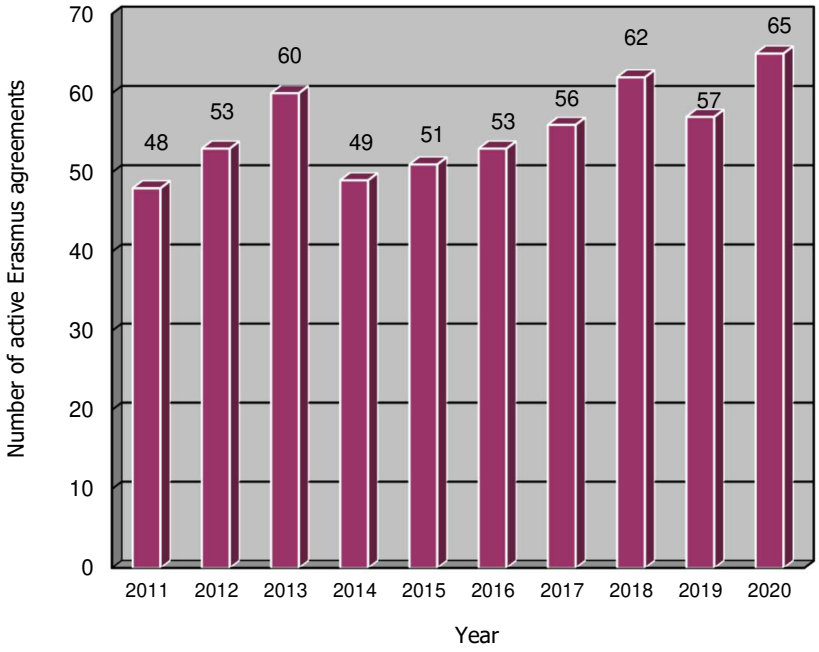
Partner firm/institution – projects funded by TA CR	Partner firm/institution – projects funded by sectoral providers
Aircraft Industries, a.s., Kunovice	Applycon, s.r.o., Dobřany
ASIO, s.r.o., Brno	Austis, a.s., Praha
Cayman Pharma, s.r.o., Neratovice	Barvy a laky TELURIA, s.r.o., Letovice
CEITEC, Brno	Bochemie, a.s., Bohumín
Centrum organické chemie, s.r.o., Pardubice	CICERO Stapro Group, s.r.o., Pardubice
COLORLAK, a.s., Staré Město	Color Spektrum, a.s., Hodonín
Contipro Pharma, a.s., Dolní Dobrouč	Czech Proof House for Arms and Ammunition, Praha
Česká membránová platforma, z.s., Česká Lípa	Ecocoal s.r.o., Ostrava
ČVUT Praha	Explosia, a.s., Pardubice
Diamo, s. p., Stráž pod Ralskem	Explosia, a.s., Pardubice, VÚPCh
EPS biotechnology, s.r.o., Kunovice	University Hospital Olomouc
Explosia, a.s., Pardubice	University Hospital Hradec Králové
FOTON, s.r.o., Nová Paka	Graz University of Technology
GALATEK, a.s., Ledeč nad Sázavou	Holding Contipro, a.s., Dolní Dobrouč
Holzbecher, s.r.o., barevna a bělidlo Zlíč	CHEMOTEX Děčín, a.s.
Honeywell Aerospace, s.r.o., Olomouc	Innogy Energo, s.r.o., Teplárna Náchod, Náchod
INOTEX, s.r.o., Dvůr Králové nad Labem	Masaryk Memorial Cancer Institute, Brno
Invaz, s.r.o., Trutnov	MEGA, a.s., Stráž pod Ralskem
K2pharm, s.r.o., Opava	MemBrain, s.r.o., Stráž pod Ralskem
Ligum, s.r.o., Jablonec nad Nisou	NOVATISK, a.s., Blansko
KOMFI, spol. s r.o., Lanškroun	Pardam, s.r.o., Roudnice nad Labem
Masarykova univerzita Brno	Pardubice Regional Hospital
MIT — Ministry of Industry and Trade of the Czech Republic	Poličské strojírny, a.s., Polička
OTK GROUP, a.s., Kolín	Departments of the Ministry of the Interior of the Czech Republic
OPTAGLIO, s.r.o., Husinec-Řež	SPUR, a.s., Zlín
PARDAM, s.r.o., Pardubice	Stavební chemie, a.s., Slaný
SOMA, s.r.o., Lanškroun	Synpo, a.s., Pardubice
SVÚOM, s.r.o., Praha	Synthesia, a.s., Pardubice
Synpo, a.s., Pardubice	ŠKODA AUTO, a.s., Mladá Boleslav
Synthesia, a.s., Pardubice	TOSEDA, s.r.o., Staré Čívice
Teramed, s.r.o., Praha	Charles University, Faculty of Medicine, Hradec Králové
UniCRE, Unipetrol výzkumně vzdělávací centrum, a.s., Ústí nad Labem	Institute of Analytical Chemistry, Czech Academy of Sciences, Brno
Tomáš Baťa University in Zlín	Institute of Macromolecular Chemistry, Czech Academy of Sciences, Prague
VITON, s.r.o., Veselí nad Lužnicí	UCT Prague, Faculty of Food and Biochemical Technology
UCT Prague, Faculty of Chemical Engineering	BUT Brno
UCT Prague, Faculty of Food and Biochemical Technology	Výzkumný ústav organických syntéz, a.s., Pardubice
BUT Brno	Crop Research Institute, Prague
Výzkumný ústav anorg. chemie, a.s., Ústí nad Labem	Výzkumný ústav stavebních hmot, a.s., Brno
Výzkumný ústav bramborářský, s.r.o., Havlíčkův Brod	
Forest and Game Management Research Institute, Opočno	
Výzkumný ústav organických syntéz, a.s., Pardubice	
Veterinary Research Institute, Brno	
VZLÚ, a.s., Praha-Letňany	
ZVVZ MACHINERY, a.s., Milevsko	

Partner firm/institution – contract research projects
ASIO, spol. s r. o., Brno
Austin Detonator, s.r.o., Vsetín
AVX Czech Republic, s.r.o., Lanškroun
Belmer, a.s., Litovel
BG SYS HT, s.r.o., Pardubice
BOCHEMIE, a.s., Bohumín
Contipro, a.s., Dolní Dobrouč
DEZA, a.s., Valašské Meziříčí
ECO-TREND PLUS, s.r.o., Praha
EKOMOR, s.r.o., Lískovec
Ekotech ochrana ovzduší, s.r.o., Všestary
EMS PATVAG, s.r.o., Brankovice
EOP Opatovice, a.s., Pardubice
Explosia, a.s., Pardubice
Fatra, a.s., Napajedla
GEOTEST, a.s., Brno
Glanzstoff Bohemia, s.r.o., Lovosice
GrapheneUP SE, Tuřany u Slaného
HE3DA, s.r.o., Praha
Huhtamaki Česká republika, a.s., Přibyslavice
Chemotex Děčín, a.s., Boletice nad Labem, Děčín
IQ Structures, s.r.o., Husineč - Řež
KRUŽÍK, s.r.o., Kroměříž
Lachepra, s.r.o., Pardubice
Lučební závody Draslovka, a.s., Kolín
ManukaMed Ltd. Partnership, Masterton, New Zealand
Metrohm, s.r.o., Praha
Mondi Štětí, a.s., Štětí
Orkla Foods Česko a Slovensko, Jinonice
Papcel, a.s., Litovel
PARDAM, s.r.o., Pardubice
PLEAS, a.s., Havlíčkův Brod
PRECHEZA, a.s., Přerov
SAINT GOBAIN ADFORS CZ, s.r.o., Litomyšl
SINPOL, s.r.o., Starý Kolín
SPM – Security Paper Mill, a.s., Praha
Synpo, a.s., Pardubice
ŠKODA AUTO, a.s., Mladá Boleslav
Tomil, s.r.o., Vysoké Mýto
Toray Textiles Central Europe, s.r.o., Prostějov
VCI Brasil Indústria Ltda., Bauru, São Paulo, Brazil
VÚOS, a.s., Pardubice
VVUÚ, a.s., Ostrava – Radvanice
Zentiva Group, a.s., Praha

5. International Cooperation

5.1 International Cooperation in Education

An important activity in the field of international cooperation of the faculty in the area of education and science is involvement of employees and students in the ERASMUS+ and CEEPUS programmes. The total number of inter-institutional agreements in 2020 was 65. In the framework of ERASMUS+, 2 teacher mobilities took place, 3 mobilities were prepared but did not take place due to force majeure (used amount 2,480.50 EUR) and 21 student mobilities lasting for a total of 63 months (42,226 EUR) took place. An overview of active agreements is shown in the figure below.



Overview of the number of active bilateral ERASMUS agreements concluded by FChT between 2011 and 2020

Involvement in Erasmus+ programme in 2020

Indicator	Erasmus 2018	Erasmus 2019	Erasmus 2020
Number of outgoing students	14	15	21
Number of incoming students	14	26	13
Number of outgoing academic employees	11	11	2
Number of incoming academic employees	7	3	2

Mobilities of students and academic staff including financial costs in 2020

	Students*			Academic employees*		
	Number of mobilities	Student/ month	Costs in EUR	Number of mobilities	Academic employees/ week	Costs in EUR
Total	21	63	42,226.0	2	2	2,480.50[1)]

*) EU funding
1) Total cost including 3 cancelled mobilities

Inter-institutional agreements with partner institutions (with some partners more than one agreement is concluded)

B	University College Arteveldehogeschool
D	Eberhard Karls Universität Tübingen
D	Friedrich-Schiller-Universität Jena
D	Technische Universität München
D	Technische Universität Chemnitz
DK	University of Southern Denmark
E	Universidad de Burgos
E	Universidad de Huelva
E	Universidad de Jaen
E	Universidad Jaume I
E	Universidad de Málaga
E	Universidad de Sevilla
E	University of the Balearic Islands
E	University of La Laguna
F	Université de Lorraine
F	Université des Sciences et Technologies de Lille I
F	Université de Rennes I
F	École Nationale Supérieure de Techniques Avancées Bretagne
G	University of West Attica (2 agreements)
G	National and Kapodistrian University of Athens
G	University of Piraeus
G	Agriculture University of Athens (2 agreements)
HR	University of Dubrovnik
HR	University of Zagreb
HU	University of Debrecen
HU	University of Dunaújváros
I	Universita Degli Studi di L'Aquilla
I	Universita Degli Studi di Modena e Reggio Emilia
I	University of Turin
LT	Kauno Kolegia
LT	Klaipeda University
LV	Riga Technical University
N	NTNU – Norwegian University of Science and Technology
NL	Hanzehogeschool Groningen
P	Universidade de Aveiro
P	University of Coimbra
P	Universidade da Madeira
P	Universidade do Minho
P	University of Viseu
PL	Akademia Górniczo-Hutnicza im. Stanisława Staszica w Krakowie
PL	Uniwersytet Łódzki
PL	Uniwersytet Mikołaja Kopernika w Toruniu
PL	Uniwersytet Marii Curie-Skłodowskiej (2 agreements)
PL	Uniwersytet Rolniczy im. Hugona Kołłątaja w Krakowie
PL	Zachodniopomorski Uniwersytet Technologiczny w Szczecinie
PL	Military University of Technology
RO	Universitatea Transilvania din Brasov
RO	Military Technical Academy of Bucharest
RO	University of Craiova
RS	University of Novi Sad
S	Umea University

SF	Abo Akademi Turku
SI	Univerza v Ljubljani (2 agreements)
SK	Technical University of Košice (2 agreements)
SK	Slovak University of Technology in Bratislava (2 agreements)
TR	Ankara University
TR	Canakkale Onsekiz Mart University
TR	Marmara University
TR	Mersin University

In 2020 the faculty was involved in two networks under the CEEPUS programme ("Central European Exchange Program for University Studies"). The mobilities are specified below.

