DETAILED PROPOSAL OF THE STUDY PROGRAMME

1. GENERAL INFORMATION ON THE STUDY PROGRAMME			
1.1. Name of the study programme	Graduate university study programme Food Engineering		
1.2. Provider of the study programme	University of Zagreb Faculty of Food Technology and Biotechnology		
1.3. Partner institutions	-		
1.4. Type of study programme	Vocational study programme ☐		University study programme ☒
1.5. Level of study programme	Undergraduate ☐	Graduate ☒	Integrated ☐
1.6. Manner of implementation of the study programme	Classical ☐	Mixed (classical + online) ☒	Online in entirety ☐
1.6.1. Is it a?	☒single major ☐double major ☐interdisciplinary study ☐multidisciplinary study ☐developing programme		
1.7. Academic/vocational title earned at completion of the study	Master of Science Engineer in Food Technology (mag. ing. techn. aliment.)		
1.8. Scientific/artistic field/area of the proposed study programme	Biotechnical sciences / Food technology		

2. INTRODUCTION		
2.1. Reasons for starting the study programme	Scientific need	The undergraduate study programme Food Engineering was officially established in 1956 at the Biotechnology Department of the Faculty of Chemistry, Food and Mining, but it has been conducted under different names since 1921 at the University of Zagreb. The Faculty of Food Technology and Biotechnology, in its current form, has been operating since 1978. From its founding until today, it has been extremely important because it educates experts in the field of food technology that are necessary for the successful operation of large food industries, small-sized enterprises and family farms and government agencies in agriculture and food sector as well as scientific research institutes. Changes in the study system in the Croatian higher education system in accordance with the Bologna process have led to the redefinition and further modernization of study programmes. Since the academic year 2005/2006, the studies at the Faculty have been organized on the principle of 3+2 cycles, with three undergraduate studies lasting

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		3 years: Food Technology, Biotechnology and Nutrition, and since the academic year 2008/2009, there have also been five two-year graduate study programmes: Food Engineering, Food Safety Management, Bioprocess Engineering, Molecular Biotechnology and Nutrition. Intensive development of science and technology in the previous two decades, requires further profiling and modernization of study programmes and is in accordance with the Strategy for Education, Science and Technology of the Republic of Croatia (2014), the Smart Specialisation Strategy of the Republic of Croatia (2016-2020) and the UniZG-FFTB Development Strategy (2019-2025), the Faculty Council of UniZG-FFTB has made a decision to launch new university study programmes within the current vertical organization: at the undergraduate level - Food Technology 2 (FT 2), and at the graduate level of studies - Food Engineering 2 (FE 2). The new study programmes FT 2 and FE 2 will replace the existing study programmes Food Technology and Food Engineering, which have been taught, with minor modifications (up to 20%) recorded by the Quality Management Committee of the University of Zagreb (notice of 11 January 2016), from the academic year 2005/2006 and 2008/2009. The new study program is based on the existing one, but has been modernized in a way that it has been expanded by adding specific new content, and the existing content has been adapted to the new needs. The needs of the market for young, educated, professional staff whose work can follow the development and progress of technology are growing in both the public and private sectors. The constant development of science and the food industry in the field of food technology has led to the need for further profiling of curricula. The basic goal of these changes is increasing the attractiveness of the study programme for domestic and foreign students, which offers specific interesting content from a scientific and professional point of view, and fits into the Croatian Qualifications Framework. One of the reasons for starting the study programme is constant increase of interest in this scientific discipline and the growing interest of domestic and foreign students for the inclusion, in part or in full, into the study programme, using the possibility of choosing elective courses at other components of the UniZG and/or through the student mobility and exchange programmes. Another, by no means less significant, reason is the growing needs of the labour market for professionals who have completely mastered modern technologies in food production and control. FFTB-UniZG has the human resources and infrastructure to conduct the proposed study programme. A programme draft for the study has been developed and the teachers for specific parts of the programme have been designated, which includes local experts from the subject areas. The programme is based on the latest scientific knowledge in the fields of chemistry,

