COURSES OFFERED IN ENGLISH

faculty of
food technology
and biotechnology

University
of Zagreb

LIST OF COURSES

Semester: Winter						
COURSE	COURSE TEACHER	L	S	E	e-learning	ECTS
Modelling and Optimisation in Nutrition	Jasenka Gajdoš Kljusurić	20	10	20	0	4
Modelling in Food Engineering	Jasenka Gajdoš Kljusurić	25	5	10	0	3
Basics of Measurement Methods in Nutrition	Jasenka Gajdoš Kljusurić	10	15	15	0	3
Process Measurement and Control in Food Engineering	Jasenka Gajdoš Kljusurić	25	0	20	0	3
Food Packaging	Kata Galić	25	0	15	0	4
Selected Topics in Food Packaging	Kata Galić	15	15	0	0	3
Genetics of Industrial Organisms	Višnja Bačun Družina	20	0	15	0	3
The Fundamentals of Bioorganometallic Chemistry	Lidija Barišić	15	0	23	0	3
Peptidomimetics and Pseudopeptides	Lidija Barišić	15	4	20	0	3
Food Process Engineering 2	Zoran Herceg	20	15	30	0	5
Chemistry and Technology of Cereals	Duška Ćurić	60	15	45	0	10
Genetic Engineering	Ivan Krešimir Svetec	27	0	27	0	4
GMOs in Food Production	Ivan Krešimir Svetec	20	15	0	0	3

Semester: Summer						
COURSE	COURSE TEACHER	L	S	E	e-learning	ECTS
Shelf Life of Packaged Foodstuffs	Mario Ščetar	15	15	0	0	3
Nutrigenomics	Jurica Žučko	20	10	20	0	4
Bioinformatics	Antonio Starčević	20	10	10	0	4
Ecogenetic Studies	Ksenija Durgo	12	12	0	0	2
Biochemical Analysis	Vladimir Mrša	30	0	45	0	6
Biochemical Function of Vitamins and Ions in Food and Nutrition	Vladimir Mrša	45	0	0	0	5
Powder Technology	Maja Benković	20	10	0	0	3
Organic Chemistry	Lidija Barišić	30	15	30	0	6
Ultrasound in Food Engineering	Mladen Brnčić	30	20	10	0	5
Mechanisms of Evolution	Višnja Bačun Družina	20	15	0	0	3
Mineral, Spring and Table Water	Josip Ćurko	15	0	22	0	3
Membrane Bioreactors in Environment Protection	Marin Matošić	15	7	15	0	3
Production of Predicate and Sparkling Wines	Natka Ćurko	20	7	8	0	3

COURSE ENROLMENT REQUIREMENTS

Modelling and Optimisation in Nutrition	Mathematics Basic Informatics
Process Measurement and Control in Food Engineering	Transport Phenomena
	Unit Operations
	Statistics
Genetic Engineering	Molecular Genetics
	Biochemistry 1

INFORMATION ON INDIVIDUAL EDUCATIONAL COMPONENTS

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Jasenka Gajdoš Kljusurić, PhD, Full Professor Davor Valinger, PhD, Assistant Professor Ana Jurinjak Tušek, PhD, Assistant Professor Tamara Jurina, PhD Jelena Đugum, PhD, Assistant Professor	1.8. Semester when the course is delivered	winter
1.2. Course title	**Modelling and Optimisation in Nutrition**	1.9. Number of ECTS credits allocated	4
1.3. Course code	32441	1.10. Number of contact hours (L+E+S+e-learning)	20 + 18 + 10 + 2
1.4. Study programme	Undergraduate university study programme Nutrition	1.11. Expected enrolment in the course	50
1.5. Course type	compulsory	1.12. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2. 5 %
1.6. Place of delivery	lectures in P2, exercises in P6	1.13. Language of instruction	Croatian & English
1.7. Year of study when the course is delivered	second	1.14. Mogućnost izvođenja na stranom jeziku	Y

2. COURSE DESCRIPTION	
2.1. Course objectives	Through the introduction to the Course Modeling and Optimization in Nutrition, the distribution of DRI (recommendation) and their differences in nutrition planning for groups and individuals will be clarified. Students will learn how to use the energy and nutrition content databases and apply the basics of linear optimization (Simplex method). Recommendations will be used in programming of meals and daily/weekly meal plans. Pareto Optimization will be one of the aims (more goal functions: price, nutrition and preferences). Diversity will be highlighted in optimizing age, gender and energy needs. It also analyses the impact of technological process and storage on nutritional value and the energy and nutritional composition of foods and the loss during thermal treatment. Through lectures and exercises, students will investigate various PC tools for optimization and analysis of menus. The Course is also aimed to teach the basics of fuzzy logic that is used daily in food science (eg. linguistic variables as "slightly", "increase intake" and so on).
2.2. Enrolment requirements and/or entry competences required for the course	To enrol in this course, the following courses must be completed: • Mathematics • Basic Informatics
2.3. Learning outcomes at the level of the programme to which the course contributes	• have knowledge and understanding of specific and general skills and knowledge of basic and applied disciplines • define and explain particular problems in the systems which deal with food preparation or food distribution to targeted population groups / individuals in state and private institutions of the above mentioned profile • define and explain methods in the systems which deal with dietary status assessment of nation and / or an individual in state and private institutions of the above mentioned profile • understand and apply appropriate methods in the systems which deal with diet quality assessment on national and / or individual level • collect and interpret results obtained by methods which assess diet quality of healthy population groups

	• present independently and / or as a member of the homogenous or interdisciplinary team results in verbal and written form, using professional terminology • present and popularize the profession • apply ethical principles in relationships to coworkers and employer • use and value scientific and occupational literature with the aim of lifelong learning and profession enhancement
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	• Define the differences in model division and differentiate data from information that are important in nutrition • define and describe the database on the chemical composition of the food and identify what affects the nutritional value of foods (in most cases) • explain the modeling of nutritional recommendation distribution curves and their statistical background and distinguish similarities and differences in nutrition planning. • adapt dietary recommendations to different users using computer programs (eg adjusting programs for different gender, age, physical activity, etc. based on different needs/recommendations) • define the basic structure of each step in nutrition planning through the structure of the LINDO program (a goal associated with nutritional constraints) and highlight the differences in nutritional supply planning and in planning of optimal conditions for a new product • define and explain what are linguistic variables and why they are applied in nutrition • address set tasks that apply insignificance in nourishment with analysis and comparison with explicit values (such as, for example, recommendations)
2.5. Course content (syllabus)	The subject is fundamental on the second year of undergraduate study (4 ECTS) and it is performed through the following units: 1) Modeling and models in nutrition (Data and information. Models and modeling. The application and review of types of modeling and models in nutrition. The recommendations of the daily intake of nutrients; model examples) 2) Databases of the chemical composition of foods (Databases of energy and nutritional composition of foods. Defining different types of database structures and where they belong to. The development and lifespan of a database on chemical composition. Thermal treatment of foods and databases.) 3) Meal/menu criteria, dimensions and decision theory in the analysis and planning of meals/menus (analysis and planning menus through criteria, dimensions and application of the theory of case-based reasoning and conclusion on the basis of the rules) 4) Linear optimization in the analysis and meal/menu planning (Basics of linear optimization, the Simplex method, the structure of the linear program. The recommendations in linear programming and planning meals and menus. The differences in the optimization considering the age, gender and energy needs. Summary of work with the software for optimization, programming and analysis of food / menu. Optimization and meal planning, menu, and a new product.) 5) Fuzzy logic in nutrition (Linguistic variables and their relationship with nutrition. The basics of fuzzy logic and its applications in analysis and planning meals and menus. Diversity membership functions of energy and nutrients fuzzy set due to age, gender and energy needs. Pareto optimization (more equally important objective function). The basics of fuzzy optimization. Defuzzification (translation fuzziness in the express collection) using Prerow value). Course Objective: Familiarizing with models, modelling and optimization processes in nutrition as well as development of the creative thinking and application in the profession.
2.6. Format of instruction:	☒ lectures ☒ seminars and workshops ☒ exercises ☐ *online in entirety* ☐ partial e-learning ☐ field work ☐ independent assignments ☒ multimedia and the internet ☒ laboratory ☐ work with mentor ☐ (other)
	2.7. Comments:

2.8. Praćenje rada studenata	Class attendance		N	Research	Y		Oral exam		N

	Experimental work		N	Report		N	(other)		
	Essay		N	Seminar paper	Y		(other)		
	Preliminary exam		N	Practical work	Y		(other)		
	Project		N	Written exam	Y		ECTS credits (total)	4	

2.9. Assessment methods and criteria

Two partial exams are written, each lasting 60 minutes and bringing 30 points.

the first partial exam is taken mid-semester
the second partial exam is taken at the end of semester

A minimum of 15 points needs to be achieved on the partial tests to pass.

Students also make a seminar paper covering a given topic and implying group work. The seminar paper is orally presented and shows team work in which through course knowledge application – data needed for computer nutrition planning is gathered and organized, with the objective of adoption of expert terminology, rounding up the whole and summing up crucial facts and independent conclusions related to the seminar paper theme.
The maximum number of points for the seminar paper is 40.
The exam is used for assessing knowledge level, and the seminar paper for assessing knowledge application level.
Through additional, continuous work (monitored through homework) an additional five points can be achieved.
The final grade is a sum of partial tests points and seminar paper points (and homework points, if applicable). The final grade is achieved according to the total number of points:

< 51→ fail (1)
51 – 62 → sufficient (2)
63 – 75 → good (3)
76 – 88 → very good (4)
89 – 100 → excellent (5)

Students who did not take or did not pass one of the partial exams in the first take, have the right to retake the exam in partial form (in the first exam period immediately following the second partial exam). Students who didn't pass any partial exam and the ones who did not fulfil requirements to pass even after retaking the partial exam, take the exam covering the entire syllabus which lasts 120 minutes.

Students who are unsatisfied with the final grade can take the oral exam.

2.10. Student responsibilities

To pass the course, students have to:

- successfully do all the exercises in practical work
- pass the exam (through partial exams or writing the entire course content)
- prepare a seminar paper
- attend classes (a maximum of two absences is allowed, any further absence makes passing the course not possible)

2.11. Required literature (available in the library and/or via other media)

Title	Number of copies in the library	Availability via other media
J. Gajdoš Kljusurić (2011) Modelling and Optimisation in Nutrition (reviewed internal script)	0	YES, Merlin and web pages

2.12. Optional literature

- Kurtanjek, Ž., Gajdoš Kljusurić, J. (2014) Statistical modelling of anthropometric characteristics evaluated on nutritional status. U Mathematical and Statistical Methods in Food Science and Technology (ur. Granato, D. i Ares, G.) John Wiley and Sons, Oxford, UK. pp. 285 – 302.
- Gajdoš Kljusurić, J., Rumora, I., Kurtanjek, Ž. (2012) Application of Fuzzy Logic in Diet Therapy – Advantages of Application. U Fuzzy Logic – Emerging Technologies and Applications (ur. Dadios, E.P.), InTech, Rijeka.