Mobilities of students and academic staff including financial costs in 2020 under the CEEPUS programme

Programme	CEEPUS 2016	CEEPUS 2017	CEEPUS 2018	CEEPUS 2019	CEEPUS 2020
Number of projects	3	4	3	2	2
Number of outgoing students	2	1	4	0	0
Number of incoming students	2	13	6	19	4
Number of outgoing academic employees	4	2	16	5	1
Number of incoming academic employees	6	10	21	19	1
Funding EUR	5,666	13,465[1]	16,327[2]	17,965[3]	6,344[4]

1) Of which 12,933 EUR incoming – FChT contract, 532 EUR outgoing – Rector's Office contract
2) Of which 13,913 EUR incoming – FChT contracts, 2,414 EUR outgoing – Rector's Office contract
3) Of which 16,970 EUR incoming – FChT contracts, 997 EUR outgoing – Rector's Office contract
4) Of the total allocated amount of CZK 166,513 (approx. 6,344 EUR): used 3,505 EUR – FChT contract, 2,743 EUR transferred to FChT fund, 96 EUR – Rector's Office contract

In 2020 FChT had two CEEPUS networks:

- CIII-CZ-0212 - Ing. Radovan Metelka, Ph.D.
- CIII-RS-0704 - Ing. Ondrej Panák, Ph.D.

5.2 International Cooperation in Research and Development

The faculty is involved in research and development programmes aimed at the development of international cooperation. The faculty investigates and applies for projects funded by both domestic providers to promote bilateral cooperation and grants from international providers. Specifically, in 2020 the faculty investigated two projects funded under Horizon 2020 – EU Framework Programme for Research and Innovation.

European Research Council (ERC) Project

Since 2015 FChT has been a host institution of the prestigious European Research Council grant for excellent young scientists (ERC Starting grant) who demonstrate significant potential of independence and a convincing original scientific plan. Research activities under the CHROMTISOL grant focus on a new generation of hybrid photovoltaic cells which will ensure more efficient conversion of solar energy to electrical energy. The total amount of support awarded under Horizon 2020 amounts to 1,7 million EUR.

New materials and processing in organic electronics (MADRAS)

The second project funded by Horizon 2020 is a consortium project called *New materials and processing in organic electronics (MADRAS)*. Under this project the faculty cooperates with 11 European partners from Spain, France, the Netherlands and Denmark under the leadership of the Eurecat Technology Centre in Spain. The project addresses the need for the development and use of new materials for the manufacture of new generation intelligent products in the area of organic and large-scale electronics.

The faculty continues solid cooperation with a number of foreign institutes. In view of the current situation and the restrictions resulting from the Covid-19 pandemic, cooperation was transformed to the online form. Some of the planned international travel and visits of foreign teams was postponed and moved to the following year. The mobility of the employees of the Faculty in the context of international cooperation required, inter alia, costs for international travel, which in 2020 amounted to **19,889 EUR**. Their amount is significantly influenced by the global spread of the Covid-19 virus.

Payment of international travel (in EUR)

Year	2014	2015	2016	2017	2018	2019	2020
Costs of international travel	352,101	243,478	228,090	207,087	254,927	252,538	19,889

The structure of the sources used to cover international travel in 2020 is shown in the following table.

Sources of financing of international travel in 2020

Source of financing	Funding in EUR
Basic funding (including participation in ZG and KO), development of research organization	8,497
Specific science	2,629
Developmental projects MEYS	-
Other main activities	495
Other science MEYS	-
R+D – GA CR	1,219
R+D – Extra-budgetary grants	-
R+D – Foreign grants	991
R+D – Other types of scientific cooperation	-
OP RDE	6,058
Licence study	-
Contract research	-
Total	**19,889**

Last year, the faculty implemented programmes to support international collaboration in science and research, which significantly contributed to increasing the quality of scientific and research work. An overview of the projects is shown in following table.

International science and research collaboration projects

Project Number	Investigator	Funding in EUR	Provider/Programme
EHP-BFNU-OVNKM-3-134-01-2020	Tetřevová Liběna, Doc. Ing. Ph.D.	the whole amount moved to 2021	Ministry of Finance/EEA and Norway grants
638857	Macák Jan, Dr.-Ing.	90,679	EU/Horizont2020
862492	Syrový Tomáš Doc. Ing. Ph.D.	49,986	EU/Horizont2020
EHP-CZ-ICP-1-002	Vávra Jan, Ing., Ph.D.	44,369	DZS/EEA and Norway grants
8JCH1003	Syrový Tomáš, Doc. Ing., Ph.D.	the whole amount moved to 2021	MEYS/Czech-Chinese Mobility Programme
LTAIN19101	Bureš Filip Prof. Ing. Ph.D.	55,439	MEYS/Czech-Indian Mobility Programme

A considerable share of international activities of the faculty and its departments is represented by agreements on cooperation concluded with foreign universities and institutions.

Agreements concluded between the Faculty of Chemical Technology and foreign universities and institutions

Foreign University/Institution	City	Country	Date of conclusion of agreement
Karl-Franzens Universität	Graz	Austria	1993
South Valley University	Qena, Aswan	Egypt	2001
Eberhard-Karls-Universität Tübingen	Tübingen	FRG	2004
National Institute of Chemistry	Ljubljana	Slovenia	1994
University of Ljubljana	Ljubljana	Slovenia	1998
Technical University of Szczecin (currently West Pomeranian University of Technology)	Szczecin	Poland	1998
Military University of Technology	Warsaw	Poland	2000
Technical University of Košice	Košice	Slovakia	2000
Institute of Industrial Organic Chemistry	Warsaw	Poland	2001
Institute of Chemistry	Vilnius	Lithuania	2001
M.V. Lomonosov Moscow State Academy of Fine Chemical Technology	Moscow	Russia	2002
China Academy of Engineering Physics	Mianyang	China	2004
National Institute for Material Science	Tsukuba	Japan	2009
Kumamoto University	Kumamoto	Japan	2015
Xian Modern Chemistry Research Institute	Xi'an	China	2015
Austin Peay State University	Clarksville	USA	2013
Tennessee Tech University	Cookeville	USA	2016
Matsumoto University	Matsumoto	Japan	2006
Alexander Dubček University of Trenčín	Trenčín	Slovakia	2011
Institute of Optical Materials and Technologies	Sofia	Bulgaria	2017

These agreements resulted in many projects supporting especially teacher and student mobility. In addition to agreements concluded by the faculty, there are university agreements concluded for example with the University of Rennes I, Rennes, France, Belarusian State Technological, Minsk, Belarus, Toyota Technological Institute, Nagoya, Japan, Friedrich-Schiller-Universität, Jena, Germany, Saint-Petersburg University, Russia, Nanyang Technological University, Singapore, Alexander Dubček University of Trenčín, Slovakia, Kyoto Prefectural University of Medicine, Kyoto, Japan, Yeungnam University,

Gyeongsan, Republic of Korea, Gulbarga University, Karnataka, India, VNU-University of Sciences, Hanoi, Vietnam, Institute of Chemistry – Vietnam Academy of Science and Technology, Hanoi, Vietnam, who also cooperate with a number of departments and institutes at FChT.

6. Projects and Grants Implemented at FChT

6.1 GA CR, TA CR, IDC and Other Departmental Projects

Department of General and Inorganic Chemistry

Project Number	Project title	Provider	Investigator for FChT UPa
GA CR Projects			
18-01976S	New prospective phosphate and borophosphate glasses and glass-ceramics	GA CR	Mošner Petr, Prof. Ing., Dr.
18-10222S	From simple precursors to unprecedented heterocyclic systems containing heavier Group 15 elements	GA CR	Dostál Libor, Doc. Ing., Ph.D.
18-12761S	Thermoelectric magnetic sulfides	GA CR	Kucek Vladimír, Ing., Ph.D.
19-11814S	Laser micro-patterning of the high-refractive index glasses	GA CR	Knotek Petr, Ing., Ph.D.
19-17156S	Chemistry of globular shaped hydrocarbons with boron-cage scaffolding inside the methylated sheath	GA CR	Růžičková Zdeňka, Ing., Ph.D.
20-10417S	Auto-ionizated main group cations as catalysts for ring-opening polymerization reactions	GA CR	Jambor Roman, Prof. Ing., Ph.D.
TA CR Projects			
TH02010197	Modern cyclization reactions	TA CR	Jambor Roman, Prof. Ing., Ph.D.
TH04010080	Functional dyes for security printing	TA CR	Růžička Aleš, Prof. Ing., Ph.D.
TH04010146	Polyglycerine production and its utilisation at the production of alkyds, polyesters and polyurethanes	TA CR	Růžička Aleš, Prof. Ing., Ph.D.
GAMA2-02/004	Lactic acid derivatives for disinfection applications	TA CR	Olejník Roman, Ing., Ph.D.
Ministry of Industry and Trade Projects			
FV10240	Catalyzed aerobic oxidation in the industry	MIT	Jambor Roman, Doc. Ing. Ph.D.
FV40362	Production technology for vinylchloroformate for advanced materials	MIT	Růžička Aleš, Prof. Ing., Ph.D.
Internal Development Competition Projects			
IRS 2020_039	Modernization of student laboratory for synthesis of organometallic compounds	MEYS	Vinklárek Jaromír, Prof. Ing., Dr.

Department of Economy and Management of Chemical and Food Industry

Project Number	Project title	Provider	Investigator for FChT UPa
Other projects			
EHP-CZ-ICP-1-002	Innovation of education methods and skills at the University of Pardubice - INEMSUP	DZS	Vávra Jan Ing.,Ing., Ph.D.

Institute of Chemistry and Technology of Macromolecular Materials

Project Number	Project title	Provider	Investigator for FChT UPa
TA CR Projects			
GAMA2-01/003	New hydrogen peroxide stabilizers	TA CR	Burgert Ladislav, doc. Ing., CSc.
GAMA02/008	New ecological drying systems based on complex vanadium compounds	TA CR	Kalenda Petr, Prof. Ing., CSc.
Ministry of Industry and Trade Projects			
FV40136	Innovative increase of the utility properties and resistance of ammunition from combustible mass	MIT	Filipi Michaela, Ing., Ph.D.
Internal Development Competition Projects			
IRS 2020_021	Study of anticorrosive resistance of pigmented coatings by potentiodynamic measurements	MEYS	Kohl Miroslav, Ing., Ph.D.

Institute of Applied Physics and Mathematics

Project Number	Project title	Provider	Investigator for FChT UPa
GA CR Projects			
19-16315S	Exploration of electronic states of transition metals in tetradymites and their band structure – comparison of 3d, 4d and 5d elements	GA CR	Navrátil Jiří, Ing., CSc.
GA19-13659S	Interfaces between Fe-chalcogenide thin films and insulators: impact on structure, magnetism, and unconventional superconductivity	GA CR	Drašar Čestmír, Prof. Ing., Dr.
Internal Development Competition Projects			
IRS 2020_012	Innovation and attractiveness of physical exercises of the Laboratory of Physics	MEYS	Sajdlová Světlana, Mgr./ Drašar Čestmír, Prof. Ing., Dr.