		biochemistry, microbiology and production processes with the aim of ensuring food safety and quality. During their studies, students acquire practical knowledge, covering all segments that are encompassed by food technology today, starting from the storage of raw materials and products, through preservation, processing and production of finished products, and control and management of production processes. With the project of launching the proposed study programme, the existing teaching activities are improved and new ones are introduced, a network of intra-institutional cooperation at FFTB-UniZG is established, and cooperation with related domestic and foreign institutions is achieved. The use of existing human and material resources is ensured, with stronger infrastructure and increased competitiveness at the international level. All this contributes to the affirmation of the University of Zagreb, as well as the Faculty of Food Technology and Biotechnology as its component, the expansion of its activities and ensuring the sustainability of teaching and research activities.
	Cultural need	With this study programme, we educate professionals who will know the important features of food products and the production procedures from an expert point of view. Professionals who master such knowledge, in today's time of growing production of various food products, are extremely necessary in order to be able to disseminate and transfer that knowledge to the entire population. Educating the general population about the importance of knowing certain food products, their value and their specifics, as well as the importance of choosing the right foods, is certainly a feature of developed societies and contributes to the development of culture in general, as well as food culture. In highly developed societies, an important feature of the population is the knowledge and acceptance of proper eating habits, which is something the professionals educated on the matter through this study programme will certainly contribute to. Also, it is especially important to preserve and nurture, both in food production, as well as in large industrial and small production plants, the production of already known, but perhaps a bit forgotten, traditional food products. In this way, the traditional food processing will be spread and passed on to the younger generations, which contributes to the preservation of our cultural heritage. Furthermore, designing new food products based on the possibly neglected raw materials of our region will contribute to a better understanding of our history and cultural heritage. And it is a well-known fact that food, knowledge of food customs and food production are a significant

		part of the cultural identity of every nation. Numerous cultural events that are organized in all our regions also promote the food culture of that area, whether it is the coast and Mediterranean food, or the inland and some specific products of the continental regions. When it comes to organization, promotion of ideas about preserving tradition and education on food, and certainly in the production and control of many food products that are an essential part of all these cultural events, the presence of food engineers is indispensable. Based on all of the abovementioned, and given that food is a part of the culture of every society, the need for this study programme, which will educate food engineers responsible for all aspects of food production, is certainly evident, especially from the aspect of culture.
	Social need	The task of every society is to provide health safety, quality and nutritional value of food for the entire population of a country, and that is exactly the mission of food technology. Food technologists and engineers play a particularly important role in fulfilling this task. Their role is not only related to the production and control of food products, but they are vital participants in building a legislative framework that defines the criteria that later affect the achievement of the required characteristics of food, and the production of such food, which is a significant contribution to public health. According to the UN General Assembly (1985), food is one of the three key factors that contribute to human health. The study of food engineering is also important because it represents a specific and concrete basis for continuing education in postgraduate doctoral and specialist studies at FFTB or other universities that educate professionals of the highest level of expertise in research, creation, production and control of food and design, management and control of bioprocesses in food production. Knowledge society is the goal that the Republic of Croatia strives for, and specific knowledge about the production, control and supervision of food production that is acquired in this study programme is necessary for the proper functioning of society as a whole. The study programme Food Engineering covers all the aforementioned issues and enables students to learn about the need to respect the highest ethical standards and the principles of sustainable production. The social benefit of this study programme is reflected in the education of professionals focused on environmental protection as well as the disposal of by-products of the food industry. In addition to compulsory courses, the study programme contains a number of elective courses through which students

		are able to acquire specific knowledge which meets the needs of the society for a variety of experts who can find their place in various jobs not only in the food industry but also in relevant ministries and research institutes, as well as in state institutes and thus contribute to the development of society as a whole.
	Economic need	The study of food engineering has been carried out at the Food and Biotechnology Study of the University of Zagreb since 1978, and it is expected that it will, just as it has thus far, enable the education of experts necessary for the development of the food industry in the Republic of Croatia. This two-year study, as an upgrade to the previous three-year one, is necessary to expand the acquired and obtain additional knowledge about the scientific accomplishments necessary for the development of food engineering. The needs of the market for professional and scientific staff whose work can ensure the development of technology in a segment particularly important for the overall economic development of the Republic of Croatia are growing in both the public and private sectors. Masters of Food Engineering will find their place in scientific institutions and research and development institutes in both large food industries and small private enterprises. High requirements for placing on the market health-safe and quality food products according to the highest criteria, regardless of the capacity of the production plant, call for the engagement of primarily food technologists. Experts of this profile are trained to perform tasks of appropriate complexity related to the production, distribution and marketing and storage of raw materials, semi-finished products and food products in plants of the entire food industry as well as jobs of appropriate complexity in microbiological, physical and chemical, sensory and instrumental laboratories of the food industry and in control laboratories where quality, safety and authenticity of food products are controlled. They are also trained to manage, supervise and control production, especially in small-capacity plants of food industry, following all regulations for sustainable production, which includes waste disposal and the use of byproducts. In addition to all of the above, they are trained to perform tasks of an appropriate level of complexity related to the preparation of process water, water for human consumption and wastewater treatment. From the aforementioned, it is clear that without the experts of this profile there is no economic survival and progress of the Republic of Croatia in the extremely important sector of food production. One of the prominent strategic