	• Koh, Eunsook T., Owen, Willis L. (2001) Introduction to Nutrition and Health Research. Springer.
2.13. Exam dates	*Exam dates are published in Studomat.*
2.14. Other	-

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Jasenka Gajdoš Kljusurić, PhD, Full Professor Davor Valinger, PhD, Assistant Professor Ana Jurinjak Tušek, PhD, Assistant Professor Tamara Jurina, PhD	1.8. Semester when the course is delivered	winter
1.2. Course title	**Modelling in Food Engineering**	1.9. Number of ECTS credits allocated	3
1.3. Course code	53291	1.10. Number of contact hours (L+E+S+e-learning)	25 + 9 + 5 + 1
1.4. Study programme	Graduate university study programme Food Engineering	1.11. Expected enrolment in the course	10
1.5. Course type	optional B	1.12. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2. 5 %
1.6. Place of delivery	lectures in P6, exercises in the LMRA	1.13. Language of instruction	Croatian and English
1.7. Year of study when the course is delivered	first	1.14. Mogućnost izvođenja na stranom jeziku	Y

2. COURSE DESCRIPTION	
2.1. Course objectives	• By means of models clarify food production processes because the development of biotechnical sciences leads to the need to study, monitor and control an increasing number of parameters - morphological, physiological, and chemical, etc. Progressive increase of parameters and data that in very complex relationships are facilitated by statistical models and procedures that provide a complete picture of the observed measuring system that is the subject of research. • Univariate analyses that individually analyse variables do not provide sufficiently reliable options for aggregating multiple observations, nor ultimately for a proper scientific conclusion. On the other hand, multivariate analysis is a branch that is involved in the analysis of multiple measurements of a larger number of variables on one or more of the observed samples. Through this subject we will start from simple tests and regression models, and through the application of multivariate analysis methods, clarify application in food engineering, and how and by using these methods can and must be concluded. • Using examples from the biotechnical field (with particular reference to the food industry) to demonstrate the application and purpose of modeling and to use the data collected for final and / or graduate work and process them with the aim of extracting key information from the observed measurement system.
2.2. Enrolment requirements and/or entry competences required for the course	-
2.3. Learning outcomes at the level of the programme to which the course contributes	• know key aspects of food production and food industry • understand basic principles of research work • understand the importance of environment protection and know the systems and methods of environment protection • supervise and manage the quality management system for production processes in food production • conceptualize and carry out improvement of existing technological procedures

<table>
<tr><td></td><td>

conceptualize and carry out production of new products
conduct scientific research in the field of food
make everyday decisions related to production processes in food production companies
identify the need to improve certain segments in such companies
present modern food technology trends
apply contemporary optimal communication methodology with their colleagues in verbal and written way, using appropriate terminology
apply ethical principles, legal regulations and standards related to specific requirements of the profession
use and value scientific and occupational literature with the aim of lifelong learning and profession enhancement

</td></tr>
<tr><td>2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)</td><td>

define mathematical modeling and its application (and importance) in food engineering
identify primary and secondary "variables" in the observed system with the use of technological processes models
evaluate the application of modeling and chemometric techniques in processing experimental data
organize data analysis methods by complexity (descriptive analysis and multivariate analysis)
plan complex data analysis according to the set research goals, using the chemometric tools (cluster analysis, factor analysis and main component analysis)
create and evaluate conclusions about the connection of variables and samples in the observed multivariate system using certain computer skills (Excel. XLStat, R program)

</td></tr>
<tr><td>2.5. Course content (syllabus)</td><td>Mathematical modeling and its application (and importance) in food engineering.
How to evaluate the application of modeling and chemometric techniques in the processing of experimental data
The organization method of data analysis according to the complexity of the (descriptive analysis and multivariate analysis)
The way you design complex data analysis according to the set objectives of the research, using chemometric tools (cluster analysis, factor analysis and principal component analysis)
Interpretation and valid conclusions in the observed multivariate system using specific computer skills in the available computer programs

The topics are as follows:
Mathematical models and their basics.
Models through the manufacturing system in the food industry.
Basics of Data Analysis and Computer Support Overview Determining the Space of Major Components and Latent Variables. Identification and classification of food samples in the space of the main components. Applying regression models for monitoring and management. Estimation of space by chemometric method. Process quality algorithms based on "cluster analysis" in the main components area.

Seminar presentation (S = 2)
Individual seminar work with the topic modeling using processes and collected data from a chosen food production process or a part of it.</td></tr>
<tr><td>2.6. Format of instruction:</td><td>☒ lectures
☒ seminars and workshops
☒ exercises
☐ on-line in entirety
☐ partial e-learning
☐ field work</td><td>☐ independent assignments
☒ multimedia and the internet
☒ laboratory
☐ work with mentor
☐ (other)</td><td>2.7. Comments:</td></tr>
<tr><td>2.8. Monitoring student work</td><td>
<table>
<tr><td>Class attendance</td><td></td><td>N</td><td>Research</td><td>Y</td><td></td><td>Oral exam</td><td></td><td>N</td></tr>
<tr><td>Experimental work</td><td></td><td>N</td><td>Report</td><td></td><td></td><td>(other)</td><td></td><td></td></tr>
</table>
</td></tr>
</table>

	Essay		N	Seminar paper	Y		(other)		
	Preliminary exam	Y		Practical work	Y		(other)		
	Project		N	Written exam		N	ECTS credits (total)	3	

2.9. Assessment methods and criteria	Students make an independent seminar paper concerning food safety through the prism of models and modelling. The seminar paper is orally presented to show course knowledge application, with the objective of adoption of expert terminology, rounding up the whole and summing up of crucial facts and independent conclusions related to the seminar paper theme. The seminar paper is graded, and the oral exam is an option for students to raise their grade. The seminar paper must be handed in by the end of the semester; if the dead line is exceeded, the grade is lowered. The oral exam is held according to agreement and another student or associate is present with the lecturer and student.
2.10. Student responsibilities	To pass the course, students have to: • successfully do all the exercises in practical work • attend a minimum of 80% of all lectures • write and hand in a seminar paper

2.11. Required literature (available in the library and/or via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	J. Gajdoš Kljusurić (2013) Modeliranje i kemometrija u prehrambenom inženjerstvu (internal script)	0	YES, Merlin and web pages

2.12. Optional literature	• R. G. Brereton: Chemometrics: Data Analysis for the Laboratory and Chemical Plant, John Wiley, 2003. • Serafim Bakalis, Kai Knoerzer and Peter J Fryer (ed.) Modeling Food Processing Operations. Woodhead Publishing Series in Food Science, Technology and Nutrition, 2015.
2.13. Exams	*Exam dates are published in Studomat.*
2.14. Other	-

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Jasenka Gajdoš Kljusurić, PhD, Full Professor Davor Valinger, PhD, Assistant Professor Ana Jurinjak Tušek, PhD, Assistant Professor Tamara Jurina, PhD	1.8. Semester when the course is delivered	winter
1.2. Course title	**Basics of Measurement Methods in Nutrition**	1.9. Number of ECTS credits allocated	3
1.3. Course code	66826	1.10. Number of contact hours (L+E+S+e-learning)	10 + 14 + 15 + 1
1.4. Study programme	Graduate university study programme Nutrition	1.11. Expected enrolment in the course	25
1.5. Course type	optional A	1.12. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2. 5 %
1.6. Place of delivery	lectures in P6, Exercises in the LMRA	1.13. Language of instruction	Croatian i engleski
1.7. Year of study when the course is delivered	first	1.14. Mogućnost izvođenja na stranom jeziku	Y

2. COURSE DESCRIPTION	
2.1. Course objectives	• The subject provides an overview of the measurement methods used in nutrition, with their application. Each laboratory or the subject in the food business is collecting data in real or controlled conditions. Experimental measurements (laboratory, warehouse, food preparation place) or collected from questionnaires in the field of nutrition and food control often represent data that should be further elaborated. • During the lectures, seminars and exercises, the types of errors that may occur during the measurement can be identified and their impact on the final result can be analysed and how to properly avoid the wrong interpretation of such results. • The aim of the experimental work is to clarify the importance of good interpretation of measured data and basic statistical parameters so that the student can give a critical review of the importance of measuring errors occurring during measurement and how to choose a proper measuring method and instruments. • Measurements that are not directly related to the computer (eg anthropometric measurements: body height, body mass, electrical conductivity and impedance (fat tissue measurement), and operation with metering systems connected to the measuring instrument (eg mass, pressure, temperature, humidity, automatic FIA measurement systems), the student can evaluate the advantages and disadvantages of both measurement systems. Measuring systems computer-related with measuring instrument are very important in food preparation, warehouses, distribution, production units and control laboratories All procedures and examples of measured the method is accompanied by views of the application in practice. The ethics in data analysis is also explained.
2.2. Enrolment requirements and/or entry competences required for the course	-
2.3. Learning outcomes at the level of the programme to which the course contributes	• understand and have knowledge of basic and specific disciplines of the profession • understand and acquire knowledge of general skills in particular interdisciplinary disciplines through elective modules • apply research methods from the field of nutrition science • present and apply acquired knowledge in order to improve food monitoring systems and strategy programs on national levels, which refer to human diet, improve communication and monitoring of consumers behaviour on the food market, improve food distribution for the healthy and the ill, improve food quality assessment and nutritional and health status, improve production and processing of food and food supplements, and analysis and communication of food and diet • set priorities in communication referring to food and diet • analyse, compare and interpret the results obtained by research methods • present and popularize particular contemporary trends in the field of nutrition science to scientific, professional and laymen circles • present and popularize the result of their individual and team work • use and value scientific and occupational literature with the aim of lifelong learning and profession enhancement
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	• collect and store data, with understanding metrics as well as potential measurement errors, of the measurer and / or measurement methods • expand and deepen their knowledge of basic principles of measurement methods in food science that will enable the students better interpretation and metric analyses based on measurement precision and accuracy • critically evaluate the applicability of certain measurement procedures and the data processing • analyse relationships of experimental data using specific computer skills • practical application of different computer programs (such as Excel and Statistica) in processing and analysing measured data
2.5. Course content (syllabus)	The subject is divided into 4 methodological units: 1) Measurements and Measurement Features in Food Science (L / S / E = 4/4/3) Course contents related to method unit 1:

	L: The basic features of the measurement and the measurement result. Precision vs. accuracy in the measuring system. Simple and complex measurement systems and measurement errors. Confidence interval and the least square method in measuring and interpreting results. Calibration of the measuring instrument. S: Experimental data example - clarifying precision, accuracy and error (Excel). Understanding the application of reliability intervals and the method of the smallest squares in the processing of measurement results. Solve tasks on the same topic. E: Collection of measurement data in the laboratory (Exercise Calibration of the pipette of different volume and determination of the density of an unknown sample) with the statistical processing of metering data; by computing the mean values, by monitoring the accuracy and precision of measurements with the calculation of measurement errors. 2) Impedance as a measurement method for determining body composition and flow measurement (L / S / E = 4/6/6) Course contents related to methodical unit 2: L: Current, resistance, voltage and impedance measurement. Measurement of volume and mass flow in industry and in a system such as human organs. S: Conductivity and impedance through animation and calculation of fatty tissue content based on resistance and current. Getting acquainted with the basic features of measuring volumetric and mass flow through animation and flow calculation on the example of a calorimetric measurement experiment (chips, nuts, etc.). E: Using an oscilloscope to measure impedance and measurements. Calorimetry by monitoring the change of temperature during burning of a given food. Calculation of energy values per unit of mass and serving as well as comparison with data on the declaration. Calculation of faults due to loss of heat transferability. 3) Temperature, acoustics, humidity and radiation and movement of food molecules as important nutrition factors (L / S / E = 4/2/6). Course contents related to methodical unit 3: Temperature and humidity, radiation, acoustics, and motion of food molecules L: Measurement of temperature and humidity. Radiation and connection with food and nutrition. Acoustics and food. Spectroscopic Methods - Example of NIR Spectroscopy. S: Temperature and humidity as a direct and immediate measure of nutrition science, Calculation of tasks on the subject. Spectroscopy and vibration of molecules, acoustics and frequencies. E: Using an optical pyrometer in temperature measurement with the calculation of actual temperature on a remote body, apparent and relative errors. Acoustic Measurement of Fruit. NIR spectroscopy of solid and liquid samples and interpretation of the result of the food industry (level, heat transfer). Adjusts the PID controller parameters in the open and closed circuit. Application of artificial intelligence algorithms for monitoring and managing food process technologies (neural networks, fuzzy logic, genetic algorithm). 4. Seminar exposition (S = 2) Individual preparation of a seminar work on the subject of some measurement procedure used in food science (control, safety, public health etc.)