Institute of Organic Chemistry and Technology

Project Number	Project title	Provider	Investigator for FChT UPa
GA CR Projects			
18-03847S	Pseudopeptide proteasome inhibitors	GA CR	Imramovský Aleš, Doc. Ing., Ph.D.
18-03881S	Selenide-based 2D nanomaterials by atomic layer deposition with exciting properties	GA CR	Bureš Filip, Prof. Ing., Ph.D.
19-22783S	Molecular materials: towards breaking Shockley-Queisser limit	GA CR	Imramovský Aleš, Doc. Ing., Ph.D.
TA CR Projects			
GAMA2-01/002	New wound covers for chronic wounds	TA CR	Hrdina Radim, Prof. Ing., CSc.
Ministry of Industry and Trade Projects			
FV30048	New additives for multifunctional modification of polymer surfaces	MIT	Hrdina Radim, Prof. Ing., CSc.
MEYS projects			
LTAIN19101	Carbon-conjugated 2D-covalent organic frameworks based on alternative D-A-D/A-D-A systems with exceptional optoelectronic properties	MEYS	Bureš Filip, Prof. Ing., Ph.D.
OP RDE Projects			

CZ.02.1.01/0.0/0.0 /16_025/0007445	Organic redox couple-based batteries for energetics of traditional and renewable resources	MEYS	Bureš Filip, Prof. Ing., Ph.D.

Department of Analytical Chemistry

Project Number	Project title	Provider	Investigator for FChT UPa
GA CR Projects			
18-12204S	Characterization of human lipidome and metabolome for personalized healthcare and biomarker discovery: case study of kidney cancer	GA CR	Holčapek Michal, Prof. Ing., Ph.D.
18-14893S	Focusing effects in multidimensional liquid phase separations	GA CR	Česla Petr, Doc. Ing., Ph.D.
19-03160S	Electrochemical study on new artificial enzymes and their role in sensing of neurotransmitters	GA CR	Mikysek Tomáš, Ing., Ph.D.
20-23290Y	Supercritical fluid chromatography hyphenated to mass spectrometry for the absolute quantitation of ionic and polar biomolecules	GA CR	Wolrab Denise, Dr.
Internal Development Competition Projects			
IRS 2020_048	Potentiometry with ion-selective electrodes	MEYS	Mikysek Tomáš, Ing., Ph.D.
TA CR Projects			
GAMA2-01/009	Early detection of pancreatic cancer based on the lipidomic analysis of blood samples using mass spectrometry	TA CR	Holčapek Michal, Prof. Ing., Ph.D.
Ministry of the Interior (MI) Grants			
VI20152020004	Identification of residues of improvised explosives using physico-chemical analytical methods under real conditions	MI	Ventura Karel, Prof. Ing. CSc.

Department of Biological and Biochemical Sciences

Project Number	Project title	Provider	Investigator for FChT UPa
GA CR Projects			
GA19-11867S	Research on toxicity mechanism of S-conjugates of aminophenolic drugs	GA CR	Roušar Tomáš, Doc. RNDr.,Ph.D.
Internal Development Competition Projects			
IRS 2020_008	Differentiation and determination of nucleic acids (introduction of new laboratory exercise of biochemistry)	MEYS	Štěpánková Šárka, Mgr., Ph.D.
IRS 2020_031	Implementation of modern laboratory exercises in newly designed immunological subjects	MEYS	Slováková Marcela, Mgr., Ph.D.
TA CR Projects			
TJ02000134	Removal of polyfluorinated acids from contaminated materials using chemical degradation	TA CR	Šilha David, Ing., Ph.D.
OP RDE Projects			
CZ.02.1.01/0.0/0.0 /17_048/0007421	Strengthening of interdisciplinary cooperation in the research of nanomaterials and their effects on living organisms	MEYS	Bílková Zuzana, Prof. RNDr., Ph.D.

CZ.02.1.01/0.0/0.0 /18_069/0010054	IT4Neuro	MEYS	Roušar Tomáš, Doc. RNDr., Ph.D.

Institute of Environmental and Chemical Engineering

Project Number	Project title	Provider	Investigator for FChT UPa
GA CR Projects			
20-01589S	New strategies for improving sensing properties of novel electrode materials via their surface pretreatment or modification	GA CR	Šelešovská Renáta, Doc. Ing., Ph.D.
TA CR Projects			
TH02030823	Development of methodological-technical procedures, minimizing the impacts of forest management on the quality of groundwater as a result of the migration of excess reactive nitrogen and phosphorus	TA CR	Slezák Miloslav, Ing., CSc.
TH03030260	Biocomposite component for slow release of active minerals in soil for plant nutrition	TA CR	Slezák Miloslav, Ing., CSc.
TJ04000226	Combined procedure of elimination of chloroacetanilide pesticides from contaminated water and soil	TA CR	Peroutková Petra, Ing.
GAMA2-01/005	Removal of dangerous compounds from contaminated waste applicable for recycling according to the circular economy	TA CR	Weidlich Tomáš, Doc. Ing., Ph.D.
GAMA2-02/003	Increasing of resistivity of textile face covers by impregnation using virucidal preparation	TA CR	Weidlich Tomáš, Doc. Ing., Ph.D.
Ministry of Industry and Trade Projects			
FV40062	Zero liquid discharge of industrial waste water using electrodialysis	MIT	Doleček Petr, Doc. Ing., CSc.
Internal Development Competition Projects			
IRS 2020_032	Preparation of study course – Sustainable Chemistry – for students of Faculty of Chemical Technology	TA CR	Weidlich Tomáš, Doc. Ing., Ph.D.

Joint Laboratory of Solid State Chemistry

Project Number	Project title	Provider	Investigator for FChT UPa
TA CR Projects			
TH02020201	New generation of functionally modified layered nanoparticles with improved manipulation and processing in polymeric matrix	TA CR	Beneš Ludvík, Doc. Ing., CSc.

Institute of Energetic Materials

Project Number	Project title	Provider	Investigator for FChT UPa
Ministry of Industry and Trade Projects			
FV40140	Perspective methods of production and testing of emulsion explosives	MIT	Pachman Jiří, Doc. Ing., Ph.D.
TA CR Projects			

TH03020263	Propellants with increased specific impulse	TA CR	Matyáš Robert, Doc. Ing., Ph.D.
Internal Development Competition Projects			
IRS 2020_025	Laboratory practice: Schlieren technique for flow visualization	MEYS	Pachman Jiří, Doc. Ing., Ph.D.

Department of Physical Chemistry

Project Number	Project title	Provider	Investigator for FChT UPa
GA CR Projects			
20-02183Y	Kinetic processes in chalcogenide bulks and thin films – correlation between crystal growth, viscosity and self-diffusion	GA CR	Barták Jaroslav, Ing., Ph.D.
20-12735S	Exploring zeolites with nanoscale architecture: Synergy between experiment and theory	GA CR	Bulánek Roman, Prof. Ing., Ph.D.
20-09914S	Heterojunction photocatalysts and simultaneously metal and non-metal doped TiO_2 photocatalysts for environmental photocatalytic reactions	GA CR	Čapek Libor, Prof. Ing., Ph.D.
19-00669S	The relations between activity and structure of Mg-Al/Fe mixed oxides including post-treatment for transesterification and Guerbet reaction	GA CR	Hájek Martin, Doc. Ing., Ph.D.
19-19542S	A structure-based predictive model for Brønsted acid catalyzed reactions	GA CR	Bulánek Roman, Prof. Ing., Ph.D.
19-22978S	Quantifying the basicity of reconstructed layered double hydroxides and correlating this with their performance in base-catalysed reactions	GA CR	Čapek Libor, Prof. Ing., Ph.D.
Internal Development Competition Projects			
IRS 2020_030	Surface tension study in melts and undercooled melts of amorphous materials	MEYS	Barták Jaroslav, Ing., Ph.D.

Department of Graphic Arts and Photophysics

Project Number	Project title	Provider	Investigator for FChT UPa
GA CR Grants			
18-03823S	Advanced methods of fabrication of chalcogenide thin films and their modifications	GA CR	Němec Petr, Prof. Ing., Ph.D.
19-24516S	Chalcogenide films doped with rare-earth ions for gas sensing in the mid-infrared spectral region	GA CR	Nazabal Virginie, Doc., Dr.
TA CR Projects			
GAMA2-01/007	Development of UV curable inkjet varnish by UV LED technology	TA CR	Jašúrek Bohumil, Ing., Ph.D.
Ministry of Industry and Trade Projects			
FV20137	Research and development of a system to support Lean Manufacturing for production processing technology in the printing industry	MIT	Němec Petr, Prof. Ing., Ph.D.
FV30065	Research and development of the integration of telemetric and analytical processes into the management of	MIT	Němec Petr, Prof. Ing., Ph.D.

	polygraphic production and the implementation of elements of industry 4.0		
Ministry of Agriculture Projects			
QK1810010	SMARTFIELD - Autonomous acquisition of temperature and moisture data of microclima and earth for smart farming based on platform IoT	MA	Syrový Tomáš, Doc. Ing., Ph.D.
MEYS projects			
8JCH1003	Gravure-printed ammonia sensor based on 3D RGO	MEYS	Syrový Tomáš, Doc. Ing., Ph.D.

Centre of Materials and Nanotechnologies

Project Number	Project title	Provider	Investigator for FChT UPa
GA CR Grants			
19-17997S	Amorphous to crystal (3D2D) transition in van der Waals bonded chalcogenide materials	GA CR	Krbal Miloš, Ing., Ph.D.
GC20-23392J	Engineering of glass formation and photoinduced property modification of hybrid amorphous chalcogenides via controlled content of lone-pair electrons	GA CR	Krbal Miloš, Ing., Ph.D.
MEYS projects			
LM2018103	CEMNAT Research Infrastructure	MEYS	Vlček Miroslav, Prof. Ing., CSc.
OP RDE Projects			
CZ.02.1.01/0.0/0.0/ 16_013/0001829	Modernization and upgrade of the CEMNAT infrastructure	MEYS	Vlček Miroslav, Prof. Ing., CSc.
CZ.02.1.01/0.0/0.0/ 17_048/0007376	High-sensitivity sensors and low-density materials based on polymeric nanocomposites-NANOMAT	MEYS	Vlček Miroslav, Prof. Ing., CSc.

Faculty projects

Project Number	Project title	Provider	Investigator for FChT UPa
OP RDE Projects			
OP RDE - PRAKTIK: CZ.02.2.67/0.0/0.0/ 16_016/0002458	Modernization of practical teaching and innovation of practical skills in technically focused study programs	MEYS	Čapek Libor, Prof. Ing., Ph.D.

Student Grant Competition (SGC) projects at FChT in 2020

Project Number	Project title	Provider	Investigator for FChT UPa
SGC FCHT 2020			
SGS_2020_002	Modern instrumental methods in analysis of materials, food and biological samples	UPa	Ventura Karel, Prof. Ing., CSc.
SGS_2020_003	Research in selected areas of environmental engineering and modern value management procedures	UPa	Mikulášek Petr, Prof. Ing., CSc.
SGS_2020_004	Research and development of new organic materials – From synthesis and characterization to their potential application and safe handling	UPa	Hanusek Jiří, Prof. Ing., Ph.D.

SGS_2020_005	Modern analytical, molecular biological, microbiological and cytological methods for analysis of biological samples	UPa	Kanďár Roman, Prof. Mgr., Ph.D.
SGS_2020_006	Synthesis and study of perspective inorganic materials	UPa	Koudelka Ladislav, Prof. Ing., DrSc.
SGS_2020_007	Synthesis and properties study of macromolecular and supramolecular materials	UPa	Novák Miroslav, Ing., Ph.D.
SGS_2020_008	Research of prospective materials for chemical and pharmaceutical technology and other applications	UPa	Komersová Alena, Doc. Ing., Ph.D.

6.2 European Research Council (ERC) Project

Centre of Materials and Nanotechnologies

Project Number	Project title	Provider	Investigator for FChT UPa
ERC			
638857	Towards new generation of solid-state photovoltaic cell: Harvesting nanotubular titania and hybrid chromophores - CHROMTISOL	EU	Macák Jan, Dr.-Ing.