		documents that are the result of the Europe 2020 strategy is **Industrial Strategy of the Republic of Croatia 2014-2020,** where it is pointed out that '*production of food products, according to the criterion of total income and number of employees, is the largest industrial activity in the Republic of Croatia and, as in most EU countries, is strategically important due to the resources it manages*. ' Furthermore, the same document states that the low position of Croatian industry in the global value chain is, among other things, a consequence of "*low levels of the share of highly educated workforce in the total number of employees ".* It is clear from the aforementioned that the need for college-educated staff in the food industry is extremely important and that the proposed study programme will contribute to positive changes in the industrial sector.
2.2. Assessment of the study programme's usefulness relative to the demands of the labour market in the public and private sectors	The market targeted by the participants of this study programme is the public and private sector pertaining to food production and control in the Republic of Croatia. The purpose of the study programme stems from the need for staff with competencies in management, supervision, control and management pertaining to the production, distribution and placing on the market and storage of raw materials, semi-finished products and food products in the entire food industry as well as research and innovation in the field of food technology. With this programme, the Faculty of Food Technology and Biotechnology of the University of Zagreb strives to meet European standards and needs arising from the dynamic international labour market. The programme is based on the latest scientific knowledge in physical and chemical properties and changes of food ingredients during production, distribution and storage. During the studies, the student would gain additional knowledge necessary to create new products, master new techniques and technologies in the field of food engineering as well as specific engineering knowledge needed to plan, design, lead and manage new processes.	
2.3. Compatibility of the study programme with the University mission and the strategy of the proposer, as well as with the Higher Education Institutions Network strategic plan	The study is fully in line with the mission and vision of the Faculty. The programme is based on the latest scientific achievements from basic, applied and engineering scientific disciplines in the field of food technology. During their studies, students acquire practical knowledge, covering all segments of food technology, starting from the storage of raw materials and products, through preservation, processing and production of finished products, and quality control and management of production processes. During the studies, critical thinking and awareness of the need for lifelong learning is encouraged.	
2.4. Comparability of the study programme with other accredited programmes in higher education institutions in the Republic of Croatia and the EU (name at least two programmes, one of which is from an EU	The proposed program is comparable to the programs of eminent European universities, especially Wageningen University and University College Cork, which have many years of experience in conducting modern and internationally recognized studies of food technology. University College Cork, four-year undergraduate study (Food Science and Technology) and one-year graduate study	