2.6. Format of instruction	☒ lectures ☒ seminars and workshops ☒ exercises ☐ *online in entirety* ☐ partial e-learning ☐ field work	☐ independent assignments ☒ multimedia and the internet ☒ laboratory ☐ work with mentor ☐ (other)	2.7. Comments:

2.8. Monitoring student work	Class attendance		N	Research	Y		Oral exam		N
	Experimental work		N	Report			(other)		
	Essay		N	Seminar paper	Y		(other)		

	Preliminary exam		N	Practical work	Y		(other)		
	Project		N	Written exam	Y		ECTS credits (total)	3	

2.9. Assessment methods and criteria	One exam is taken, in duration of 60 minutes, and the maximum number of points is 45. The exam consists of all the themes from the syllabus. Students prepare seminar papers on a given theme of measurement and/or measurement methods in nutrition or food technology. The seminar paper is orally presented to show course knowledge application, with the objective of adoption of expert terminology, induction and summing up of crucial facts and independent conclusions related to the seminar paper theme. The maximum number of points for the seminar paper is 40. The exam is used for assessing knowledge level, and the seminar paper for assessing knowledge application level. The final grade is a sum of points of the exam and the seminar paper, and is allocated according to this scale: **3. Grading scale:** < 48 → fail (1) 48 – 59 → sufficient (2) 60 – 71 → good (3) 72 – 83 → very good (4) > 84 → excellent (5) An oral exam is offered as an option to student which want to increase their grade. The oral exam is held according to agreement and another student or associate is present with the lecturer and student.
2.10. Student responsibilities	To pass the course, students have to: • successfully do all the exercises in practical work • achieve a minimum of 50% of points on the written exam • attend a minimum of 80% of all lectures • write and hand in a seminar paper

2.11. Required literature (available in the library and/or via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	J. Gajdoš Kljusurić (2014) Basics of Measurement Methods in Nutrition (internal script)	0	YES, Merlin and web pages

2.12. Optional literature	• Bower, John (2009) Statistical Methods for Food Science: Introductory procedures for the food practitioner by John Wiley and Sons • Engle, Patrice L., Menon, Purnima, Haddad, Lawrence (1997) Care and Nutrition: Concepts and Measurement (Occasional Papers (International Food Policy Research Institute, Washington, DC: International Food Policy Research Institute. • Ireton-Jones, Carol S., Gottschlich, Michele M. Bell, Stacey J. (1998) Practice-Oriented Nutrition Research: An Outcomes Measurement Approach Jones & Bartlett Publishers
2.13. Exams	*Exam dates are published in Studomat.*
2.14. Other	-

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Jasenka Gajdoš Kljusurić, PhD, Full Professor Davor Valinger, PhD, Assistant Professor Ana Jurinjak Tušek, PhD, Assistant Professor Tamara Jurina, PhD	1.8. Semester when the course is delivered	winter
1.2. Course title	**Process Measurement and Control in Food Engineering**	1.9. Number of ECTS credits allocated	3

1.3. Course code	39769	1.10. Number of contact hours (L+E+S+e-learning)	25 + 19 + 0 + 1
1.4. Study programme	Undergraduate university study programme Food Technology	1.11. Expected enrolment in the course	70
1.5. Course type	compulsory	1.12. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2. 5 %
1.6. Place of delivery	lectures in P4, exercises in the LMRA	1.13. Language of instruction	Croatian and English
1.7. Year of study when the course is delivered	third	1.14. Mogućnost izvođenja na stranom jeziku	Y
2. COURSE DESCRIPTION			
2.1. Course objectives	• Teach the students a systematic approach to metrology. Provide them with the necessary knowledge and experience on the methodology of experiment planning in the biotechnical field (examples from the food industry) with an emphasis on measurements, and processing data for management purposes. • To enable the acquisition of knowledge for the selection of measuring devices, measurement methods and measurement accuracy analysis and static evaluation of experimental results when measuring individual Physics sizes in certain accuracy classes • Introduce students with the basic concepts of system control, structural forms of management and control based on the analysis of the dynamics of the system in technological processes, in the food industry. In addition to the theoretical basis, practical knowledge of PID regulator parameters for higher-level system models with time lag is also gained.		
2.2. Enrolment requirements and/or entry competences required for the course	To enrol in this course, the following courses must be completed: • Transport Phenomena • Unit Operations • Statistics		
2.3. Learning outcomes at the level of the programme to which the course contributes	• apply knowledge and skills from basic, applied and engineering scientific disciplines in the field of food technology • apply acquired knowledge and skills from food engineering practically in the conduct of technological processes of food production and processing • identify, analyse, solve simple problems, and do complex jobs in microbiological and physical-chemical control laboratories of food industry • apply and integrate the acquired knowledge and skills and participate in quality control work (quality control of production and food) • identify problems in production and communicate them to their superior and subordinates • collect and interpret results of laboratory food analyses • summarize conclusions based on research results from the field of food technology • present plant, research, laboratory and business results in verbal and written form, using professional terminology • develop learning skills which are needed to continue studying at graduate levels and conscience about the need of lifelong learning • apply ethical principles, legal regulations and standards related to specific requirements of the profession		
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	• assess the calibration procedure, the importance of the accuracy class and the measuring range of the measuring instruments • review different statistical indicators in the analysis of laboratory results and relate them with accuracy and precision • describe different measurement methods used in the food industry • valorise the various measurement methods used in the food industry • evaluate the basic concepts of management of technical systems and structural forms of management (program, feedback and pre-connection)		

	• validate the simulation of system dynamics in the manufacturing process in the food industry • distinguish linear systems by using transfer functions of basic technological operations in the food industry
2.5. Course content (syllabus)	The subject is divided into 3 basic methodological units: 1) Basic measurement and production process management functions and processing of measurement data (L / S / E = 6/3/3) Course contents related to method unit 1: Basic features of measurement and management of the production process, and processing of measurement data (measurement system and its features). (The basic features of measurement and management and review of measurement errors in the measurement system. The precision vs. accuracy in measurement. Measuring systems (simple and complex). Accuracy class in a measurement system. Measurements and the connection of the measurement result with a confidence interval, and the method of least squares. Calibration) 2) Measurement of individual physical units in the food production process (L / S / E = 9/6/9) Course contents related to methodical unit 2: Measurement of the individual process(es) (individual measurements in the production process (current, voltage, resistance, pressure, humidity, level, flow rate (mass, volume, and the molar flow rate, the flow of energy in the example calorimetry), temperature (and the thermistors) and radiation (thermography and spectroscopy)). the divisions and descriptions of measurement methods for each measured value) 3) Automation Process and Dynamic System Governance (L / S / E = 9/3/9) Course contents related to method unit 3: Automation and Industrial Control Systems (Introduction to the automation and industrial control systems. The meaning and classification size in the control system. The dynamics of the system 1st and 2nd degree. The poles of the transfer function. Features management with two common types of automation: Feedback Control and Sequence Control. Introduction to algorithms tuning PID controller parameters in industrial drives, and use of computer programs for the analysis and simulation of the system) · Seminar paper - option for additional points
2.6. Format of instruction	☒ lectures ☒ seminars and workshops ☒ exercises ☐ *online in entirety* ☒ partial e-learning ☒ field work ☐ independent assignments ☒ multimedia and the internet ☒ laboratory ☐ work with mentor ☐ (other)
2.7. Comments:	

2.8. Monitoring student work									
	Class attendance		N	Research	Y		Oral exam		N
	Experimental work		N	Report		N	e-learning tests	Y	
	Essay		N	Seminar paper	Y		(other)		
	Preliminary exam	Y		Practical work	Y		(other)		
	Project		N	Written exam	Y		ECTS credits (total)	3	

2.9. Assessment methods and criteria	
1. Maximum number of points by activity type:	
1. partial exam	40
2. partial exam	30
Final exam (exercises)	12,5
Exercises (Preliminary exam)	17,5

	Total 100 Students can get bonus points: Seminar paper 5 Test/e-learning 2 Bonus points are added up to other points to get the final grade. **2. Partial exams** In the exam period, the failed partial exam is taken. If students do not pass the course via partial exams, taking the exam in the exam period is considered to be the first examination. Passing prior partial exams is not a prerequisite for taking the subsequent ones. **3. Grading scale:** < 51,0 fail (1) ≥ 51,1 – 62,0, sufficient (2) ≥ 62,1 - 75,0 good (3) ≥ 75,1 – 88,0 very good (4) ≥ 88,1 excellent (5) An oral exam is offered as an option to students who want to increase their grade. The oral exam is held according to agreement and another student or associate is present with the lecturer and student.
2.10. Student responsibilities	To pass the course, students have to: • achieve a minimum of 50% of points on the preliminary exams in practical work (exercises) • pass the preliminary exams and successfully do all the exercises in practical work • attend all lectures (a maximum of two unjustified absences is allowed) • achieve a minimum of 51 % of points on each partial exam

2.11. Required literature (available in the library and/or via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	J. Gajdoš Kljusurić i sur (2016) Mjerenja u prehrambenoj industriji (internal script)	0	YES, Merlin and web pages

2.12. Optional literature	• Bhuyan, M. (2007) Measurement and Control in Food Processing. CRC, Taylor & Francis Group. • Kurtanjek, Ž., Gajdoš Kljusurić, J. (2014) Mathematical and Statistical Methods in Food Science and Technology (ur. Granato, D. i Ares, G.) John Wiley and Sons, Oxford, UK. • Chau, P.C. (2002) Process Control: A First Course with MATLAB, Cambridge University Press, United Kingdom. • Prljača, N., Šehić, Z. (2008) Automatsko upravljanje: analiza i dizajn. Mikroštampa, Tuzla.
2.13. Exam dates	*Exam dates are published in Studomat.*
2.14. Other	-

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Kata Galić, PhD, Full Professor Mario Ščetar, PhD, Assistant Professor Mia Kurek, PhD, Assistant Professor	1.8. Semester when the course is delivered	winter
1.2. Course title	**Food Packaging**	1.9. Number of ECTS credits allocated	4
1.3. Course code	53282	1.10. Number of contact hours (L+E+S+e-learning)	25 + 15 + 0 + 0
1.4. Study programme	Graduate university study programme Food Engineering	1.11. Expected enrolment in the course	50
1.5. Course type	compulsory	1.12. Level of application of e-learning (level 1, 2, 3),	2. 0 %

		percentage of online instruction (max. 20%)	
1.6. Place of delivery	Lectures and seminars P5, Laboratory exercises in LPCC	1.13. Language of instruction	Croatian and English
1.7. Year of study when the course is delivered	first	1. 14. Possibility of instruction in English	Y
2. COURSE DESCRIPTION			
2.1. Course objectives	The objective of the course is to learn types, methods of production and characteristics of food packaging materials. Students will learn about food packaging methods, food interaction patterns with a particular type of food packaging material as well as with the consequences for packed food.		
2.2. Enrolment requirements and/or entry competences required for the course	-		
2.3. Learning outcomes at the level of the programme to which the course contributes	• recognize the importance of all segments of food production (raw material features, technology applied, production and packaging conditions , effect of processing and preservation on chemical composition of food products, potential effects of packaging, quality assurance) • select and purchase raw materials and packaging materials, and conduct quality control of raw materials and products • conceptualize and carry out improvement of existing technological procedures • do highly-complex jobs in microbiological, physical and chemical control and development laboratories of food industry • make conclusions about selection and purchasing of raw materials, packaging and equipment • manage or work in an interdisciplinary team, which conceptualizes and conducts experiments in the field of food technology • apply ethical principles in relationships to coworkers and employer • apply ethical principles, legal regulations and standards related to specific requirements of the profession • use and value scientific and occupational literature with the aim of lifelong learning and profession enhancement		
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	• apply appropriate analytical methods for the characterisation of different packaging materials • interpret the advantages of aseptic food packaging in comparison to other food packaging methods • apply vacuum packaging to the appropriate food product • apply modified atmosphere packaging to the appropriate food product • provide examples of active and intelligent food packaging and their use for a specific food product • explain the consequences of the food/packaging interaction • explain advantages and disadvantages of use of different packaging materials and packaging methods for a specific food product • explain a possible interaction of a specific food product with different food packaging materials		
2.5. Course content (syllabus)	Definitions, functions and classification of packaging materials (basic, with regard to: waste, handling, material type). Functions and importance of food packaging. Materials (wood; glass, metal, paper, plastics, laminates, biodegradable and edible materials). Packaging manufacture (injection moulding, pressing, blowing, extrusion, calendering, blow molding, two and three pieces cans production, glass and plastic bottles). Packaging forms and shapes. Closures. Packaging systems. Packaging methods: aseptic, vacuum, modified/controlled, active and intelligent packaging, susceptors. Food/packaging interaction (corrosion, migration, gas and water vapour permeability). Handling and transportation. Types of transport. Warehouses. Packaging machinery. Packaging regulations (EU legislation). Packaging and environment (package waste and recycling).		