6.3 Involvement in Other Projects under Framework EU Programme

Department of Graphic Arts and Photophysics

Project Number	Project title	Provider	Investigator for FChT UPa
862492	New materials and processing in organic electronics (MADRAS)	EU	Syrový Tomáš, Doc. Ing., Ph.D.

7. Academic Staff

This chapter specifies the number of academic staff of the faculty in recent years and at the end of 2020. For comparison, the numbers of other employees are shown as well. The tables also suggest the qualification and age structure of the faculty teachers and trends of relevant indicators.

Recalculated number of FChT employees from 2016 until the end of 2020 (each year as of 31 December)

Year	Educational staff	Scientific staff	Other staff				Total
			Technical experts, laboratory technicians	Administration TES	Workers	Total	
2020	171.5	66.2	43.4	35.0	6.0	84.4	322.1
2019	168.4	64.3	44.5	34.9	6.0	85.4	318.1
2018	168.8	54.2	43.6	34.4	6.0	84.0	307.0
2017	169.9	51.4	46.6	31.3	6.2	81.1	302.4
2016	171.7	48.3	43.4	28.5	6.2	78.1	298.1

Qualification structure of educational staff as of 31 December of the relevant year

Working position	2016		2017		2018		2019		2020	
	F	P	F	P	F	P	F	P	F	P
Professors	40	33.8	40	34.1	42	36.8	40	36.1	38	34.9
Associate professors	44	42.5	45	42.3	45	41.9	47	42.4	51	45.8
Assistant professors	91	89.0	90	87.5	87	84.5	86	84.4	87	84.9
Assistants	9	6.5	9	6.0	8	5.6	9	5.5	9	5.9
Total	**184**	**171.8**	**184**	**169.9**	**182**	**168.8**	**182**	**168.8**	**185**	**171.5**

Note: F – physical number, P – recalculated number

Age structure of educational staff as of 31 December 2020 (number of persons)

Age	Educational staff			
	Professors	Associate professors	Assistant professors	Assistants
Less than 29 years	0	0	2	3
30–39 years	0	1	23	5
40–49 years	8	29	43	0
50–59 years	10	8	13	0
60–69 years	12	8	6	1
More than 70 years	8	5	0	0

Average age in the groups of academic staff in recent years

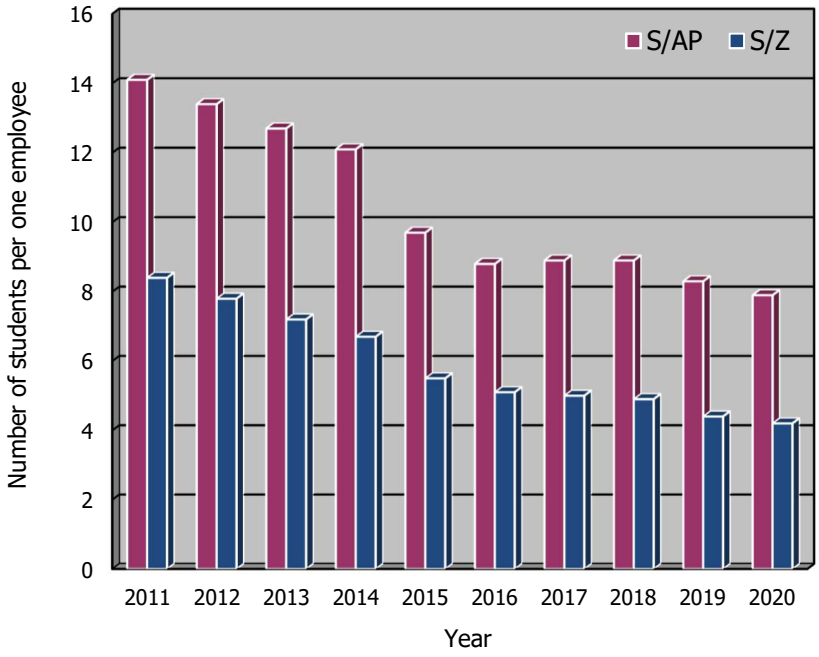
Age	Educational staff				Researchers
	Professors	Associate professors	Assistant professors	Assistants	
Average age 2016	62.2	50.2	42.0	36.2	36.3
Average age 2017	62.2	50.8	42.5	35.6	37.3
Average age 2018	60.8	51.8	43.1	35.7	38.3
Average age 2019	61.3	52.3	43.8	36.7	38.2
Average age 2020	60.2	51.8	44.2	35.9	37.3

Average age of academic staff from 2014 until the end of 2020

Year		2014	2015	2016	2017	2018	2019	2020
Average age	Educational staff	47.0	47.7	48.0	48.7	49.2	49.5	49.2
	Researchers	35.5	36.4	36.3	37.3	38.3	38.2	37.3

Number of students (S) for 1 average recalculated teacher (AP) and for 1 average recalculated employee (Z) of the Faculty

Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
S/AP	14.1	13.4	12.7	12.1	9.7	8.8	8.9	8.9	8.3	7.9
S/Z	8.4	7.8	7.2	6.7	5.5	5.1	5.0	4.9	4.4	4.2



Number of students (S) per one teacher (AP) and number of students per one employee of the faculty (Z) in recent years

Habilitation procedure and professor appointment procedure

List of areas for habilitation procedure and professor appointment procedure

Names of areas for habilitation procedure and professor appointment procedure	Validity of accreditation
Analytical chemistry	until 1 November 2023
Inorganic chemistry	until 1 November 2023
Organic chemistry	until 1 November 2023
Physical chemistry	until 1 November 2023
Chemical engineering	until 1 November 2023
Chemistry and technology of inorganic materials	until 1 November 2023
Technology of organic substances	until 1 November 2023
Surface engineering	until 31 May 2024
Environmental chemistry and engineering	until 12 November 2029

Ongoing habilitation proceedings in 2020

Surname, first name, title	Faculty	Field of expertise	Result of procedure
Krupka Miloslav, Ing., Dr.	FChT	Technology of organic substances	in progress
Večeřa Miroslav, Ing., CSc.	FChT	Technology of macromolecular substances	in progress

Associate professors appointed in 2020

Surname, first name, title	Faculty	Field of expertise	Effect of appointment
Janíček Petr, RNDr. Ph.D.	FChT	Surface engineering	1 January 2020
Bouška Marek, Ing. Ph.D.	FChT	Surface engineering	1. April 2020
Veselý David, Ing. Ph.D.	Tomas Bata University in Zlín	Technology of macromolecular substances	1 August 2020

Ongoing professor appointment procedures in 2020

Surname, first name, title	Faculty	Field of expertise	Result of procedure
Čermák Jan, Doc. Ing. CSc.	Faculty of Science, JEPU Ústí nad Labem	Organic chemistry	completed
Kolská Zdeňka, Doc. Ing. Ph.D.	Faculty of Science, JEPU Ústí nad Labem	Surface engineering	in progress
Imramovský Aleš, Doc. Ing. Ph.D.	FChT	Technology of organic substances	in progress
Krejčová Anna, Doc. Ing. Ph.D.	FChT	Environmental chemistry and engineering	in progress

Professors appointed in 2020

Surname, first name, title	Faculty	Field of expertise	Effect of appointment
Pouzar Miloslav, Doc. Ing. Ph.D.	FChT	Environmental and Chemical Engineering	15 December 2020

8. Quality and Culture of Academic Life

At the 70th anniversary of higher chemical education in Pardubice, the **Silver Medal for outstanding work for the faculty** was issued. In 2020, the Dean of the Faculty of Chemical Technology awarded the medal to the team of employees and doctoral students of the Department of Biological and Biochemical Sciences who tested samples of indicated Covid-19 patients in collaboration with the Pardubice Regional Hospital.

Members of the test team:

Jankovičová Barbora, Mgr. Ph.D.
Čukanová Renáta, Bc.
Fousová Ivana, Bc.
Kňavová Jana
Michalcová Lucie, Ing.
Mannová Nikola, Mgr.

Academic ceremonies at FChT in 2020

Following the emergency measures related to the spread of Covid-19, all academic ceremonies at the faculty in 2020 were cancelled.

There was no graduation ceremony of the 122 graduates of the follow-up master's degree who completed the required board exams, defended their master's diploma theses and successfully completed their study at our faculty.

There was no pledge of the 163 graduates of bachelor's degree who completed the required board exams and defended their bachelor's theses.

Due to the continuing anti-epidemic measures, there was no official matriculation of students who enrolled in the first year of bachelor's degree at the Faculty of Chemical Technology.

Appreciation of FChT employees for their work in 2020

Prof. Ing. Michal Holčapek, Ph.D.
Power List 2020 Award for the world's 60 most influential scientists in analytical chemistry (The Analytical Scientist), October 2020.

Included in the list of "World's top 2% most cited scientists" issued by Stanford University and Elsevier.

Prof. Ing. Filip Bureš, Ph.D.
Prof. Ing. Pavel Jandera, DrSc.
Dr.-Ing. Jan Macák,
Prof. Ing. Jiří Málek, DrSc.
Ing. Roman Svoboda, Ph.D.
Prof. Ing. Svatopluk Zeman, DrSc.

Included in the list of "World's top 2% most cited scientists" issued by Stanford University and Elsevier.

9. Activities of the Faculty and Other Affiliates

The main activities of the Faculty focus on education, science and research. These activities are described in detail in Chapters 2 and 3 of this Annual Report. This section describes only those activities that support or develop the main activities of the faculty or those that provide the conditions necessary for further development of the faculty.

9.1 Publishing

An overview of university textbooks and monographs issued at FChT in 2020 is provided in Chapter 2.7 of this Annual Report. In 2020, the following proceedings were issued.

1. Scientific Papers of the University of Pardubice, Series A, Faculty of Chemical Technology, Volume 26 (2020), 85 copies.
2. Proceedings of the 23rd Seminar on New Trends in Research of Energetic Materials, 50 copies + 8 pcs CD-ROM + 250 pcs USB.
3. 22nd Conference on Special Inorganic Pigments and Powder Materials, 44 pcs CD-ROM.
4. Students' scientific activity 2019/20 – Proceedings, 122 copies.
5. VITATOX 2020 – Proceedings, 70 copies.
6. Pardubice Chemistry Labyrinth over the Course of 70 Years, 500 copies.

In total, the FChT published 6 titles, 827 copies + 52 pcs CD-ROM + 250 pcs USB.

9.2 Service Departments at FChT

In 2020 the Faculty of Chemical Technology operated a number of service departments that provided their services both to the faculty and entities outside the faculty. The service departments are specified below (the abbreviations in brackets identify the institutes of the Faculty where the service department is established).