country, and compare them with the proposed programme; provide internet addresses of the programmes)	(Food Science) https://www.ucc.ie/admin/registrar/calendar/food/food013.html and https://www.ucc.ie/admin/registrar/calendar/postgraduate/Masters/food/page09.html, Wageningen University, graduate study programme Food Technology: a two-year study with an identical number of ECTS credits. Comparable programmes https://www.wur.nl/en/Education-Programmes/master/MSc-programmes/MSc-Food-Technology/Programme-of-Food-Technology.htm and Josip Juraj Strossmayer University of Osijek, Faculty of Food Technology, graduate study programme Food Engineering: comparable programmes, courses, learning outcomes and competencies acquired by students. http://www.ptfos.unios.hr/index.php/o-fakultetu/natjecaji/studiji/diplomski-studij
2.5. Openness of the study to student mobility (horizontal, vertical in the Republic of Croatia and international)	Horizontal student mobility is regulated by the Decision on the manner of implementation of student mobility procedures: http://www.pbf.unizg.hr/o_fakultetu/dokumenti2/odluka_o_nacinu_provedbe_postupaka_mobilnosti_studenata Vertical mobility is achieved through the possibility of continuing education. Upon completion of this graduate university study programme, the student may acquire the right to enrol in postgraduate studies at the Faculty of Food Technology and Biotechnology, University of Zagreb. The enrolment requirements are available on the FFTB website. The requirements for enrolment in postgraduate study programmes at other higher education institutions are determined by these institutions. International mobility is defined by the University Regulations on International Mobility. In the academic year 2019/2020, a total of 55 ERASMUS+ Agreements were signed, of which 50 were intended for students of the graduate study of Food Engineering.
2.6. Relationship with the local community (economy, entrepreneurship, civil society, etc.)	The food industry is the most important economic branch in the Republic of Croatia and there is a great interest in this study programme. Graduated masters of food engineering, in addition to large food industries, have the opportunity to be employed in small family businesses and can find their job posts in public administration, which contributes to the development of civil society. Furthermore, they can be involved in educational processes, consulting and research work in the field of food technology.
2.7. Compatibility with the requirements of professional associations, if any exist	The study programme is in accordance with the goals and tasks of the Croatian Association of Food Technologists, Biotechnologists and Nutritionists and similar professional associations.
2.8. Name possible partners outside the higher education system	Ministry of Agriculture, Dukat d.d., Podravka d.d., Franck d.d., PPK Karlovačka mesna industrija d.d.
2.9. Other (as the proposer wishes to add)	-

3. GENERAL INFORMATION	
3.1. Duration of the study programme (is there an option of distance learning, part-time	The study programme lasts four (4) semesters, or two (2) academic years.

studying, etc.)	
3.2. The minimum number of ECTS credits required for completion of study	120 ECTS
3.3. Enrolment requirements and admission procedure	The requirements for enrolment into the study programme and the classification procedure are published in the Open call for enrolment in the first year of graduate studies for academic year 2020/2021 http://www.pbf.unizg.hr/natjecaj_za_upis_u_prvu_godinu_diplomskih_studija_pbf_a_2020_2021 Candidates who have completed the relevant undergraduate university or professional study programme and acquired at least 180 ECTS credits have the right to enrol. For enrolment into the FOOD ENGINEERING graduate study programme, the appropriate undergraduate studies are studies in the field of: food technology, biotechnology, nutrition, plant sciences, animal sciences, applied chemistry, chemical technology, chemical engineering, eco-engineering and sanitary engineering.
3.4. Language of the study programme	The study programme is conducted in Croatian
3.5. Learning outcomes of the study programme relative to legislative acts, requirements of applicable professional associations, demands of the labour market, possibilities for continuation of education and general social needs (name 15-20 learning outcomes)	The anticipated learning outcomes of the study programme are formed on the basis of previous study programmes, experiences, accreditation processes and in accordance with the recommendations. Upon completion of the study programme, the students will be able to: 1. Manage production plants throughout the entire food industry and accompanying services. 2. Manage a quality management system for the production processes of the food industry and quality control of raw materials and products. 3. Organize activities to improve production and implement new products. 4. Develop technological projects for new warehousing, processing and production capacities in the field of food industry. 5. Perform highly-complex professional tasks in microbiological and physical and chemical control and development laboratories in the food industry. 6. Apply wastewater treatment procedures in food production and preparation processes and generally complete the necessary activities pertaining to environmental protection. 7. Participate in creating appropriate legislation from the standpoint of a subject engaged in food production. 8. Conduct scientific research in the field of food. 9. Make everyday decisions pertaining to the production process flow in food production companies and conclusions on the selection and procurement of raw materials, packaging and equipment. 10. Give a final opinion on the results of conducted physical, chemical and microbiological analyses of raw materials and the final product. 11. Make decisions on the development and expansion of production and the need to improve certain segments of the companies.