<table>
<tr><td>2.6. Format of instruction</td><td colspan="3">☒ lectures
☒ seminars and workshops
☐ exercises
☐ on-line in entirety
☐ partial e-learning
☐ field work</td><td colspan="3">☐ independent assignments
☐ multimedia and the internet
☒ laboratory
☐ work with mentor
☐ (other)</td><td colspan="3">2.7. Comments:</td></tr>
<tr><td rowspan="6">2.8. Monitoring student work</td><td>Class attendance</td><td></td><td>N</td><td>Research</td><td></td><td>N</td><td>Oral exam</td><td></td><td>N</td></tr>
<tr><td>Experimental work</td><td>Y</td><td></td><td>Report</td><td></td><td>N</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>N</td><td>Seminar paper</td><td>Y</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td></td><td>N</td><td>Practical work</td><td></td><td>N</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>N</td><td>Written exam</td><td>Y</td><td></td><td>ECTS credits (total)</td><td colspan="2">4</td></tr>
<tr><td></td><td colspan="9"></td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">$$Grade\ (\%) = \left(\frac{T_{achieved}}{T_{max}}\right) * 60 + \left(\frac{S_{achieved}}{S_{max}}\right) * 20 + \left(\frac{L_{achieved}}{L_{max}}\right) * 20$$

1. Maximum number of points by activity type:
1. Partial exam (T) 30
2. Partial exam (T) 30
Seminar paper presentations (S) 20
Laboratory exercises (L) 20
Total 100

2. Partial exams
In the exam period, the failed partial exam is taken. If students do not pass the course via partial exams, taking the exam in the exam period is considered to be the first examination. Passing the first partial exam is not a prerequisite for taking the second partial exam.

3. Grading scale:
90 - 100 (excellent-5)
80 - 89 (very good-4)
70 - 79 (good-3)
60 - 69 (sufficient-2)
0 - 59 (fail-1)

Oral exam: A possibility for increasing grades</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9">To pass the course, students have to:
successfully do all the exercises in practical work and hand in the reports
attend all lectures
present a given topic (case study)
achieve a minimum of 16 points on each partial exam
achieve a minimum of 12 points with laboratory exercises
achieve a minimum of 12 points with the topic presentation (case study)
achieve a minimum of 60 points in total</td></tr>
<tr><td rowspan="2">2.11. Required literature (available in the library and/or via other media)</td><td colspan="4">Title</td><td>Number of copies in the library</td><td colspan="4">Availability via other media</td></tr>
<tr><td colspan="4">VUJKOVIĆ I., GALIĆ K., VEREŠ M., Ambalaža za pakiranje namirnica,</td><td>10</td><td colspan="4">YES, Laboratory for Food Packaging, 400 copies</td></tr>
</table>

	Sveučilišni udžbenik, TECTUS, Zagreb 2007., chapters 1-14.		
	GALIĆ K., CIKOVIĆ N., BERKOVIĆ K. "Analiza ambalažnog materijala", izdavač: Hinus, Zagreb, 2000.	NUL - 1	YES, http://www.hinus.hr/wp-content/knjige/2011/10/ANALIZA-AMBALAZNOG-MATERIJALA.pdf
2.12. Optional literature	• ROBERTSON, G. L., Food Packaging, Principles and Practice, Marcel Dekker, Inc., New York 2013		
2.13. Exams	*Exam dates are published in Studomat.*		
2.14. Other	-		

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Kata Galić, PhD, Full Professor	1.8. Semester when the course is delivered	winter
1.2. Course title	**Selected Topics in Food Packaging**	1.9. Number of ECTS credits allocated	3
1.3. Course code	53732	1.10. Number of contact hours (L+E+S+e-learning)	15 + 0 + 15 + 0
1.4. Study programme	Graduate university study programme Food Safety Management	1.11. Expected enrolment in the course	do 5
1.5. Course type	optional A	1.12. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2. 0 %
1.6. Place of delivery	Consultations in lecturer's room (102)	1.13. Language of instruction	Croatian and English
1.7. Year of study when the course is delivered	second	1. 14. Possibility of instruction in English	Y
2. COURSE DESCRIPTION			
2.1. Course objectives	The course objective is to learn students about the choice of packaging materials and methods for a particular group of food products (fresh, frozen, dehydrated, etc.) depending on the processing conditions (thermal and non-thermal). Students will be familiar with different forms of interaction of food with a particular food packaging material as well as with the consequences for packed food.		
2.2. Enrolment requirements and/or entry competences required for the course	-		
2.3. Learning outcomes at the level of the programme to which the course contributes	• establish, manage, control and supervise food safety system in the production chain, and manage its potential risks • do complex food analyses in microbiological and physical-chemical control and research laboratories • independently analyse, make conclusions and present results of conducted analyses; • independently study and interpret results, and make conclusions and solutions • manage or participate in interdisciplinary teams, which create or implement new methods with the aim of improving food safety and quality system from field to table • convey their knowledge and conclusions to both professionals and the general public, in a clear and well-reasoned manner • continuously follow up contemporary trends in the field of food safety • apply ethical principles in relationships to coworkers and employer • apply ethical principles, legal regulations and standards related to specific requirements of the profession • use and value scientific and occupational literature with the aim of lifelong learning and profession enhancement		

<table>
<tr><td>2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)</td><td colspan="9">

explain the choice of protective laquerer depending on the agressiviness of a particular food product
list the criteria for a protective lacquerer on the metal cans for food packaging
explore and present examples of use of multilayer materials for packaging of frozen and dehydrated food
argue the choice of packaging material for fresh food
explain the composition of mulitilayer and composite materials used in thermal processing of packed food
list examples of food packaging materials to be used in thermal processing
argue the choice of food packaging material with regard to thermal processing of packed food
argue the choice of food packaging material with regard to non-thermal processing of packed food and list the examples
list parameters for packaging integrity control with regard to metal and polymer packaging
list parameters for packed food safety control with regards to metal and polymer packaging

</td></tr>
<tr><td>2.5. Course content (syllabus)</td><td colspan="9">Functional requirements of packaging materials. Protective laquers on food cans with regard to food type. Multilayer (laminates) and composite (metallised, susceptors) materials. Advances in food packaging materials and methods. Packaging machinery. Storage conditions. Selection of food packaging material for fresh, dehydrated, processed food (thermal, non-thermal). Food-packaging interaction. Legislation in food packaging.Selection of food packaging material and method with regard to food product (student presentation on selected food product).</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="3">☒ lectures
☒ seminars and workshops
☐ exercises
☐ on-line in entirety
☐ partial e-learning
☐ field work</td><td colspan="3">☐ independent assignments
☐ multimedia and the internet
☐ laboratory
☒ work with mentor
☐ (other)</td><td colspan="3">2.7. Comments:</td></tr>
<tr><td rowspan="5">2.8. Monitoring student work</td><td>Class attendance</td><td>Y</td><td></td><td>Research</td><td></td><td>N</td><td>Oral exam</td><td>Y</td><td>For higher grade</td></tr>
<tr><td>Experimental work</td><td></td><td>N</td><td>Report</td><td></td><td>N</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>N</td><td>Seminar paper</td><td>Y</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td></td><td>N</td><td>Practical work</td><td></td><td>N</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>N</td><td>Written exam</td><td></td><td>N</td><td>ECTS credits (total)</td><td colspan="2">3</td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">
1. Maximum number of points by activity type:
Class attendance 5
<u>Seminar paper presentation (95):</u>
Prepared presentation 20
Presentation 35
<u>Answering questions 40</u>
Total 100

2. Grading scale:
90 - 100 (excellent - 5)
80 - 89 (very good- 4)
70 - 79 (good - 3)
60 - 69 (sufficient - 2)
< 60 (fail - 1)
</td></tr>
</table>

	Oral exam: students who are unsatisfied with the achieved grade can register for the oral exam. The grade achieved on the oral exam is final, even if it is lower than the previously achieved one.		
2.10. Student responsibilities	To pass the course, students have to: • attend all lectures • present a given topic (case study) • achieve a minimum of 60 points in total		
2.11. Required literature (available in the library and/or via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	VUJKOVIĆ I., GALIĆ K., VEREŠ M., Ambalaža za pakiranje namirnica, Sveučilišni udžbenik, TECTUS, Zagreb 2007., chapters 2, 4, 6, 8, 12, 14.	10	YES, Laboratory for Food Packaging **400 copies**
2.12. Optional literature	• ROBERTSON, G. L., Food Packaging, Principles and Practice, Marcel Dekker, Inc., New York 2013		
2.13. Exams	*Exam dates are published in Studomat.*		
2.14. Other	-		

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Mario Ščetar, PhD, Assistant Professor Kata Galić, PhD, Full Professor Mia Kurek, PhD, Assistant Professor	1.8. Semester when the course is delivered	summer
1.2. Course title	**Shelf Life of Packaged Foodstuffs**	1.9. Number of ECTS credits allocated	3
1.3. Course code	53298	1.10. Number of contact hours (L+E+S+e-learning)	15 + 0 + 15 + 0
1.4. Study programme	Graduate University Study Programme Food Engineering, Graduate University Study Programme Food Safety Management, Graduate University Study Programme Nutrition, Graduate University Study Programme Molecular Biotechnology	1.11. Expected enrolment in the course	20
1.5. Course type	optional B	1.12. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2. 0 %
1.6. Place of delivery	P5	1.13. Language of instruction	Croatian i English
1.7. Year of study when the course is delivered	second	1. 14. Possibility of instruction in English	Y
2. COURSE DESCRIPTION			
2.1. Course objectives	The objective of the course is to learn students about food shelf-life defifntion and factors that influence the food shelf-life. Main principles and legislation frame related to the determination of shelf-life of packed food. Methods (direct and indirect) and protocol for determination of food shelf-life.		
2.2. Enrolment requirements and/or entry competences required for the course	-		
2.3. Learning outcomes at the level of the programme to which the course contributes	Graduate University Study Programme Food Engineering • select and purchase raw materials and packaging materials, and conduct quality control of raw materials and products • do highly-complex jobs in microbiological, physical and chemical control and development laboratories of food industry		

	• apply ethical principles, legal regulations and standards related to specific requirements of the profession • use and value scientific and occupational literature with the aim of lifelong learning and profession enhancement Graduate University Study Programme Food Safety Management • define principles and strategy of product quality, organize and manage quality system in food industry • establish, manage, control and supervise food safety system in the production chain, and manage its potential risks • manage or participate in interdisciplinary teams, which create or implement new methods with the aim of improving food safety and quality system from field to table • manage or participate in interdisciplinary teams, which create or implement new methods with the aim of improving food safety and quality system from field to table • apply ethical principles, legal regulations and standards related to specific requirements of the profession • use and value scientific and occupational literature with the aim of lifelong learning and profession enhancement Graduate University Study Programme Molecular Biotechnology • manage particular laboratory units in biotechnology, food and pharmaceutical industry and other institutions owing to their knowledge of contemporary biochemical, microbiological, molecular genetic and instrumental methods Graduate University Study Programme Nutrition • evaluate food distribution systems (hospitals, schools...) in order to improve the quality of food preparation and nutrititive value of meals • analyse, compare and interpret the results obtained by research methods • use and value scientific and occupational literature with the aim of lifelong learning and profession enhancement
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	• explain the influence of packaging material and packaging method on the food shelf-life • define barrier properties of food packaging material (gas permeability, water vapour permeability) and their influence on the degradation of packed foodstuff • define external parameters and their influence on the packed food shelf-life • argue the choice of food shelf-life testing method and its applicability with regard to packed food product • explain consequences of food/packaging interaction and the possibility to prove this interaction • identify and explain the desirable and undesirable characteristics of the shelf-life of certain pakaging material for a specific food product • present and explain the protocol for determination of the food shelf-life of the selected food product in the appropriate (adequate) food packaging material • explain and argue the possibilities of increasing the validity of the packaged food product
2.5. Course content (syllabus)	General shelf life analysis requirements. Effect of packaging material on product shelf-life. Shelf-life protocols. Challenge study; Accelerated shelf life testing; Confirmatory storage study; On-going shelf life monitoring. Factors affecting permeation characteristics of packaging materials. Barrier characteristics of packaging materials. Packaging permeation on: gases, water vapour. Permeability ratio (material selectivity). Food-package interaction (corrosion, migration: global, specific). Shelf-life with regard to: moisture gain, moisture loss. Evaluation of the rate of oxidation of foods packaged in a semipermeable pouch. The kinetic model. Determination of shelf-life of food stored in frige and refrigerator. Recomended gas content for food packed in the modified atmosphere with regard to product: fresh fruits and vegetables: respiration rate, rate of etilene production.