- Centre of statistical analyses using SW IBM SPSS Statistics (KEMCh)
- Physical-mechanical testing laboratory for plastics, composite and textile materials (ÚChTML)
- Assessment of the properties of paper, cardboard, paperboard and cellulose (ÚChTML)
- Thermoanalytical laboratory (KAnT)
- AFM microscopy laboratory (SLChPL)
- Water analysis laboratory (ÚEnviChI)
- Centrifugal spinning laboratory (CEMNAT)
- Electron microscopy and x-ray analysis laboratory (SLChPL and KOAnCh)
- Electron microscopy, x-ray analysis, FIB and electron lithography laboratory (CEMNAT)
- Electron paramagnetic resonance laboratory (KOAnCh)
- FTIR and Raman spectroscopy laboratory (SLChPL)
- Infrared and Raman spectroscopy energetic materials laboratory (ÚEnM)
- Dispersion system analysis laboratory (ÚEnviChI)
- Pigments and powder material analysis laboratory (KAnT)

- Thermoelectric material analysis laboratory (SLChPL)
- Infrared spectroscopy laboratory (CEMNAT)
- Nuclear magnetic resonance laboratory (ÚOChT)
- Organic elemental analysis laboratory (ÚOChT)
- Powder x-ray diffractometry laboratory (KOAnCh)
- Raman and infrared spectroscopy laboratory (KOAnCh)
- X-ray diffractometry laboratory (CEMNAT)
- X-ray diffractometry of mono-crystalline materials laboratory (KOAnCh)
- X-ray photoelectron spectroscopy laboratory XPS (CEMNAT)
- Rheometry laboratory (ÚEnviChI)
- Thermal analysis and optical microscopy laboratory (SLChPL)
- Measurement of temperature and thermal conductivity (ÚAFM)
- Surface and thin layer optical laboratory (ÚAFM)
- Polygraphic testing laboratory (KP)
- Thermal stability tests DTA, DSC, TGA (ÚEnM)
- Simultaneous analysis of samples using TG-GC-MS (CEMNAT)
- Micronization of samples by flow grinding (CEMNAT)
- Element analysis service (ÚEnviChI)
- Determination of electrostatic spark sensitivity (ÚEnM)
- Press services (KPF)
- Development workshops of FChT (ÚEnviChI)

10. Other Activities of FChT Staff and Students

- Involvement of the members of the academic community in the activities of university bodies, Council of Higher Education Institutions, Governmental Office for Research, Development and Innovation, National Accreditation Bureau for Higher Education,
- Active involvement of the faculty representatives in scientific and research departments and in various professional boards, including grant commissions as well as in working groups of relevant advisory bodies,
- Involvement of students and employees in various professional and interest organizations:

American Society for Mass Spectrometry,
Association for Blasting Technology and Pyrotechnics,
Association for Youth, Science and Technology AMAVET
Association of Chemical Industry of the Czech Republic,
Association of Chemical Industry of the Czech Republic,
Association of Paint Manufacturers of the Czech Republic,
Association of Polygraphic Entrepreneurs,
Association of Textile Chemists and Colourists,
Association of the Pulp and Paper Industry (ACPP), Czech Republic,
Association of the Pulp and Paper Industry, Czech Republic, Slovak Republic,
Central European Group for Separation Sciences (CEGSS),
Czech and Slovak Crystallographic Association,
Czech Anglers Union, branch Pardubice,
Czech Association of University Educators of Non-Medical Health Professions,
Czech Astronomical Society,
Czech Chemical Society, Expert Groups,
Czech Glass Society,
Czech Immunological Society,
Czech Marketing Association,
Czech Membrane Platform,
Czech Packaging Association SYBA
Czech Physiological Society,
Czech Society for Biochemistry and Molecular Biology,
Czech Society for New Materials and Technologies,
Czech Society for Nutrition,
Czech Society of Chemical Engineering,
Czech Society of Clinical Biochemistry,
Czech Society of Cosmetology,
Czech Statistical Society,
Czech Technology Platform for Sustainable Chemistry,
Czechoslovak Association for Crystal Growth,
Czechoslovak Microscopy Society,
Czechoslovak Society for Forensics Genetics,
Czechoslovak Society for Microbiology,
Department of Human Nutrition and Food Quality CAAS,
Engineering Academy of the Czech Republic,
European Chemical Society (EUCheMS),
European Defence Agency,
European Federation of Chemical Engineering, Section on Membrane Separation,
European Safety, Reliability, and Data Association (ESReDA),
European Union of Cellulose and Paper Industry (EUCEPA), EU,
Evaluation Board of Natural and Legal Entities on the Capacity to Perform
FameLab Finalists' Club, British Council Czech Republic,
Federation d'Associations de Techniciens des Industries de Peintures, Vernis, Emaux et Encres d'Imprimerie de l'Europe (FATIPEC),
Filtration Society UK,

International Adsorption Society,
International Association of Research Organizations for the Information, Media and Graphic Arts Industries (IARIGAI),
International Biographical Centre Advisory Council,
International Circle of Educational Institutes for Graphic Arts Technology and Management (IC),
International Confederation for Thermal Analysis and Calorimetry (ICTAC),
International Federation of Associations of Textile Chemists and Colourists (IFATCC),
International Humic Substances Society,
International Lipidomics Society (ILS),
International Polymer Colloids Group (IPCG),
International Pyrotechnic Society,
International Society of Electrochemistry (ISE),
International Society of Explosives Engineers,
International Zeolite Association,
Ioannes Marcus Marci Spectroscopic Society,
IPMA Czech Republic – member of the International Project Management Association
Materials Research Society (MRS), USA,
NANOPROGRESS, z.s.,
Optical Society of America (OSA), USA,
Organic Electronics Association (OE-A),
Pardubice University Choir,
Printing Association, (Flexogryphy Expert Group for the Czech and Slovak Republic, Czech Association of Scientific and Technical Societies),
Printing of Functional Applications Summer School – Swansea University,
Research, Development and Expert Opinions, Ministry of Education, Science, Research and Sport of the Slovak Republic
Slovak Association for Blasting and Drilling,
Slovak Information and Marketing Society,
Slovak Research and Development Agency
Society for Imaging Science and Technology,
Society of Applied Spectroscopy,
Students Board, University of Pardubice,
Students' Professional Activities (SPA),
Sustainable Development of Energy, Water and Environment Systems (SDEWES),
Technical Association of Pulp and Paper Industry (TAPPI), USA,
Technical Normalization Committee 142,
Technical Workgroup of the Ministry of the Environment, Waste Water and Gas Treatment,
Tesla Pardubice Sports Club,
The Comenius Academic Club,
The Electrochemical Society, Inc.,
The European Membrane Society,
The European Society of Rheology,
Union of Czech Mathematicians and Physicists, branch Pardubice,
University Sports Club, Pardubice,
University Trade Union, University of Pardubice.

- 4 major scientific and educational events and conferences organized and co-organized by the faculty departments (overview provided in Chapter 3.4),
- Participation of the faculty employees in similar events focused on education, science and research both in the Czech Republic and abroad,
- Open days for potential applicants from secondary schools, provision of information and materials concerning the admission exam (see Chapter 2.3),

- Continuation of the series of specialized seminars for secondary school chemistry teachers, where advances in various areas of chemistry were presented; the programme of the course was organised in cooperation with the participants and continuation is expected in the following years,
- To allow active involvement of the University and FChT in international education, in 2020 FChT organized language courses for the administrative staff of the Dean's office, departments and institutes,
- Active participation in the meeting of the management of chemical faculties from the Czech Republic and Slovakia held on 5–9 October 2020 in Velké Karlovice.

Publicity

Despite the emergency measures, the faculty continued to increase the awareness of potential applicants and the general public. In this respect, the most significant activities included the participation in the traditional higher education exhibitions in the Czech Republic – Gaudeamus in Prague and online Gaudeamus in Brno.

A significant event in the area of publicity is the presentation of the faculty in selected secondary schools. In 2020, the representatives of the faculty could not visit grammar schools and secondary vocational schools in person. In November, an online presentation was held with the students from SPŠCh akademika Heyrovského Ostrava.

On the other hand, some secondary schools visited the faculty (January–February 2020). The students were provided with all the information about the study, they had the opportunity to see the buildings and equipment, laboratories and specialized lecture rooms. In 2020 the faculty was visited by the students from Gymnázium Dašická, Pardubice, Gymnázium Svitavy, SŠIS Dvůr Králové nad Labem and SPŠCh akademika Heyrovského Ostrava.

The university organized a number of promotional events including "University of Motion", holiday visits to summer camps, day camps or special programme day camps directly at the faculty. The faculty took part in the European project Researchers' Night the purpose of which was to support young people's interest in studying technical and natural scientific disciplines.

On a regular basis, the faculty updates the offer of various educational courses (especially the licence study) in the national electronic database, the faculty continues to organize seminars for secondary school teachers. To increase publicity and awareness, the faculty uses the internet (website, direct mail) and social networks (Facebook Instagram, YouTube). In 2020 the faculty continued to improve the faculty website, including the websites of the departments and institutes, and its Facebook and Instagram profile. These activities still continue. Cooperation with local influencers was initiated. The faculty presents the offer of study programmes on relevant websites.

Information about FChT events were contained in dozens of press releases and media reports in Czech and Slovak newspapers and in national and regional radio broadcasting. Many current reports and articles were published in the University of Pardubice Newsletter including its electronic version.

11. Care for Students

11.1 Information and Counselling Services

In 2018, the management of the faculty continued to improve the system of providing information and counselling for students in order to facilitate their decisions concerning the selection of their future employers. The faculty published the demand of enterprises for graduates, regularly informed about study abroad as well as organized regular meetings of FChT students with the representatives of chemical enterprises called KONTAKT.
Last year, 60 companies from different sectors applied for participation in the fair. Due to the emergency measures in relation to the epidemiological situation the trade fair was cancelled. Catalogues with current job offers were distributed to students.

11.2 Physical education, Sports and Other Activities

Sport is an inseparable part of the students' free time. In the academic year 2019/2020, the traditional competition for the Flag of the Rector of the University of Pardubice was held. Throughout the whole year, assistants from the Department of Physical Education and Sports organized competitions in ten sports (athletics, aerobics, badminton, floorball, futsal, swimming, squash, rowing, multi-event, volleyball) but due to the epidemiological situation only 12 sports disciplines were available involving a total of 488 athletes. The 62nd year of the competition for the Flag of the Rector was won by the Faculty of Transport Engineering (60.5 points), followed by the Faculty Chemical Technology (45 points) and the Faculty of Economics and Administration (35.5 points).

The following FChT students were among the best university athletes for 2019/2020:

2nd place Academic Championship – athletics
Jan Kalous

2nd place University Ergocup – rowing machine
Robin Majoroš
Monika Pospíšilová
Lucie Smetanová

3rd place Academic Championship – table tennis
Adéla Velechová

3rd place National University Floorball League Final
Mário Krajčír (team member)
Petr Listík (team member)

Also in 2020 the employees of the faculty were actively involved in the preparation of the "Run of Hope" (Run of the University of Pardubice). However, the run did not take place due to the Covid-19 pandemic.

12. Evaluation

12.1 Internal Evaluation

Internal evaluation is performed on a regular basis and involves the whole faculty and its departments and institutes. The same was performed in 2020.

Evaluation of academic staff

All educational staff of the faculty undergo yearly evaluation according to the following structure.

Educational activity:
- Teaching: lectures – seminars – laboratories;
- Supervision of master's and bachelor's diploma theses, supervision of doctoral students;
- Development of teaching aids, teaching plans, laboratory tasks, building of laboratories;
- Educational activity in different institutions (faculties).

Scientific activity:
- Papers published in the previous year;
- Participation in conferences;
- Grants, technological projects, additional activity;
- International visits and travel;
- Membership in scientific and professional boards and committees.

Other activities:
- Organization activities;
- Increasing qualification;
- Other worthwhile activities.

Evaluation of excellence

In 2020, the evaluation of excellent scientific teams in basic and applied research was performed with a special focus on the following:
- Implementation of scientific projects;
- Publication activity;
- Recognition by the international community;
- Leadership of the scientific team;
- Solving scientific problems;
- Commercialization of applied research.

In all of the cases, emphasis was on the quality of activities taking into account the evaluation of research organizations.

Evaluation of the quality of education by students

Between May and September 2020, students evaluated the quality of education using a special module in the IS STAG system. This evaluation was organized in the context of the whole university.

Dean's Annual Reports

These Annual Reports are submitted to the Academic Senate of FChT and the academia at the beginning of each calendar year.