	12. Manage or work in a professional and/or interdisciplinary team that designs and conducts experiments in the field of food technology. 13. Present and refer to modern trends in food technology. 14. Apply optimal contemporary methodology in verbal and written communication with colleagues using appropriate terminology. 15. Apply ethical principles, legislation and standards pertaining to the specific requirements of the profession.
3.6. Evaluation of student employability at completion of the study programme, including opinions or official documents from three organizations associated with the labour market (e.g. professional associations or scientific institutions, employers or their associations, unions, public services, etc.) on the suitability of the anticipated learning outcomes to the demands of the labour market	The assessment of the employability of students after the completion of the study programme was given by the food industries Podravka d.d., PPK Karlovačka mesna industrija d.d., Dukat d.d., Franck d.d., the Ministry of Agriculture and the Association of Food Technologists, Biotechnologists and Nutritionists. The opinions state that the learning outcomes of the graduate study programme Food Engineering 2 correspond to the needs of their production and other business processes.
3.7. Possibilities of continuing studies at a higher level	Masters of Engineering who complete the graduate study programme proposed in this draft will be able to continue their studies at the postgraduate level (postgraduate doctoral and specialist studies), not only in Croatia, but also in Europe and the world.
3.8. Upon submitting proposals for graduate study programmes, name undergraduate studies of the proposer or other institutions in the Republic of Croatia that qualify for admission to the proposed graduate study	Relevant undergraduate studies are studies in the field of: food technology, biotechnology, nutrition, plant sciences, animal sciences, applied chemistry, chemical technology, chemical engineering, eco-engineering and sanitary engineering.

4. DESCRIPTION OF THE STUDY PROGRAMME	
4.1. List of mandatory and elective courses and/or modules with class hours and ECTS credits (appendix: Table 1)	
4.2. Description of each course (appendix: Table 2)	
4.3. Structure of the study (number of semesters, trimesters, class sizes for lectures and exercises/seminars)	The number of semesters in the study is 4. The total number of ECTS credits is 120. In the first semester, the student collects 28 ECTS credits from the core courses and 3 from the elective course. In the second semester, 26 in the core and 3 from elective courses. In the third semester 29 ECTS credits are collected in core courses and in the fourth semester 6 ECTS credits from elective courses. In Article 77, paragraph 1 of the Collective Agreement for Science and Higher Education, the sizes of teaching groups

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	for direct forms of teaching have been agreed upon for lectures, seminars and exercises (size of the group for lectures 150, exercises 10, seminars 30 students).
4.4. Enrolment requirements for the following semester or trimester	The requirement for regular enrolment into the following academic year is the collection of 50 ECTS credits in the previous one. Prerequisites for enrolment in individual courses, and thus the requirements for the next semester and year, are defined by the operational plan of studies or prerequisites for enrolment of individual courses.
4.5. List of courses and/or modules offered in a foreign language (which language)	List of courses that can be taught in English http://www.pbf.unizg.hr/courses_offered_in_english6
4.6. Completion of the study:	
a. Final requirement for completion of the study	Final thesis ☐ Diploma thesis ☒ Final exam ☐ Diploma exam ☐
b. Requirements for application of final/diploma thesis and/or final/diploma exam	After passing all the exams in this study programme, or exceptionally if he or she has only one failed exam (if he or she has one failed exam, the student submits and applies the thesis to the Diploma Thesis Committee), and after writing the diploma thesis reviewed by the mentor, the student submits it to the Graduate Thesis Committee through the Undergraduate and Graduate Studies Office - the Student Office.
c. Evaluation procedure for final/diploma exam and evaluation and defence procedure for final/diploma thesis	The procedure is stated in the Ordinance on the preparation of diploma theses and defending the diploma thesis for students studying according to the Bologna system: Ordinance on Diploma Thesis and the Diploma Thesis Guide http://www.pbf.unizg.hr/media/datoteke/upute_za_izradu_diplomskog_rada

Table 2 Course description – IN A SEPARATE DOCUMENT

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Table 3 List of required and elective courses and modules with class hours and ECTS credits

LIST OF COURSES/MODULES									
Year of study: 1									
Semester: I									
MODULE	COURSE	COURSE TEACHER	From n to x semester	L	S	E	e-learning	ECTS	Required/ elective
	Chemistry and technology of cereals	Duška Ćurić	1	49	7	42	5%	6	Required
	Chemistry and technology of carbohydrates and confectionery products	Draženka Komes	1	49	7	42	10%	6	Required
	Innovative food processing techniques	Zoran Herceg	1	20	15	30	5%	5	Required
	Modern methods in food quality control	Nada Vahčić	1	22	-	50	10%	5	Required
	Hygiene and sanitation in food industry	Sanja Vidaček Filipec	1	22	6	4	10%	3	Required
	Process Control in Food Industry	Sven Karlović	1	15	15	15	5%	3	Required
	Modelling in food engineering	Jasenka Gajdoš Kljusurić	1	10	15	25	20%	3	Elective
	Food Additives	Dubravka Škevin	1	20	15	-	5%	3	Elective
	Sensory analyses of foods	Ksenija Marković	1	20	-	15	10%	3	Elective
	Production and use of baker's and food-grade yeast	Jasna Mrvčić	1	10	5	25	5%	3	Elective
	Application of spectroscopic methods for characterization of bioactive compounds	Jasmina Lapić	1	10	15	5	5%	3	Elective