<table>
<tr><td></td><td colspan="9">Shelf-life determination: case studies. Tasks definition and allocation. Seminars presentation by students.</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="3">☒ lectures
☒ seminars and workshops
☐ exercises
☐ on-line in entirety
☐ partial e-learning
☐ field work</td><td colspan="3">☒ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td colspan="3">2.7. Comments:</td></tr>
<tr><td rowspan="6">2.8. Monitoring student work</td><td>Class attendance</td><td>Y</td><td></td><td>Research</td><td></td><td>N</td><td>Oral exam</td><td>Y</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>N</td><td>Report</td><td></td><td>N</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>N</td><td>Seminar paper</td><td>Y</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td></td><td>N</td><td>Practical work</td><td></td><td>N</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>N</td><td>Written exam</td><td></td><td>N</td><td>ECTS credits (total)</td><td colspan="2">3</td></tr>
<tr><td></td><td colspan="9"></td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">1. Maximum number of points by activity type:
1. Class attendance 5 points
2. Seminar paper presentation 50 points
3. Oral exam 45 points
Total 100 points

2. Grading scale:
90 - 100 (excellent - 5)
80 - 89 (very good - 4)
70 - 79 (good - 3)
60 - 69 (sufficient - 2)
0 - 59 (fail - 1)</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9">To pass the course, students have to:
• attend all lectures
• give a presentation of a given theme (case study)
• achieve a minimum of 35 points from the presented theme (case study)
• achieve a minimum of 25 points on the oral exam
• achieve a minimum of 60 points in total</td></tr>
<tr><td rowspan="3">2.11. Required literature (available in the library and/or via other media)</td><td colspan="6">Title</td><td>Number of copies in the library</td><td>Availability via other media</td></tr>
<tr><td colspan="6">VUJKOVIĆ I., GALIĆ K., VEREŠ M., Ambalaža za pakiranje namirnica, Sveučilišni udžbenik, TECTUS, Zagreb 2007.; chapters 2, 4, 6, 8, 12, 14.</td><td>10</td><td>YES, Laboratory for Food Packaging, 400 copies</td></tr>
<tr><td colspan="6">STEEL, R. (Ed.) Understanding and measuring the shelf-life of food, Woodhead Publiching Limited and CRC Press LLC, 2004., pp. 1 - 448</td><td>0</td><td>YES, WEB</td></tr>
<tr><td>2.12. Optional literature</td><td colspan="9">• ROBERTSON, G. L., Food Packaging, Principles and Practice, Marcel Dekker, Inc., New York 2013.</td></tr>
<tr><td>2.13. Exams</td><td colspan="9">Exam dates are published in Studomat.</td></tr>
<tr><td>2.14. Other</td><td colspan="9">-</td></tr>
</table>

1. GENERAL INFORMATION

1.1. Course lecturer(s)	Jurica Žučko, PhD, Assistant Professor Višnja Bačun-Družina, PhD, Full Professor	1.8. Semester when the course is delivered	summer
1.2. Course title	**Nutrigenomics**	1.9. Number of ECTS credits allocated	4
1.3. Course code	66827	1.10. Number of contact hours (L+E+S+e-learning)	20 + 20 + 10 + 0
1.4. Study programme	Graduate university study programme Nutrition	1.11. Expected enrolment in the course	40
1.5. Course type	optional A	1.12. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	1. 20 %
1.6. Place of delivery	P6	1.13. Language of instruction	Croatian and English
1.7. Year of study when the course is delivered	first	1. 14. Possibility of instruction in English	Y

2. COURSE DESCRIPTION	
2.1. Course objectives	The objective of the course is to introduce students to the basics of various "omics" used to decipher interaction between our genetic makeup and environmental factors, including nutrients, and to explain technology behind it. The course will also cover basic concepts of genetics and evolution as well as newer concepts involved in controlling our genetic makeup and health such as epigenome and microbiome.
2.2. Enrolment requirements and/or entry competences required for the course	-
2.3. Learning outcomes at the level of the programme to which the course contributes	• understand and have knowledge of general skills in basic and applied disciplines • understand and acquire knowledge of general skills in particular interdisciplinary disciplines through elective modules • analyse and evaluate conditions to apply the appropriate method of food quality assessment and the strategies for the improvement of dietary habits with the goal of prevention and improvement of national health or the one of targeted population groups • analyse, compare and interpret the results obtained by research methods • present and popularize particular contemporary trends in the field of nutrition science to scientific, professional and laymen circles • apply ethical principles, legal regulations and standards related to specific requirements of the profession • use and value scientific and occupational literature with the aim of lifelong learning and profession enhancement
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	• define basic concepts in genetics and nutrigenomics emphasising population genetic diversity and single nucleotide polimorphisms as driving forces for diseases • categorise methods for DNA sequencing, analyse current methods of DNA sequencing and genetic testing • explain scope of nutrigenetics and nutrigenomics, review existing data on nutrition-gene interactions • propose ethical, legal and social questions in regard to nutrigenomics testing, taking into account individual's right to privacy and use of personal genetic data • search online literature databases using various search types and controlled vocabulary used in biomedicine
2.5. Course content (syllabus)	• data retrieval • basic concepts in nutrigenomics • Influence factors • Omics • Food and genes

2.6. Format of instruction	☒ lectures ☒ seminars and workshops ☒ exercises ☐ *online in entirety* ☒ partial e-learning ☐ field work			☐ independent assignments ☒ multimedia and the internet ☐ laboratory ☐ work with mentor ☐ (other)			2.7. Comments:			
2.8. Monitoring student work	Class attendance		N	Research	Y		Oral exam		N	
	Experimental work		N	Report		N	(other)			
	Essay		N	Seminar paper	Y		(other)			
	Preliminary exam		N	Practical work		N	(other)			
	Project		N	Written exam	Y		ECTS credits (total)	4		
2.9. Assessment methods and criteria	Depending on student's choice: Written exam only – 100% of points Written exam 70 % and seminar paper 30 % of points. The total number of points is 30 and they are allocated according to the chosen assessment method. The grade is formed as a sum of all gathered points divided by 30 and multiplied by 100, whereby the final grade is formed as follows: < 60 % fail ≥ 60 % sufficient ≥.70 % good ≥ 80 % very good ≥ 90 % excellent									
2.10. Student responsibilities	To pass the course, students have to: • successfully do all the exercises in practical work and seminars and pass the written exam • achieve a minimum of 60% of total points									

2.11. Required literature (available in the library and/or via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Internal script	0	YES, Merlin
2.12. Optional literature	• M. Lucock: Molecular Nutrition and Genomics: Nutrition and the Ascent of Humankind, Wiley-Blackwell (2007) • R. Brigelius-Flohé, H.G. Joost: Nutritional Genomics: Impact on Health and Disease, Wiley VCH (2006)		
2.13. Exams	*Exam dates are published in Studomat.*		
2.14. Other	-		

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Antonio Starčević, PhD, Associate Professor Jurica Žučko, PhD, Assistant Professor Janko Diminić, PhD, Assistant Professor	1.8. Semester when the course is delivered	summer
1.2. Course title	**Bioinformatics**	1.9. Number of ECTS credits allocated	4
1.3. Course code	53249	1.10. Number of contact hours (L+E+S+e-learning)	20 + 10 + 10 + 0

1.4. Study programme	Graduate university study programme Molecular Biotechnology	1.11. Expected enrolment in the course	40
1.5. Course type	compulsory	1.12. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	1. 20 %
1.6. Place of delivery	lecture hall 6	1.13. Language of instruction	Croatian and English
1.7. Year of study when the course is delivered	first	1.14. Possibility of instruction in English	Y

2. COURSE DESCRIPTION

2.1. Course objectives	This course will ensure the theoretical and practical education in the field of computational biology. In order to achieve this in the given timeframe, students will get to learn how to use most common bioinformatic algortihms and interpret their results. They will obtain overview of biological sequence public repositories and finally they will be able to perform independent bioinformatic analyses of genes and gene clusters.
2.2. Enrolment requirements and/or entry competences required for the course	-
2.3. Learning outcomes at the level of the programme to which the course contributes	• integrate knowledge acquired from the fields of microbiology, microbe physiology, molecular biology, genetics and bioinformatics with the aim of producing traditional and modern biotechnological products • apply knowledge acquired in order to construct genetically modified organisms of desired traits • participate in biomedical and related biomolecular researches on account of basic knowledge of molecular and cellular biology and genetics, bioinformatics, immunology and human physiology • select corresponding model organism for conducting of particular biological tests or scientific researches • use scientific literature in English, and present the existing results to experts and laymen, and convey their knowledge and skills to their peers • present, valorize and popularize modern accomplishments and courses of development of molecular biotechnology • participate actively in scientific paper discussion from the field of molecular biotechnology and related sciences • act in accordance with ethical principles and acquire new knowledge and skills, as a part of lifelong learning and profession promotion, including PhD studies in molecular biotechnology and other bio-sciences
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	• define bioinformatics and its area of application • name and number major bioinformatic data sources • number and describe major bioinformatic tools for public database searches • construct logical query for targeted data acquisition (genes, proteins,...) from single organism, multiple organisms, gene loci, expression sites etc. • name major examples of modern (next gen) sequencing technologies and to discuss their strengths/weaknesses compared to Sanger sequencing method • categorize proteins based on their respective protein families • discuss terms and concepts of proteomics and functional genomics • define concept of phylogeny
2.5. Course content (syllabus)	• Basic bioinformatics • Bioinformatics in genomics • Bioinformatics in proteomics • Algorithms in bioinformatics

2.6. Format of instruction	☒ lectures ☒ seminars and workshops ☒ exercises ☐ *online in entirety*	☒ independent assignments ☒ multimedia and the internet	2.7. Comments:

	☒ partial e-learning ☐ field work			☐ laboratory ☐ work with mentor ☐ (other)						
2.8. Monitoring student work	Class attendance	Y		Research	Y		Oral exam		N	
	Experimental work		N	Report	Y		(other)			
	Essay		N	Seminar paper	Y		(other)			
	Preliminary exam		N	Practical work	Y		(other)			
	Project	Y		Written exam	Y		ECTS credits (total)	4		
2.9. Assessment methods and criteria	**Maximum number of points by activity type** 1. Final exam 70 2. Seminar paper 20 3. Practical work 10 Total 100 **Grading scale:** < 60 % fail (1) ≥ 60 % sufficient (2) ≥ 70 % good (3) ≥ 80 % very good (4) ≥ 90 % excellent (5)									
2.10. Student responsibilities	To pass the course, students have to: • successfully do all the exercises in practical work and seminars • achieve a minimum of 60 % of total number of points									

2.11. Required literature (available in the library and/or via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Jean-Michel Claverie, Cedric Notredame, Bioinformatics For Dummies, 2nd Edition (2006) Wiley Publishing, Inc., ISBN: 978-0-470-08985-9	0	YES, libraries, Internet
	http://www.ncbi.nlm.nih.gov/sites/gquery	0	YES, online
	http://www.bioinformatics.org/	0	YES, online
2.12. Optional literature	-		
2.13. Exams	*Exam dates are published in Studomat.*		
2.14. Other	-		