12.2 External Evaluation

The most significant external evaluation of the University of Pardubice and the Faculty of Chemical Technology conducted already in 2018 is undoubtedly that by the National Accreditation Bureau for Higher Education as part of our application for awarding institutional accreditation to the University of

Pardubice. The Faculty of Chemical Technology was actively involved in the preparation of institutional accreditation for the following areas of education: Chemistry, Economy courses and Healthcare courses. On 7 September 2018 the decision came into force by which the University of Pardubice was awarded institutional accreditation for a period of 10 years for the following educational areas:
a) Transport; bachelor's, master's and doctoral degree programme;
a) Economy courses; bachelor's, master's and doctoral degree programme;
a) Historical science; bachelor's, master's and doctoral degree programme;
a) Chemistry; bachelor's, master's and doctoral degree programme;
a) Information science; bachelor's, master's and doctoral degree programme;
a) Healthcare courses; bachelor's and master's degree programme.

Institutional accreditation in the above specified educational areas at the University of Pardubice allows, through the Internal Evaluation Board (IEB), the implementation of internal processes the purpose of which is to acquire, extend or prolong the period of validity of the accreditation. The Faculty of Chemical Technology is represented in IEB by Prof. Ing. Petr Kalenda, CSc. and Doc. Ing. Jiří Cakl, CSc. IEB has three scientific committees: Technical and Natural Science; Economic; and Healthcare, Humanities and Arts. In 2020, FChT was represented in the Technical and Natural Science Committee by its chairperson (Prof. Ing. Petr Kalenda, CSc.) and two of its members (Prof. Ing. Petr Mikulášek, CSc.; Prof. Ing. Petr Němec, Ph.D.). Member of the Economic Committee of IEB in 2020 was Prof. Ing. Hana Lošťáková, CSc.

Evaluation of educational activity

Following Rector's Decree No. 1/2019 concerning the Study Programme Boards, in 2020 the FChT Study Programme Board was appointed by the Dean of FChT as an authority to oversee the delivery of bachelor's and follow-up master's degree programmes accredited at FChT. The course and the quality of study in doctoral degree programmes was supervised and evaluated by the Subject Area Boards appointed separately for each doctoral degree programme.

In 2020, internal accreditation of FChT study programmes was performed and accreditation was granted for the following study programmes.

Academically-focused follow-up master's degree programme **Material Engineering**, standard length 2 years, full-time form of study, in compliance with Section 44a of Act No. 111/1998 Coll., on Higher Education Institutions and on amendment to some acts (the Higher Education Act), as last amended, the study programme shall be included in the area of education Chemistry delivered by the Faculty of Chemical Technology, University of Pardubice, for a period of 10 years, i.e. until 8 June 2030. The guarantor of the study programme appointed by the Dean of FChT effective from 1 August 2020 for the period of accreditation is Prof. Ing. Petr Mošner, Dr.

Academically-focused follow-up master's degree programme **Materials Chemistry**, standard length 2 years, full-time form of study, in compliance with Section 44a of Act No. 111/1998 Coll., on Higher Education Institutions and on amendment to some acts (the Higher Education Act), as last amended, the study programme shall be included in the area of education Chemistry delivered by the Faculty of Chemical Technology, University of Pardubice, for a period of 10 years, i.e. until 8 June 2030. The guarantor of the study programme appointed by the Dean of FChT effective from 1 August 2020 for the period of accreditation is Doc. RNDr. Petr Janíček, Ph.D.

Academically-focused follow-up master's degree programme **Inorganic and Bioinorganic Chemistry**, standard length 2 years, full-time form of study, in compliance with Section 44a of Act No. 111/1998 Coll., on Higher Education Institutions and on amendment to some acts (the Higher Education Act), as last amended, the study programme shall be included in the area of education Chemistry delivered by the Faculty of Chemical Technology, University of Pardubice, for a period of 10 years, i.e. until 8 June 2030. The guarantor of the study programme appointed by the Dean of FChT effective from 1 August 2020 for the period of accreditation is Prof. Ing. Aleš Růžička, Ph.D.

Academically-focused follow-up master's degree programme **Evaluation and Analysis of Foodstuffs,** standard length 2 years, full-time form of study, in compliance with Section 44a of Act No. 111/1998 Coll., on Higher Education Institutions and on amendment to some acts (the Higher Education Act), as last amended, the study programme shall be included in the area of education Chemistry delivered by the Faculty of Chemical Technology, University of Pardubice, for a period of 10 years, i.e. until 8 June 2030. The guarantor of the study programme appointed by the Dean of FChT effective from 1 August 2020 for the period of accreditation is Doc. Ing. Libor Červenka, Ph.D.

Academically-focused follow-up master's degree programme **Analytical Chemistry**, standard length 2 years, full-time form of study, in compliance with Section 44a of Act No. 111/1998 Coll., on Higher Education Institutions and on amendment to some acts (the Higher Education Act), as last amended, the study programme shall be included in the area of education Chemistry delivered by the Faculty of Chemical Technology, University of Pardubice, for a period of 10 years, i.e. until 8 June 2030. The guarantor of the study programme appointed by the Dean of FChT effective from 1 August 2020 for the period of accreditation is Doc. Ing. Jan Fischer, CSc.

Academically-focused follow-up master's degree programme **Physical Chemistry**, standard length 2 years, full-time form of study, in compliance with Section 44a of Act No. 111/1998 Coll., on Higher Education Institutions and on amendment to some acts (the Higher Education Act), as last amended, the study programme shall be included in the area of education Chemistry delivered by the Faculty of Chemical Technology, University of Pardubice, for a period of 10 years, i.e. until 29 June 2030. The guarantor of the study programme appointed by the Dean of FChT effective from 1 August 2020 for the period of accreditation is Doc. Ing. Pavel Čičmanec, Ph.D.

Academically-focused follow-up master's degree programme **Organic Chemistry and Technology**, standard length 2 years, full-time form of study, in compliance with Section 44a of Act No. 111/1998 Coll., on Higher Education Institutions and on amendment to some acts (the Higher Education Act), as last amended, the study programme shall be included in the area of education Chemistry delivered by the Faculty of Chemical Technology, University of Pardubice, for a period of 10 years, i.e. until 14 September 2030. The guarantor of the study programme appointed by the Dean of FChT effective from 1 November 2020 for the period of accreditation is Prof. Ing. Jiří Hanusek, Ph.D.

Doctoral degree programme **Economics and Management of Businesses with Process Manufacturing Operations,** standard length 4 years, full-time and part-time form of study, in compliance with Section 44a of Act No. 111/1998 Coll., on Higher Education Institutions and on amendment to some acts (the Higher Education Act), as last amended, the study programme shall be included in the area of education Economy courses and Chemistry delivered by the Faculty of Chemical Technology, University of Pardubice, for a period of 5 years, i.e. until 14 December 2025.

Evaluation of the results of science and research

From 2004 to 2017, the Research, Development and Innovation Board (RDIB) performed yearly evaluation of R&D results. The methodology that RDIB used for the evaluation is specified at http://www.vyzkum.cz/.

The evaluation applies only to those result that are directly linked with the activities of the respective research organization, meet the definition of the results and other requirements for the inclusion in the R&D Information System (referred to as "R&D IS"), and are properly registered in the system. The basic information sources are:

CRRP – Central register of research plans;
CRP – Central register of projects;
RII – Result information index.

Since 2017, the system called Evaluating research organisations and RD&I purpose-tied aid programmes according to M17+ Methodology has gradually been introduced. The methodology that RDIB uses for the purposes of evaluation is specified at: http://www.vyzkum.cz/.

For the time being, the results are evaluated in the following categories:

- Module 1 – Evaluation of the quality of the selected results by RDIB through Expert Panels,
- Module 2 – Evaluation of the bibliometric results based on subject-specific analyses. Provided that the bibliometric result includes multiple research organizations, the result shall be awarded to each research organization in full extent.

In 2020, the results of the third year of M17+ implementation were published. M17 included H19 evaluation (2016 to 2018 results). The following tables provide a comparison of chemical faculties in Module 1 and Module 2. The tables are based on the results of H19.

The table below shows the evaluation faculties with similar specializations in Module 1. The number of the results in Module 1 is influenced, inter alia, by the size of the research organization. The evaluation of the results in the H1 to H5 interval is carried out by RDIB through Expert Panels. H1 represents the best evaluation result. The order of the faculties reflects their results of quality evaluation H1 to H3.

University – Faculty	Number of evaluated results*							Proportion H1 to H3, %
	Total	H1	H2	H3	H4	H5	N	
UCT Prague – Faculty of Chemical Engineering	18	4	6	6	1	1	0	89
Charles University – Faculty of Science	66	13	31	14	5	2	1	88
University of Ostrava – Faculty of Science	13	0	9	2	1	1	0	85
Masaryk University in Brno – Faculty of Science	115	9	37	41	18	10	0	76
UCT Prague – Faculty of Chemical Technology	41	5	12	12	7	5	0	71
University of Pardubice – Faculty of Chemical Technology	35	2	11	11	6	5	0	69
Palacký University Olomouc – Faculty of Science	77	14	22	22	11	7	1	75
Brno University of Technology – Faculty of Chemistry	33	1	5	11	10	6	0	52
Tomas Bata University in Zlín – Faculty of Technology	8	0	0	1	4	3	0	13

The quality of the bibliometric results evaluated in Module 2 reflects the subject-specific classification of journals in the Q1 to Q4 quartiles. The order of the faculties reflects their publications in Q1 and Q2 journals.

University – Faculty	Bibliometric results*					Proportion Q1 and Q2, %
	Total	Q1	Q2	Q3	Q4	
Palacký University Olomouc – Faculty of Science	2189	1183	525	264	217	78
UCT Prague – Faculty of Chemical Engineering	473	167	182	78	46	74
Masaryk University in Brno – Faculty of Science	1837	796	574	288	179	75
Charles University – Faculty of Science	2945	1329	809	519	288	73
UCT Prague – Faculty of Chemical Technology	711	281	236	115	79	73
Tomas Bata University in Zlín – Faculty of Technology	226	64	86	47	29	66
Brno University of Technology – Faculty of Chemistry	175	50	62	45	18	64
University of Pardubice – Faculty of Chemical Technology	717	163	263	224	67	59

13. Further Development of the Faculty of Chemical Technology

13.1 Investment Development of FChT

In accordance with the long-term plan, in 2020 the faculty continued to purchase new and upgrade existing instrumentation in order to strengthen the scientific and research activity in relation to the educational activity.

The details on the economic management and investment development are included in the Annual Report on Economic Management of FChT for 2020. This document includes only significant investments.