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Year of study: 1
Semester: II

MODULE	COURSE	COURSE TEACHER	From n to x semester	L	S	E	e-learning	ECTS	Required/ elective
	Chemistry and technology of milk and milk products	Rajka Božanić	2	49	7	42	5%	6	Required
	Oil and fat chemistry and technology	Dubravka Škevin	2	49	7	42	5%	6	Required
	Food plant design	Sandra Balbino	2	30	20	10	5%	4	Required
	Food biochemistry	Irena Landeka Jurčević	2	30	-	20	5%	4	Required
	Quality assurance systems	Mara Banović	2	20	15	-	5%	3	Required
	Sensory and chemometric evaluation of wine	Karin Kovačević Ganić	2	20	-	15	5%	3	Elective
	Production of Predicate and Sparkling Wines	Natka Ćurko	2	20	7	8	10%	3	Elective
	Modified fats and oils	Klara Kraljić	2	20	6	9	10%	3	Elective
	Mineral, spring and table water	Josip Ćurko	2	15	-	22	5%	3	Elective
	Alternative and analogue dairy products	Katarina Lisak Jakopović	2	20	2	10	10%	3	Elective
	Poultry meat and egg technology	Helga Medić	2	14	12	12	5%	3	Elective
	Technology of food for specific dietary needs	Dubravka Novotni	2	20	6	4	5%	3	Elective

Year of study: 2
Semester: III

MODULE	COURSE	COURSE TEACHER	From n to x	L	S	E	e-learning	ECTS	Required/ elective

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			semester						
	Novel food	Suzana Rimac Brnčić	3	30	30	-	5%	4	Required
	Management	Marijo Ćaćić	3	30	30	-	10%	4	Required
	Development of new products in food industry	Zoran Herceg	3	16	20	-	5%	3	Required
	Chemistry and technology of fruits and vegetables	Branka Levaj	3	49	7	42	5%	6	Required
	Wine chemistry and technology	Mara Banović	3	49	7	42	5%	6	Required
	Meat and fish chemistry and technology	Helga Medić	3	49	7	42	5%	6	Required

LIST OF COURSES/MODULES

Year of study: 2

Semester: IV

MODULE	COURSE	COURSE TEACHER	From n to x semester	L	S	E	e-learning	ECTS	Required /elective
	Sensory and chemometric evaluation of wine	Karin Kovačević Ganić	4	20	-	15	10%	3	Elective
	Production of predicate and sparkling Wines	Natka Ćurko	4	20	7	8	10%	3	Elective
	Modified fats and oils	Klara Kraljić	4	20	6	9	5%	3	Elective
	Shelf life of packaged foodstuffs	Mario Šćetar	4	15	15	-	5%	3	Elective
	Advances in production, processing and application of lecithin	Sandra Balbino	4	20	5	10	5%	3	Elective
	Ultrasound in food engineering	Mladen Brnčić	4	25	5	10	5%	3	Elective

	Mineral, spring and table water	Josip Ćurko	4	15	-	22	5%	3	Elective
	Alternative and analogue dairy products	Katarina Lisak Jakopović	4	20	2	10	10%	3	Elective
	Process analytical methods in food industry	Damir Iveković	4	20	-	18	5%	3	Elective
	Sustainability of advanced food processing technologies	Anet Režek Jambrak	4	20	10	-	10%	3	Elective
	Biodegradation and organic compounds	Tibela Landeka Dragičević	4	20	8	7	5%	3	Elective
	Industry 4.0 in biotechnical sciences	Anet Režek Jambrak	4	20	10	6	10%	3	Elective
	Poultry meat and egg technology	Helga Medić	4	20	10	8	5%	3	Elective