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Višnja Bačun-Družina, PhD, Full Professor Ksenija Durgo, PhD, Full Professor Ana Huđek, mag. ing.	1.8. Semester when the course is delivered	winter
1.2. Course title	**Genetics of Industrial Organisms**	1.9. Number of ECTS credits allocated	3
1.3. Course code	53262	1.10. Number of contact hours (L+E+S+e-learning)	20 + 15 + 0 + 0
1.4. Study programme	Graduate university study programme Molecular Biotechnology	1.11. Expected enrolment in the course	20
1.5. Course type	optional A	1.12. Level of application of e-learning (level 1, 2, 3),	2. 0 %

		percentage of online instruction (max. 20%)	
1.6. Place of delivery	lectures in P5, exercises in the LBMG	1.13. Language of instruction	Croatian
1.7. Year of study when the course is delivered	first	1.14. Possibility of instruction in English	Y

2. COURSE DESCRIPTION

2.1. Course objectives	The latest discoveries about finding and designing a gene *de novo* for the production of new biomolecules will inspire innovative ideas in young experts.
2.2. Enrolment requirements and/or entry competences required for the course	-
2.3. Learning outcomes at the level of the programme to which the course contributes	Doprinos ishodima učenja programa
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	• analyze mixed bacterial culture and respond to stress, bacterial growth in the extended stationary phase and formation of different mutants. • explain the possibilities of communication between bacteria and the creation of biofilmskreirati različite postupke za analizu metagenoma i objasniti značaj komparativne genomike i metagenomskih knjižnica • explain how to modify gene by chemical and / or physical mutagenic agents, locally directed mutagenesis and in vitro suppression of amber mutations • explain the difference between directed evolution, rational design of microorganisms in vivo by mixing DNA molecules and genomic engineering using the CRISPR-Cas9 systemkategorizirati ne kodirajuće molekule RNA i kreirati najpogodnije za funkcionalnu genomiku te terapeutsku primjenu • compare the known transgenic technology methods and propose their application for the needs of molecular biotechnology and pharmaceutical industryobrazložiti razliku u nomenklaturi gena prokariotskih i eukariotskih organizama • interpret methods of preservation and maintenance of microorganisms and cell lines
2.5. Course content (syllabus)	• Properties of industrial organisms • Epigenetics of industrial organisms • Microbial diversity and metagenomics • Metabase analysis • How to change a gene? • Methods of directed evolution • Transgene cells and animals • Application of non-coding RNA molecules • Nomenclature of industrial organism genes

2.6. Format of instruction			2.7. 2.7. Comments:
	☒ lectures ☐ seminars and workshops ☒ exercises ☐ *online in entirety* ☐ partial e-learning ☐ field work	☐ independent assignments ☐ multimedia and the internet ☒ laboratory ☐ work with mentor ☐ (other)	

2.8. Monitoring student work									
	Class attendance	Y		Research		N	Oral exam		N
	Experimental work	Y		Report	Y		(other)		
	Essay		N	Seminar paper		N	(other)		
	Preliminary exam		N	Practical work		N	(other)		
	Project		N	Written exam	Y		ECTS credits (total)	3	

2.9. Assessment methods and criteria	1. The written exam consists of five desriptive questions, each graded with one point. 2. Grading scale: < 60 % fail (1) ≥ 60 % sufficient (2) ≥ 70 % good (3) ≥ 80 % very good (4) ≥ 90 % excellent (5)		
2.10. Student responsibilities	To pass the course, students have to: • successfully successfully do all the exercises in practical work in practical work and hand in a written report consisting of introduction, results and conclusions • attend all lectures (a maximum of one unjustified absence is allowed for exercises, and two for lectures) • achieve a minimum of 60% of points on the written exam		
2.11. Required literature (available in the library and/or via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	GIO 1 Script: Višnja Bačun-Družina (2005) Mixed bacterial cultures and bacterial growth in the extended stationary growth phase	0	YES, Merlin and/or web pages
	GIO 2 Script: Višnja Bačun-Družina (2013) Bacterial stress response	0	YES, Merlin and/or web pages
	Višnja Bačun-Družina, Ana Huđek, Ksenija Durgo (2015) Industrial Organism Genetics, Practical Work, Script	0	YES, Merlin and/or web pages
2.12. Optional literature	• Krebs J.E. et al. (2014) Lewin's GENES XI, Jones & Bartlett Publishers, USA • Alberts, B. et al. (2002) Molecular Biology of the Cell , Garland Publishing, New York, USA. • Brown, T. A. (2002) Genomes. BIOS Scientific Publishers, Ltd; Oxford, UK.		
2.13. Exams	*Exam dates are published in Studomat.*		
2.14. Other	-		

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Ksenija Durgo, PhD, Full Professor Ana Huđek, mag. ing.	1.8. Semester when the course is delivered	summer
1.2. Course title	**Ecogenetic Studies**	1.9. Number of ECTS credits allocated	2
1.3. Course code	53225	1.10. Number of contact hours (L+E+S+e-learning)	12 + 0 + 12 + 0
1.4. Study programme	Graduate university study programme Molecular Biotechnology	1.11. Expected enrolment in the course	5-10
1.5. Course type	optional B	1.12. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2. 0 %
1.6. Place of delivery	Lectures for Croatian students in P6, for foreign students in P6 or the LBMG	1.13. Language of instruction	Croatian and English
1.7. Year of study when the course is delivered	first	1.14. Mogućnost izvođenja na stranom jeziku	Y
2. COURSE DESCRIPTION			
2.1. Course objectives	The objective of the course is to introduce students with the toxic effects of environmental contaminants at the molecular level, and at the level of individuals, populations and		

	ecosystems as a whole. Students will be able to define the mutagenic activity of a particular environmental contaminant by applying previously acquired knowledge about the relationship between the structure and effect of chemical compounds, biological and physical agents on genetic material and will be able to explain the principles of methods used in ecotoxicological research such as modeling, biomonitoring, determination of specific biomarkers and indicators of certain mechanisms of toxicity, as well as the consequences of short-term and long-term exposure of organisms to environmental contaminants depending on their stability and biodegradation.
2.2. Enrolment requirements and/or entry competences required for the course	Basic knowledge in the field of biology, chemistry, physics, biochemistry and microbiology
2.3. Learning outcomes at the level of the programme to which the course contributes	• use equipment and instruments in chemical, biochemical, microbiological and molecular-genetic laboratories • perform biological, microbiological, immunological and molecular-genetic tests and analyzes • identify, analyze and remove common problems that occur in experimental work in microbiological, biochemical and molecular-genetic laboratories • choose an appropriate model body to carry out a specific biological test or scientific research • participate in advisory and legislative bodies in the field of molecular biotechnology • guide individual units in laboratories of biotechnology, food and pharmaceutical industries and other institutions based on the knowledge of modern biochemical, microbiological, molecular-genetic and instrumental methods • use scientific literature in English to adequately present existing results to experts and to transfer knowledge and skills to their colleagues • actively participate in the discussion of scientific papers in the field of molecular biotechnology and related biosciences • behave in accordance with ethical principles and to acquire new knowledge and skills for lifelong education and advancement of the profession, including doctoral studies in the field of molecular biotechnology and other bio-sciences
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	• describe the types of toxic agents in the environment and the mechanisms responsible for toxicity at the molecular level, and at the level of the individual, population and the ecosystem as a whole • describe the consequences of short-term and long-term exposure of organisms to environmental contaminants • explain the relationship between the concentration and effect of toxic agents with respect to the physicochemical characteristics of the agent, their availability during absorption, metabolism, distribution, elimination, bioaccumulation and biomagnification • discuss theoretical assumptions and concepts, and experimental evidence of the effects of endocrine disruptors on the animal or human organism. define endocrine disruptors • identify the hypotheses and theoretical assumptions on which the scientific papers were made, and to analyze the scientific methods, results and conclusions published in the relevant works through seminar expositions • develop communicative skills on scientific concepts, hypotheses, results and interpretation of results through seminar dissemination
2.5. Course content (syllabus)	• Introduction to Ecogenetic Studies • Absorption • Metabolism • Distribution • Elimination • Chemical compounds in the environment • Dose-response • Endocrine disruptors • Mutations and cancerogenesis • Types of mutagens • Physical agents • Biological agents • Bioconversion of toxic substances in the environment

2.6. Format of instruction	☒ lectures ☒ seminars and workshops ☒ exercises ☐ *online in entirety* ☒ partial e-learning ☒ field work			☐ independent assignments ☐ multimedia and the internet ☐ laboratory ☒ work with mentor ☐ (other)			2.7. 2.7. Comments:			
2.8. Monitoring student work	Class attendance	Y		Research		N	Oral exam	Y		
	Experimental work		N	Report		N	(other)		N	
	Essay		N	Seminar paper	Y		(other)			
	Preliminary exam		N	Practical work		N	(other)			
	Project		N	Written exam	Y		ECTS credits (total)	2		
2.9. Assessment methods and criteria	**1. Maximum number of points by activity type** 1. Class attendance 10 2. Seminar paper 15 3. Final exam 75 Total 100 **2. Grading scale:** < 60 % fail (1) ≥ 60 % sufficient (2) ≥ 70 % good (3) ≥ 80 % very good (4) ≥ 90 % excellent (5)									
2.10. Student responsibilities	To pass the course, students have to: • successfully successfully do all the exercises in practical work in practical work and seminars • attend all lectures (a maximum of two unjustified absences is allowed) • achieve a minimum of 60% of total points									
2.11. Required literature (available in the library and/or via other media)	**Title**						**Number of copies in the library**	**Availability via other media**		
	Ksenija Durgo, Ecogenetic Studies (internal script)						0	YES; Merlin and web pages		
	P. Williams, R. James, S. Roberts (2000). Principles of toxicology, Environmental and industrial applications						0	YES; Merlin and web pages		
2.12. Optional literature	• S.G. Gilbert (2012).A Small Dose of Toxicology. Healthy World Press • J. Timbrell (2002). Principles of Biochemical Toxicology. Taylor and Francis									
2.13. Exams	*Exam dates are published in Studomat.*									
2.14. Other	-									

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Vladimir Mrša, PhD, Full Professor Branko Kozulić, PhD Renata Teparić, PhD, Associate Professor Igor Stuparević, PhD, Assistant Professor	1.8. Semester when the course is delivered	summer

	Antonija Grbavac, PhD Mateja Lozančić, mag. ing. Ana Novačić, mag. ing.		
1.2. Course title	**Biochemical Analysis**	1.9. Number of ECTS credits allocated	6
1.3. Course code	53248	1.10. Number of contact hours (L+E+S+e-learning)	30 + 45 + 0 + 0
1.4. Study programme	Graduate university study programme Molecular Biotechnology	1.11. Expected enrolment in the course	oko 30
1.5. Course type	compulsory	1.12. Razina primjene e-učenja (1, 2, 3 razina), postotak izvođenja predmeta *on line* (maks. 20 %)	1. 0 %
1.6. Place of delivery	lectures in P3, laboratory exercises in the LB (6th floor)	1.13. Language of instruction	Croatian
1.7. Year of study when the course is delivered	first	1.14. Possibility of instruction in English	Y

2. COURSE DESCRIPTION

2.1. Course objectives	Acquirement of practical knowledge and skills in using different biochemical methods for determination of concentration, integrity, and activity in following and evaluating biotechnology processes.
2.2. Enrolment requirements and/or entry competences required for the course	-
2.3. Learning outcomes at the level of the programme to which the course contributes	• integrate knowledge acquired from the fields of microbiology, microbe physiology, molecular biology, genetics and bioinformatics with the aim of producing traditional and modern biotechnological products • participate in biomedical and related biomolecular researches on account of basic knowledge of molecular and cellular biology and genetics, bioinformatics, immunology and human physiology • use equipment and instruments in chemical, biochemical, microbiological and molecular-genetic laboratories • conduct biological, microbiological, immunological and molecular-genetic tests and analyses • recognize, analyse and eliminate common problems which occur during experimental work in microbiological, biochemical, and molecular-genetic laboratories
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	• establish a system of analytical assessment of concentrations of biological macromolecules during the biotechnological production process • assay proteins, carbohydrates, nucleic acids, and lipids in different substrates by most frequently used analytical methods, with critical evaluation of each method and comprehention of their advantages and limitations • determine integrity and biological activity of macromoleculs in different substrates • apply enzyme tests for determination of concentration of individual metabolites
2.5. Course content (syllabus)	**Lectures:** Chemical and physico-chemical assays of macromolecules: Proteins. Carbohydrates. Lipids. Nucleic acids. Assays of activity and biological effect of macromolecules. Quantitative analysis using enzymes, examples. Methods for testing integrity of biomacromolecules. Analytical methods applicable in living cells. Cell counting. Immunochemical methods. Quantitative analysis using polymerase chain reaction (PCR). Strategy in following biotechnology processes by biochemical methods. **Practical courses:** Different protein assays. Carbohydrate assays. Lipid assays. Nucleic acids assays. Application of enzymic tests for quantitative analysis. RIA. ELISA. Immunoblot. "Real-time" PCR. Implementation of biochemical analytics in biotechnology processes.