Investments relating to machines, devices, equipment and software (exceeding 200 thousand CZK, approx. 7,620 EUR) in 2020

Name of machine, device, equipment or software	Department	Price (thousand CZK/EUR)
Mass spectrometer with ionization in inductively coupled plasma (2nd instalment)	KAlCh	2,288/ 87
Weight detector for liquid chromatography	KAlCh	2,200/ 84
Spectrophotometric detector with LC diode field	KAlCh	603/ 23
Triple quadrupole mass spectrometer (1st instalment)	KAlCh	1,842/ 70
Water activity meter	KAlCh	407/ 16
Sorption property meter	KAlCh	1,452/ 55
Colour meter	KAlCh	540/ 21
Liquid chromatograph	KAlCh	1,961/ 75
Centrifuge	KAlCh	292/ 11
Lyophyliser	KAlCh	409/ 16
Deep freezer box (-80°C)	KAlCh	250/ 10
Supercritical fluid extraction	KAlCh	2,135/ 81
Gas chromatograph	KAlCh	3,807/ 145
Laser granulometer for particle size distribution measuring	KAnT	1,544/ 59
HPLC pump with binary gradient and cooled autosampler	KBBV	533/ 20
Antistatic scales	KBBV	300/ 11
Autoclave for biological waste sterilization	KBBV	300/ 11
CO_2 incubator	KBBV	230/ 9
Fluorescent microscope motorization	KBBV	394/ 15
PCR cycler	KBBV	203/ 8
Nanoindentation measurement system	KFCh	7,187/ 274
Air conditioning	KFCh	230/ 9
UV-VIS spectrophotometer with a probe	KFCh	325/ 12
UV-LED lamp	KFCh	208/ 8
High temperature cell	KFCh/KAnT	482/ 18
Laboratory vibration mill	KOAnCh	200/ 8
EPR spectrometer	KOAnCh	2,795/ 106
Homogenizer	KOAnCh	330/ 13
Grinder and polisher	KOAnCh	250/ 10
FLS1000-SSS-sm photoluminescent spectrometer extension	KOAnCh	1,055/ 40
Upgrade of UP858 vacuum device for pulsed laser deposition	KOAnCh	2,136/ 81
Air conditioning	KOAnCh	240/ 9
Upgrade of FTIR spectrophotometer	KPF	2,656/ 101
Closed He cryostat	ÚAFM	1,204/ 46
Upgrade of KV-2 explosion chamber hydraulic control system	ÚEnM	221/ 8
Laboratory single chamber cryogenic mill	ÚEnviChI	250/ 10
Test chamber for high-temperature water condensation tests	ÚChTML	369/ 14
Test unit for weather tests in UV radiation, water and increased temperature	ÚChTML	686/ 26
ATR probe for measuring reaction kinetics	ÚChTML	225/ 9

Raman attachment for FTIR iS50 spectrometer	ÚOChT	1,813/ 69
Peltier cooler for Duetta spectrofluorometer	ÚOChT	341/ 13
ALD cylinders	CEMNAT	454/ 17
Microwave hydrothermal reactor with super rotor	CEMNAT	1,051/ 40
Upgrade of Cyclone 1 by adding a fibre alignment device	CEMNAT	351/ 13
Cryostat	CEMNAT	423/ 16
Optical sources, controllers and mechanical elements for the optical laboratory	CEMNAT	500/ 19
Winding fibre deposition unit for Cyclone 1	CEMNAT	436/ 17
Upgrade of the Zahner electrochemical workstation	CEMNAT	998/ 38

In cooperation with the Technical Department of the University of Pardubice, the planning works for the construction of the Technological Institute in TP Doubravice were initiated, the preparation of the design and supply documents for the reconstruction of Room S21 began and the design documents for the illumination of the Chemist Statue in front of the HA building were completed. The roof of the HA building was repaired, the design for the connection of new air conditioning units in buildings HB and HC was prepared and the documents for the innovation of diesel distribution units in the HC/E server were provided. In TP Doubravice, the roof of the new press shop and the floors of some laboratories were repaired.

13.2 Priorities of the Strategic Plan for 2021

Priority objective 1: Learner competences for the 21st century

Strategic priorities (S):
S1.1 Implementation of the study programmes at an internationally competitive level.
S1.2 Increasing the quality of the study programmes with an emphasis on the application of the acquired knowledge and skills for success on the labour market.
S1.3 Application of new technologies and modern resources for the implementation of education.
S1.4 Strengthening of the global students' competences required for success on the labour market.
S1.5 Internationalisation of the bachelor's and follow-up master's degree programmes.
S1.6 Improving the quality and internationalization of the doctoral degree programmes.
S1.7 Strengthening quality assessment of the study programmes and strategic management of educational activities.
S1.8 Broadening the offer of lifelong learning programmes.
S1.9 Inter-faculty and interdisciplinary cooperation in the context of educational activities.
S1.10 Availability of information resources.
S1.11 Ongoing care for the students and systematic work with the graduates.

Activities (A):
S1.1/A4 Mapping and analysis of the students' life cycle as part of study programme quality assessment.
S1.1/A6 Emphasis on the development of own high-quality study resources. Depending on the type and funding of study resources, making them available online free of charge with an emphasis on copyright protection and preventing their further illegal dissemination.
S1.1/A7 Supporting the faculty activities in the area of education in order to increase the quality of the study programmes including innovative 21st century teaching methods as well as interactive teaching methods focusing on the transfer of information and knowledge from the application sphere.
Development of online forms of education. Supporting courses taught in a foreign language with an emphasis on joint participation of Czech and foreign students.
S1.1/A8 Innovation of the system of assessment of learning outcomes and academic failure. Monitoring of academic achievement. Supporting the activities that increase academic achievement. Taking adequate corrective measures including for example preparatory, compensatory and adaptation courses for first year students and additional courses to gain the required knowledge, peer learning.
S1.1/A9 Working with talented students. Supporting activities beyond academic responsibilities. Targeted support for talented students in the form of a scholarship scheme for excellent academic achievement. Acknowledgement of exceptional achievement in scientific and creative activity. Acknowledgement of achievement in the area of internationalization, popularization and promotion.

S1.2/A1 Supporting and increasing the links between the teaching process and the application sector, especially through final theses and involvement of professionals in the teaching process. Development of systematic cooperation with external partners and future employers.
S1.3/A2 Finding a balance between traditional and online forms of education. Training of academic staff in the key competences for online forms of education.
S1.4/A2 Emphasis on the active use of English in education as well as scientific and research activities at all levels of study (vocational courses, international mobility, final theses, active interaction with foreign students, etc.).
S1.5/A1 Delivery of the follow-up master's degree programmes in English.
S1.5/A2 Final theses in English.
S1.6/A1 Reduction of academic failure in the doctoral degree programmes.
S1.6/A3 Maintaining the motivation scholarship programme system for doctoral degree students. Maintaining the system of supporting Czech applicants for the doctoral degree programmes.
S1.6/A5 Maintaining a compulsory international internship of at least one month.
S1.10/A1 Use of information resources by means of the university departments. Use of university systems to prevent plagiarism.
S1.11/A1 Application of the university strategy to support students and employees with specific needs, those from socio-economically disadvantaged groups or caring parents. Elimination of technical barriers.

Indicators (I):
S1.1/I1 Number of secondary schools with active cooperation.
S1.1/I2 Number of talented students supported by scholarship based on their achievement in professional competitions (number of scholarships granted/number of students enrolled).
S1.1/I3 Interest in study (number of applicants and number of students enrolled).
S1.1/I4 Number of students in accredited study programmes.
S1.1/I5 Students' outcomes in the winter semester of the first year of bachelor's degree.
S1.1/I6 Students' outcomes in the first year of all degrees.
S1.1/I7 Students' outcomes in the remaining years of all degrees.
S1.1/I8 Number of graduates. Successful completion of study within the standard period and within the standard period plus one year (n+1).
S1.1/I9 Number of students receiving merit scholarship and number of students entitled to merit scholarship.
S1.1/I10 Number of students receiving scholarship for outstanding research, development, innovation, artistic or other creative outcomes.
S1.1/I11 Number of faculty students awarded in professional competitions. Number of faculty students awarded in the area of internationalization, popularization and promotion.
S1.1/I12 Graduate unemployment by study programmes.
S1.2/I1 Number of professionals/partners from practice with an active form of collaboration (practical experiences, excursions, final theses, involvement in the teaching process).
S1.2/I2 Proportion of students in the bachelor's and follow-up master's degree programmes with a specific form of interaction with the application sphere in the course of study (practical experiences, excursions, final theses).
S1.2/I3 Number of delivered study programmes (academic and vocational) with compulsory professional experience.
S1.3/I1 Number of courses using online forms or innovative teaching methods and electronic study resources.
S1.4/I1 Number of vocational courses in English.
S1.4/I2 Number of international mobilities.
S1.4/I3 Number of final theses in English in the bachelor's and follow-up master's degree programmes.
S1.5/I1 Number of delivered study programmes in English.
S1.5/I2 Number of final theses in English in the bachelor's and follow-up master's degree programmes.
S1.6/I1 Completion of the doctoral degree programme by successful defence within the standard period and within the standard period plus one year (n+1).
S1.6/I2 Proportion of doctoral degree students actively involved in projects of national or international providers.
S1.6/I3 Number of successfully defended dissertations under double supervision.

S1.6/I4 Number of successfully defended dissertations in English.
S1.6/I5 Proportion of doctoral degree students with international mobility exceeding one month.
S1.8/I1 Number of offered lifelong learning programmes.
S1.8/I2 Number of lifelong learning graduates.
S1.10/I1 Proportion of final theses checked by anti-plagiarism systems.

Priority objective 2: High-quality and respected scientific, research and creative activities

Strategic priorities (S):
S2.1 Application of the faculty assessment system of RDI quality.
S2.2 Development of high-quality or strategic scientific disciplines in which the faculty delivers its doctoral degree programmes.
S2.3 Supporting excellence in selected FORD subdisciplines.
S2.4 Strategic management of RDI and focus on international level disciplines.
S2.5 Development of modern and internationally comparable infrastructure.
S2.6 Establishing links between scientific, research and creative activities of the faculty and the application sphere with an emphasis on the commercialization of the results.
S2.7 Continued emphasis on students' involvement in scientific and research activities.
S2.8 Supporting cooperation between the faculty departments. Supporting inter-faculty cooperation.
S2.9 Strengthening the principles of open science.

Activities (A):
S2.1/A2 Implementation of external assessment in strategic management and financial allocation.
S2.1/A3 Assessment of the quality of the results of RDI and creative activities.
S2.2/A1 Definition and promotion of the quality of priority disciplines, specialized disciplines and long-term unique disciplines. The identification of research priorities should reflect social demand, social relevance, national RIS3 and the achievement of higher national and international strategic objectives and measures in the area of RDI.
S2.3/A1 Definition of excellent and promising FORD subdisciplines in basic and applied research that will receive special attention and support as part of strategic management. Setting of motivation tools to support excellence.
S2.3/A2 Motivating academic and scientific employees and teams, especially those who achieve outstanding and internationally competitive RDI results in their scientific fields. Supporting prospective excellent research teams with high social benefit and long-term internationally recognized results with a significant citation rate.
S2.3/A3 Involvement of the faculty in large international research infrastructures (European Roadmap for Research Infrastructures) and supporting ERC (or equivalent) projects.
S2.4/A3 Implementation of the strategic system of direct funding from resources allocated to long-term conceptual development of research organizations with a direct link to RDI quality assessment.
S2.4/A5 Achievement of internationally competitive research results. Development of cooperation with domestic and foreign partners in the field of basic and applied research. Involvement of the faculty in major international consortia.
S2.5/A1 Development and modernization of existing infrastructure.
S2.6/A1 Intensification of cooperation with significant entities in the application sphere to address applied and contract research projects. Participation in regional and cross-regional structures and consortia in disciplines relevant to national RIS3 and ITI. Development of the potential in industries defined by the government as strategic for the development of cluster cooperation.
S2.6/A2 More efficient use of RDI results in practice through the Centre for Technology and Knowledge Transfer. Seeking to increase income from private resources.
S2.7/A2 Placing emphasis on permanent involvement of talented students and young researchers in national as well as international research projects.

Indicators (I):
S2.2/I1 Number of submitted scientific and research projects and the amount of funding obtained from national and international projects providers.
S2.3/I1 Number of supported excellent teams.