2.6. Format of instruction	☒ lectures ☐ seminars and workshops ☒ exercises ☐ *online in entirety*	☐ independent assignments ☐ multimedia and the internet	2.7. 2.7. Comments:

	☐ partial e-learning ☐ field work			☒ laboratory ☐ work with mentor ☐ (other)					
2.8. Monitoring student work	Class attendance		N	Research		N	Oral exam	Y	
	Experimental work	Y		Report	Y		(other)		
	Essay		N	Seminar paper		N	(other)		
	Preliminary exam		N	Practical work	Y		(other)		
	Project		N	Written exam	Y		ECTS credits (total)	6	
2.9. Assessment methods and criteria	Student assessment is carried out through a written exam. The total achievable number of points on the exam is 43. Grades: 23 - 27 points - sufficient (2) 28 - 32 points - good (3) 33 - 37 points - very good (4) 38 - 43 points - excellent (5								
2.10. Student responsibilities	To pass the course, students have to: • carry out all laboratory exercises • pass the written exam								

2.11. Required literature (available in the library and/or via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	J.M. Berg, J.L. Tymoczko, L. Stryer, *Biokemija*, Školska knjiga, Zagreb, 2013. (parts related to course syllabus)	15	
2.12. Optional literature	• *Guide to protein purification* (Deutscher M.P. ured.) Methods in Ezymology 182, Academic Press Inc., San Diego, 1990.		
2.13. Exams	*Exam dates are published in Studomat.*		
2.14. Other	-		

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Vladimir Mrša, PhD, Full Professor	1.8. Semester when the course is delivered	summer
1.2. Course title	**Biochemical Function of Vitamins and Ions in Food and Nutrition**	1.9. Number of ECTS credits allocated	5
1.3. Course code	53615	1.10. Number of contact hours (L+E+S+e-learning)	45 + 0 + 0 + 0
1.4. Study programme	Graduate university study programme Nutrition	1.11. Expected enrolment in the course	oko 20
1.5. Course type	optional A	1.12. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	1. 0 %
1.6. Place of delivery	P4	1.13. Language of instruction	Croatian
1.7. Year of study when the course is delivered	first	1. 14. Possibility of instruction in English	Y
2. COURSE DESCRIPTION			
2.1. Course objectives	Acquirement of required competences related to the role of vitamins and ions in food and nutrition and their influence on health.		
2.2. Enrolment requirements and/or entry competences required for the course	-		

<table>
<tr><td>2.3. Learning outcomes at the level of the programme to which the course contributes</td><td colspan="9">• understand and have knowledge of general skills in basic and applied disciplines
• understand and have knowledge of basic and specific disciplines of the profession
• understand and acquire knowledge of general skills in particular interdisciplinary disciplines through elective modules
• present and apply acquired knowledge in order to improve food monitoring systems and strategy programs on national levels, which refer to human diet, improve communication and monitoring of consumers behaviour on the food market, improve food distribution for the healthy and the ill, improve food quality assessment and nutritional and health status, improve production and processing of food and food supplements, and analysis and communication of food and diet
• apply, define application conditions, advise and make decisions related to problem-solving in the field of nutrition</td></tr>
<tr><td>2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)</td><td colspan="9">• discuss the role of individual vitamins in human metabolism
• asses importance of individual vitamins for health
• discuss the role of individual ions in human metabolism
• asses importance of individual ions for health</td></tr>
<tr><td>2.5. Course content (syllabus)</td><td colspan="9">Lectures: Division, history of discovery and nomenclature of vitamins. General importance in nutrition. Survey of roles of vitamins / co-enzymes in energy metabolism. B1. B2. B6. Biotin. Pantotenic acid. Metabolism and role of vitamin B12 and folic acid. Metabolism and role of tocopherol. Metabolism and role of ascorbate. Metabolism and role of vitamin A. Metabolism and role of vitamin D. Metabolism and role of vitamin K. Survey of ions in human organism. General importance for health. Ion transport. Metabolism of Na^+ and K^+ ions. Metabolism of Ca^{2+} and Mg^{2+} ions. Metabolism of Zn^{2+} ions. Metabolism of Fe^{2+} and Fe^{3+} ions. Metabolism of other cations. Metabolism of Cl^- ions. Metabolism of other anions. Mechanisms for maintenance of ion concentration in the organism.</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="3">☒ lectures
☐ seminars and workshops
☐ exercises
☐ online in entirety
☐ partial e-learning
☐ field work</td><td colspan="3">☐ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td colspan="3">2.7. Comments:</td></tr>
<tr><td rowspan="6">2.8. Monitoring student work</td><td>Class attendance</td><td></td><td>N</td><td>Research</td><td></td><td>N</td><td>Oral exam</td><td>Y</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>N</td><td>Report</td><td></td><td>N</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>N</td><td>Seminar paper</td><td></td><td>N</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td></td><td>N</td><td>Practical work</td><td></td><td>N</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>N</td><td>Written exam</td><td></td><td>N</td><td>ECTS credits (total)</td><td colspan="2">5</td></tr>
<tr><td></td><td colspan="9"></td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Assessment is carried out through a written exam consisting of three to five questions. Each answer is graded on a five-point scale and the final grade is the mean value of grades from all questions. No questions may be graded with a “fail” grade.</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9">To pass the course, students have to:
• pass the written exam</td></tr>
<tr><td rowspan="3">2.11. Required literature (available in the library and/or via other media)</td><td colspan="6">Title</td><td>Number of copies in the library</td><td colspan="2">Availability via other media</td></tr>
<tr><td colspan="6">J.M. Berg, J.L. Tymoczko, L. Stryer, Biokemija, Školska knjiga, Zagreb, 2013.; (parts related to course syllabus)</td><td>15</td><td colspan="2"></td></tr>
<tr><td colspan="6">David S. Robinson: Food - Biochemistry and nutritional value, 1987, Longman, Harlow, UK.</td><td>0</td><td colspan="2"></td></tr>
<tr><td>2.12. Optional literature</td><td colspan="9">• http://www.genome.jp/kegg/pathway/map/map01190.html
• http://www.healthcyclopedia.com/nutrition-and-metabolism-disorders/vitamins-and-minerals.html
• http://www.liferesearchuniversal.com/minerals.html</td></tr>
</table>

	• http://odp.webwombat.com.au/WW413833.HTM
2.13. Exams	*Exam dates are published in Studomat.*
2.14. Other	-

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Maja Benković, PhD, Assistant Professor Davor Valinger, PhD, Assistant Professor	1.8. Semester when the course is delivered	summer
1.2. Course title	**Powder Technology**	1.9. Number of ECTS credits allocated	3
1.3. Course code	39801	1.10. Number of contact hours (L+E+S+e-learning)	20 + 0 + 10 + 0
1.4. Study programme	All FFTB undergraduate university study programmes	1.11. Expected enrolment in the course	15
1.5. Course type	optional B	1.12. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	1. 0 %
1.6. Place of delivery	LMRA	1.13. Language of instruction	Croatian
1.7. Year of study when the course is delivered	third	1.14. Possibility of instruction in English	Y
2. COURSE DESCRIPTION			
2.1. Course objectives	The course objective is to acquaint the students with the definition of powders and powder technology and to explain to which extent and why the powders are used. The students should also be able to explain the advantages and the disadvantages of powder use as raw materials and end products. Furthermore, the students are acquainted with basic particle and powder properties and the technological processes in the production and handling of powders: milling, mixing, sampling, drying, agglomeration, tableting and encapsulation. The student will be able to use the acquired theoretical skills to choose the adequate equipment for powder sampling, milling, mixing, drying and other powder handling and production processes.		
2.2. Enrolment requirements and/or entry competences required for the course	-		
2.3. Learning outcomes at the level of the programme to which the course contributes	Undergraduate university study programme Food Technology • apply knowledge and skills from basic, applied and engineering scientific disciplines in the field of food technology • identify, analyse, solve simple problems, and do complex jobs in microbiological and physical-chemical control laboratories of food industry • apply and integrate the acquired knowledge and skills and participate in quality control work (quality control of production and food) • conceptualize and organize work and manage smaller technological production units of food systems • identify problems in production and communicate them to their superior and subordinates • summarize conclusions based on research results from the field of food technology • present plant, research, laboratory and business results in verbal and written form, using professional terminology Undergraduate university study programme Biotechnology • select and use laboratory equipment and appropriate computer tools		

<table>
<tr><td></td><td colspan="9">

use typical process equipment in a biotechnological plant (production and / or pilot / research)
manage smaller production units in industrial biotechnological systems
recognize and analyse production problems and communicate them to their superiors and subordinates
interpret routine laboratory analyses in biotechnology
report on laboratory, production plant and business results in verbal and written way, using specific professional terminology

Undergraduate university study programme Nutrition

have knowledge and understanding of specific and general skills and knowledge of basic and applied disciplines
acquire knowledge and understanding of specific skills and knowledge of the profession through elective modules
present independently and / or as a member of the homogenous or interdisciplinary team results in verbal and written form, using professional terminology

</td></tr>
<tr><td>2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)</td><td colspan="9">

define powders, explain what are powders comprised of, what are their characteristics and the importance for the industry
exhibit formal knowledge and understanding of basic particle properties and particle size characterization methods
list the physical properties of powders (powder bulk properties) and explain their importance and methods of analysis
list and explain the chemical properties of powders
define powder rheology, basic types and mechanisms of powder flow
explain the principles and use of agglomeration, tableting and encapsulation
explain and understand the mechanisms of mixing and milling and list the equipment used for mixing and milling
explain and understand the basic principles of powder sampling
define nanopowders and explain the risks of powder handling in the industrial facilities

</td></tr>
<tr><td>2.5. Course content (syllabus)</td><td colspan="9">
The module consists of the following topics:

Introduction to powder technology – basic principles, particle properties and particle size determination methods
Bulk properties and industrial powder flow
Chemical properties of powders
Milling and sampling
Powder mixing
Agglomeration and encapsulation
Nanopowders and powder handling risks
Seminar 1
Seminar 2
Seminar 3

</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="4">☒ lectures
☒ seminars and workshops
☐ exercises
☐ online in entirety
☐ partial e-learning
☐ field work</td><td colspan="3">☐ independent assignments
☐ multimedia and the internet
☒ laboratory
☐ work with mentor
☐ (other)</td><td colspan="2">2.7. Comments:</td></tr>
<tr><td rowspan="4">2.8. Monitoring student work</td><td>Class attendance</td><td>Y</td><td></td><td>Research</td><td></td><td>N</td><td>Oral exam</td><td>Y</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>N</td><td>Report</td><td></td><td>N</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>N</td><td>Seminar paper</td><td>Y</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td></td><td>N</td><td>Practical work</td><td>Y</td><td></td><td>(other)</td><td></td><td></td></tr>
</table>

	Project		N	Written exam	Y		ECTS credits (total)	3

2.9. Assessment methods and criteria

Class attendance is graded with 0.25 points per lecture. By attending lectures a maximum of 2.5 can be achieved.