S2.3/I2 Number of submitted and implemented ERC projects.
S2.3/I3 Number submitted and implemented projects of foreign providers.
S2.3/I4a Number and share of publications in D1 journals (according to WOS).
S2.3/I4b Number and share of selected results submitted for evaluation in Module 1 (M17+) with H1 evaluation.
S2.4/I1a Number and share of academic employees and researchers of the faculty with at least one publication in a Q1 or Q2 journal (according to WOS) per year.
S2.4/I1b Number and share of academic employees and researchers of the faculty with at least one publication in a Q1 or Q2 journal (according to WOS) per year and/or with at least one result submitted for evaluation in Module 1 (M17+) with H1 to H3 evaluation per year.
S2.4/I2 Number and share of academic employees and researchers involved in research projects of national as well as international providers.
S2.4/I3a Number of FORD subdisciplines in which the faculty will achieve the median value of publications in Q1 and Q2 journals (according to M17+) above the median value of publications in Q1 and Q2 journals (according to M17+) in the Czech Republic.
S2.4/I3b Number of FORD subdisciplines in which the faculty will achieve above-average quality indicators (Module 1 and Module 2) compared with other research organizations in the Czech Republic.
S2.4/I4a Number and share of publications in Q1 and Q1 journals (according to WOS).
S2.4/I4b Number and share of selected results submitted for evaluation in Module 1 (M17+) with H1 to H3 evaluation.
S2.4/I5 Number of citations of publications according to WOS by specialization and number of employees.
S2.4/I6 Participation of academic employees of the faculty in editorial boards of international Q1 or Q2 scientific journals (according to WOS) and elected membership in international professional societies.
S2.4/I7 Number of lectures given at the faculty by leading foreign specialists in basic research and number of lectures given at the faculty by foreign professionals from renowned companies.
S2.4/I8 Number and share of high-quality publications in Q1 and Q2 journals (according to WOS) in cooperation with other research organizations.
S2.4/I9 Number and share of high-quality publications in Q1 and Q2 journals (according to WOS) in cooperation with foreign research organizations.
S2.4/I10 Number of academic employees and researchers of the faculty actively involved in cooperation with a foreign research organization (joint publications, joint projects, invited lectures at major foreign institutions).
S2.4/I11 Number of submitted and implemented projects of national providers.
S2.5/I1 Amount of funding invested in the upgrade and modernization of infrastructure.
S2.6/I1 Number of projects and amount of funding obtained from applied and contract research, commercialization and revenues from non-pubic resources.
S2.6/I2 Number of results of applied research with an economic impact on society: Czech and foreign licensed patents, sold licences, prototypes, spin-off, etc.
S2.7/I1 Number of students actively involved in projects of national or international providers.
S2.9/I1 Number and share of RDI published as Open Access.

Priority objective 3: Human resources

Strategic priorities (S):
S3.1 Strengthening the system of employee career development including motivation to support their work activities and performance.
S3.2 Regular application of a comprehensive system of employee evaluation according to their work performance and achievements.
S3.3 Promotion of career development and employee education, adoption of knowledge, skills and key competences.
S3.4 Strengthening of the system of human resources management.

Activities (A):
S3.1/A1 Application of the principles of career development of academic employees and researchers.
S3.2/A2 System of regular remuneration for outstanding achievements in educational, scientific, research and creative activities, promotion, popularization and 'third role'.

S3.3/A1 Following the university strategy, strengthening the system of employee training in key skills (including language skills). Supporting short-term and long-term professional traineeship of the faculty employees in the Czech Republic and abroad.
S3.4/A1 Development of talented students, students in the doctoral degree programmes and young academics and researchers.
S3.4/A2 Application of the system of post-doc positions for outstanding doctoral graduates, not only from the university but also other higher education institutions including foreign ones.

Indicators (I):
S3.1/I1 Number of newly appointed associate professors and professors.
S3.1/I2 Number of independent and leading researchers.
S3.3/I1 Number of faculty employees supported in the context of training courses and overview of implemented trainings, courses and workshops.
S3.3/I2 Number of defended final theses in English.
S3.4/I1 Number of post-doc positions, of which positions occupied by foreign citizens.

Priority objective 4: International dimension and internationalization

Strategic priorities (S):
S4.1 Development of strategic partnerships and international cooperation in education and RDI.
S4.2 Supporting student and employee mobilities.
S4.3 Implementation of attractive study programmes and courses in English.
S4.4 Strategic management of internationalization.
S4.5 Implementation of the results of the quality assessment of internationalization.

Activities (A):
S4.1/A1 Strengthening and development of existing international cooperation with strategic regions and partners. Regular monitoring of the implementation of strategic partnerships.
S4.1/A2 Monitoring of the opportunities for new strategic international partnerships.
S4.1/A3 Deepening of internationalization through international scientific teams.
S4.3/A1 Supporting final theses in a foreign language.
S4.3/A2 Exploiting the potential of foreign academic employees and researchers working at the faculty as part of the delivery of Czech and English study programmes.
S4.3/A4 Improving the quality and availability of study resources for courses in English.
S4.4/A1 Development of a bilingual internal environment.
S4.4/A3 Improving information and advisory services provided to foreign applicants.
S4.4/A4 Supporting and strengthening the integration of foreign students in the university/faculty, academic life and research teams.
S4.5/A1 Achievement of the Internationalization Action Plan by means of the faculty coordinator. Implementation of the faculty internationalization priorities.

Indicators (I):
S4.1/I1 Number of active relationships in education and RDI with foreign partners (student and employee mobility, joint publications, joint projects).
S4.1/I2 Number of active agreements on cooperation with foreign partners.
S4.1/I3 Number and structure of foreign academic employees and researchers at the faculty.
S4.1/I4 Number of organized international professional conferences/workshops.
S4.2/I1 Number of foreign mobilities of academics, researchers and administrative employees of the faculty.
S4.2/I2 Number of international mobilities of the faculty students.
S4.3/I1 Number of study programmes delivered in a foreign language.
S4.3/I2 Number of foreign students in Czech or English study programmes.
S4.3/I3 Number of courses in a foreign language and number of students enrolled.
S4.3/I5 Number of developed study resources for courses taught in English.
S4.4/I1 Number and share of students with a specific form of active use of internationalization (e.g., teaching of professional courses in a foreign language, international mobility, final thesis in a foreign language, active interaction with foreign students).

Priority objective 5: Tradition and development of the faculty

Strategies (S):
S5.1 Preserving the traditions and development of the faculty with a social impact.
S5.2 Implementation of a marketing strategy in order to develop the faculty's identity and reputation.
S5.3 Strengthening mutual cooperation with an emphasis on synergies between the faculty departments.
S5.4 Strengthening the 'third role' of the faculty within the Czech Republic.
S5.5 21st century infrastructure.

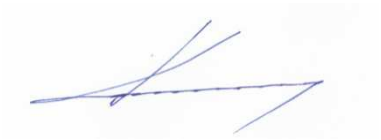
Activities (A):
S5.1/A1 Strengthening of the elements of sustainable development, environmental protection and healthy lifestyles in all activities of the faculty. Preserving the traditional values of the faculty. Inclusion of relevant themes in educational activities.
S5.1/A2 Deepening the shared values and principles of academic self-government. Raising awareness about the role of academic bodies. Raising awareness about the events, strategic plans, legislative environment and management processes at the faculty in order to develop all creative activities and knowledge. Mutual discussions between the members of the academic community, faculty management and representatives of the academic senate.
S5.1/A3 Active acquisition of financial resources to ensure sustainable development.
S5.1/A4 Developing cooperation with local governments, specifically the City of Pardubice and the Pardubice Region.
S5.2/A1 Promotion of the faculty activities through multimedia, professional competitions, etc.
S5.2/A2 Popularization of science by organizing scientific and popular-educational events.
S5.2/A3 Use of modern information technology and social networks for internal and external communication.
S5.3/A1 Involvement of leading employees and significant personalities in the strategic management of the faculty.
S5.3/A2 Deepening of horizontal and vertical cooperation between students, employees and graduates.
S5.4/A1 Intensification of the positive effect on the general as well as the professional community in the fields of study delivered at the faculty (e.g., university of the third age).
S5.5/A1 Development of modern infrastructure and facilities of the faculty for the implementation and development of high-quality education, scientific, research and creative activities as well as internationalization. Establishment of the Technology Institute in Doubravice.
S5.5/A2 Continuous improvement of the study and work environment, both indoors and outdoors.

Indicators (I):
S5.1/I1 Amount of funding received.
S5.2/I1 Number of organized popular-educational events with an impact on society as well as the general and professional community.
S5.2/I2 Number of events organized for academic members.
S5.2/I3 Number of competitions organized for elementary and secondary school students.
S5.2/I4 Number of popularization events for elementary school students.
S5.2/I5 Number of secondary schools visited.
S5.5/I1 Amount of funding invested in infrastructure including its upgrade and development.

14 Conclusion

In conclusion, I would like to thank everyone who contributed to making 2020 a special year in the life of the Faculty of Chemical Technology, University of Pardubice. I am aware that this would not have been possible without dedicated work of my closest colleagues in the management, heads of departments and institutes, academic staff, technical and economic employees, and of course students.

I hope that 2021 will be another successful year in the development of educational, scientific and research activities of the faculty, and I wish all the employees and students a lot of enthusiasm, good health, professional and academic achievements, and last but not least happiness in their personal lives.



Prof. Ing. Petr Kalenda, CSc.
Dean

The Annual Report on the activities of the Faculty of Chemical Technology, University of Pardubice was:

- Discussed and approved at the meeting of the faculty management on: 10 May 2021
- Discussed and approved by the Academic Senate of the Faculty of Chemical Technology, University of Pardubice on: 21 May 2021

Annex

Significant academic events and life at the faculty

Attracting talented students and promotion of the faculty

On 23 September 2020 the Annual Board Meeting was held and the members of our test team of indicated Covid-19 patients received the Silver Medal for outstanding work for the faculty.

On 14 August 2020 the second part of the enrolment procedure of students in the first year took place.

On 17 September 2020 at the beginning of the new academic year the management organized a pleasant afternoon for its employees – **Heart 2020**

Due to the pandemic situation a number of traditional ceremonial events could not take place.

On 1 October 2020 the awards ceremony was held in the Dean's office meeting room **where some of the bachelor's students were awarded for their theses.**

2 December 2020 Awards were presented to our successful **follow-up students.**

Between 21 and 23 January 2020 the Faculty of Chemical Technology was presented at the higher education and lifelong learning exhibition **Gaudeamus** in **Prague** and from **20 to 23 October** also in **Brno.**

On 21 January and **19 February 2020** the Faculty of Chemical Technology held **Open Days** for the public. This event was accompanied by private tours and excursions for students at various dates as requested by the secondary schools involved.

Just as in previous years, future students had the opportunity to look into the laboratories and lecture rooms.

On 7 February 2020 the fourth year of the chemical competition for secondary school students called **Chemistry Race** was held

On this day, the faculty was visited by over 70 teams not only from the Czech Republic but also Slovakia.

In groups of 3 to 5, students competed in theoretical tasks with a time limit.

The winner was the team that completed the highest number of tasks.

On 7 February 2020 seminars for secondary school teachers were held.

20 February 2020
During the period of loosened restrictions, the popular **Coffee with the Dean** session took place.

In the summer months a series of **camp** visits took place during which the children had the opportunity to meet our educational mobile teams.

Between 8 and 16 August 2020 the University of Pardubice had a permanent **Science Point** in the **Na Špici Sports park**, where our faculty was also represented.

Even during the summer our laboratories were not empty. Our students were replaced by curious young researchers of various ages who took part in several projects such as **Summer School** or **Day Camps**.

In the context of the long-term programme **Science and Technology in School Yards** we visited only two grammar schools in Moravská Třebová a Svitavy before the yards and schools went silent again.

On 12 September 2020 we took part in **Children's Super Day** at the Pardubice Racecourse.

On 24 September 2020 the opening ceremony of **ICEFA Lidice** took place.

On behalf of the faculty the awards were presented by Ing. Petra Kalendová, Ph.D. and Ing. Hana Doušová, Ph.D.