Seminar paper is graded with a maximum of 2.5 points.

Seminar and practical (laboratory) work assignments are not graded, but they are a prerequisite to taking the written exam.

Written exam:
The written exam consists of 10 questions conceptualized in the following way:
eight questions covering the theoretical part of classes (lectures)
two questions covering the practical part of classes (practical part and seminars)
Each question brings two points.

The total grade is the sum of points achieved through class attendance, seminar paper and written exam.
Grading scale according to total number of points:

- 23 - 25 points: excellent (5)
- 20 - 22 points: very good (4)
- 16 - 19 points: good (3)
- 12.5 - 15 points: sufficient (2)

If students are dissatisfied with the grade achieved on the written exam, they can take the oral exam.

2.10. Student responsibilities

To pass the course, students have to:

- finish lectures
- write and hand in the seminar paper
- solve the practical work assignments
- pass the exam

2.11. Required literature (available in the library and/or via other media)

Title	Number of copies in the library	Availability via other media
Bauman, I. - Prahovi- Teorija na hrvatskom	0	YES, Merlin and FFTB web page
Barbosa-Canovas et al: Food Powders. Kluwer Academic/Plenum Publishers, New York, 2005: - Chapter 1 (pp.3 – 17) - Chapter 2 (pp. 19 – 53) - Chapter 3 (pp. 55 – 88) - Chapter 4 (pp. 93 – 102) - Chapter 6 (pp.157 – 173) - Chapter 7 (pp. 176 – 198) - Chapter 8 (pp. 199 – 218) - Chapter 9 (pp. 221 – 244) - Chapter 12 (pp. 323 – 352)	0	YES, Section for Fundamental Engineering

2.12. Optional literature

BOOKS:

- Fayed, M.E., Otten, L. (2005) Handbook of Powder Sciences and Technology. Chapman & Hall, London.
- Seville, J.P.K. (2007) Processing of Particulate Solids. Chapman & Hall, London.
- Kaye, B.H. (2010): Powder Mixing, Chapman & Hall, London, 2010

SCIENTIFIC PAPERS:

- Benković, M., Bauman, I. (2011) Oblaganje čestica u prehrambenoj industriji. Croatian Journal of Food Technology, Biotechnology and Nutrition 6 (1-2), 13-24.

	• Benković, M., Bauman, I.(2011) Agglomeration of cocoa powder mixtures – influence of process conditions on physical properties of the agglomerates. Journal on Processing and Energy in Agriculture 15(1), 46-49. • Benković, M., Belščak-Cvitanović, A., Bauman, I., Komes, D. (2013) Physical properties of non – agglomerated cocoa drink powder mixtures containing various types of sugars and sweeteners. Food and Bioprocess Technology, 6 (4), 1044-1058. • Bauman, I. (2001) Solid-Solid Mixing with Static Mixers, Chemical and Biochemical Engineering Quarterly, 15(4) 159-165. • Benković, M., Jurinjak Tušek, A., Belščak-Cvitanović, A., Lenart, A., Domian, E., Komes, D., Bauman, I. (2015) Artificial neural network modelling of changes in physical and chemical properties of cocoa powder mixtures during agglomeration. Journal of food science and technology 64(1), 140-148. • Benković, M., Srečec, S., Špoljarić, I., Mršić, G., Bauman, I. (2015) Fortification of instant coffee beverages - influence of functional ingredients, packaging material and storage time on physical properties of newly formulated, enriched instant coffee powders. Journal of the science of food and agriculture 95(13), 2607-2618. • Benković, M., Belščak-Cvitanović, A., Bauman, I., Komes, D. (2013) Physical properties of non-agglomerated cocoa drink powder mixtures containing various types of sugars and sweeteners. Food and Bioprocess Technology, 6 (4), 1044-1058. • Benković, M., Srečec, S., Špoljarić, I., Mršić, G., Bauman, I. (2013) Flow properties of commonly used food powders and their mixtures. Food and Bioprocess Technology, 6(9), 2525-2537.
2.13. Exam dates	*Exam dates are published in Studomat.*
2.14. Other	-

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Lidija Barišić, PhD, Associate Professor Veronika Kovač, PhD, Assistant Professor	1.8. Semester when the course is delivered	winter
1.2. Course title	**The Fundamentals of Bioorganometallic Chemistry**	1.9. Number of ECTS credits allocated	2
1.3. Course code	53305	1.10. Number of contact hours (L+E+S+e-learning)	15 + 23 + 0 +0
1.4. Study programme	Graduate University Study Programme Food Engineering, Graduate University Study Programme Food Safety Management, Graduate University Study Programme Bioprocess Engineering	1.11. Expected enrolment in the course	Broj studenata
1.5. Course type	optional A	1.12. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	- 0 %
1.6. Place of delivery	Lectures in lecture hall 2 or 4, exercises in the LOC	1.13. Language of instruction	Croatian
1.7. Year of study when the course is delivered	second	1.14. Possibility of instruction in English	Y
2. COURSE DESCRIPTION			
2.1. Course objectives	The course objective is to introduce students about the possibilities for application of bioorganometallic compounds in pharmacology, biotechnology and related disciplines.		
2.2. Enrolment requirements and/or entry competences required for the course	-		

<table>
<tr><td>2.3. Learning outcomes at the level of the programme to which the course contributes</td><td colspan="9">Graduate University Study Programme Food Engineering
• understand basic principles of research work
• understand the importance of environment protection and know the systems and methods of environment protection
• do highly-complex jobs in microbiological, physical and chemical control and development laboratories of food industry
• manage or work in an interdisciplinary team, which conceptualizes and conducts experiments in the field of food technology
• use and value scientific and occupational literature with the aim of lifelong learning and profession enhancement

Graduate University Study Programme Food Safety Management
• convey their knowledge and conclusions to both professionals and the general public, in a clear and well-reasoned manner
• use and value scientific and occupational literature with the aim of lifelong learning and profession enhancement

Graduate University Study Programme Bioprocess Engineering
• use and value scientific and occupational literature with the aim of lifelong learning and profession enhancement</td></tr>
<tr><td>2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)</td><td colspan="9">• describe the structural and functional role of metal ions in biological systems
• analyse the advantages of application of bioorganometallics [conjugates of organometallics and biomolecules (DNA, carbohydrates, steroids, amino acids, peptides)] in cancer and infectious disease treatment, bioanalysis, molecular recognition, enzyme catalysis and toxicology
• designing and synthesizing of electroactive and bioactive organometallic conjugates
• evaluate the potential pharmacological and biotechnological application of bioorganometallics</td></tr>
<tr><td>2.5. Course content (syllabus)</td><td colspan="9">• An introduction to the bioorganometallic chemistry.
• Conjugates of organometallic compounds and biomolecules.
• The role of bioorganometallic compounds in metalo-immunoassays.
• Organometallic compounds as indicators of DNA hybridization.
• Metalloenzymes,
• Metal pro-drugs.</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="4">☒ lectures
☐ seminars and workshops
☒ exercises
☐ online in entirety
☐ partial e-learning
☐ field work</td><td colspan="3">☐ independent assignments
☐ multimedia and the internet
☒ laboratory
☐ work with mentor
☐ (other)</td><td>2.7. Comments:</td></tr>
<tr><td rowspan="6">2.8. Monitoring student work</td><td>Class attendance</td><td></td><td>N</td><td>Research</td><td></td><td>N</td><td>Oral exam</td><td></td><td>N</td></tr>
<tr><td>Experimental work</td><td>Y</td><td></td><td>Report</td><td>Y</td><td></td><td>Seminarsko izlaganje uz PowerPoint prezentaciju</td><td>Y</td><td></td></tr>
<tr><td>Essay</td><td></td><td>N</td><td>Seminar paper</td><td></td><td>N</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td></td><td>N</td><td>Practical work</td><td>Y</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>N</td><td>Written exam</td><td></td><td>N</td><td>ECTS credits (total)</td><td colspan="2">2</td></tr>
<tr><td></td><td colspan="9"></td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Maximum number of points by activity type:
Exercises (practical work) 10
Seminar paper presentation (with PowerPoint) 20</td></tr>
</table>

	Grading scale: < 60 % fail (1) ≥ 60 % sufficient (2) ≥ 70 % good (3) ≥ 80 % very good (4) ≥ 90 % excellent (5)		
2.10. Student responsibilities	To pass the course, students have to: • successfully do all the exercises in practical work • attend lectures and seminars (a maximum of one unjustified absence is allowed) • achieve a minimum of six points with exercises • achieve a minimum of 12 points for the seminar paper presentation • achieve a minimum of 18 points in total		
2.11. Required literature (available in the library and/or via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	G. Jaouen (Editor), Bioorganometallics: Biomolecules, Labeling, Medicine, John Wiley & Sons, Weinheim, 2006.		
2.12. Optional literature	• G. Jaouen and M. Salmain (Editors), Bioorganometallic Chemistry. Applications in Drug Discovery, Biocatalysis, and Imaging, Wiley-VCH Verlag GmbH & Co. KGaA, Boschstr. 12, 69469 Weinheim, Germany, 2015 • G. Simonneaux (Editor), Bioorganometallic Chemistry (Topics in Organometallic Chemistry), Springer-Verlag Berlin Heidelberg, 2006. • P. Štepnička (Editor), Ferrocenes: Ligands, Materials and Biomolecules, John Wiley & Sons, Chichester, 2008.		
2.13. Exams	*Exam dates are published in Studomat.*		
2.14. Other	-		

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Lidija Barišić, PhD, Associate Professor Monika Kovačević, PhD	1.8. Semester when the course is delivered	winter
1.2. Course title	**Peptidomimetics and Pseudopeptides**	1.9. Number of ECTS credits allocated	3
1.3. Course code	53304	1.10. Number of contact hours (L+E+S+e-learning)	15 + 20 + 4 + 0
1.4. Study programme	Graduate university study programme Molecular Biotechnology, Graduate University Study Programme Food Engineering, Graduate University Study Programme Food Safety Management, Graduate University Study Programme Bioprocess Engineering	1.11. Expected enrolment in the course	12
1.5. Course type	optional B	1.12. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	- 0 %
1.6. Place of delivery	Lectures in lecture hall 2 or 4, exercises in the LOC	1.13. Language of instruction	Croatian
1.7. Year of study when the course is delivered	second	1.14. Possibility of instruction in English	Y
2. COURSE DESCRIPTION			
2.1. Course objectives	The course objective is to introduce students about the possibilities to overcome the limitations of the natural peptides (their flexibility enables the interactions with different receptors leading to the undesired side effects, they are subjected to the proteolytic		

	activity of the peptidases in gastrointestinal tract and serum, the high molecular mass and polarity hinder the transport through cell membrane and blood-brain barrier) by using their synthetic mimetics.
2.2. Enrolment requirements and/or entry competences required for the course	-
2.3. Learning outcomes at the level of the programme to which the course contributes	Graduate University Study Programme Food Engineering • understand basic principles of research work • conceptualize and carry out production of new products • do highly-complex jobs in microbiological, physical and chemical control and development laboratories of food industry • manage or work in an interdisciplinary team, which conceptualizes and conducts experiments in the field of food technology • use and value scientific and occupational literature with the aim of lifelong learning and profession enhancement Graduate University Study Programme Molecular Biotechnology • participate in biomedical and related biomolecular researches on account of basic knowledge of molecular and cellular biology and genetics, bioinformatics, immunology and human physiology • use equipment and instruments in chemical, biochemical, microbiological and molecular-genetic laboratories • use scientific literature in English, and present the existing results to experts and laymen, and convey their knowledge and skills to their peers • present, valorize and popularize modern accomplishments and courses of development of molecular biotechnology • participate actively in scientific paper discussion from the field of molecular biotechnology and related sciences • act in accordance with ethical principles and acquire new knowledge and skills, as a part of lifelong learning and profession promotion, including PhD studies in molecular biotechnology and other bio-sciences Graduate University Study Programme Food Safety Management • convey their knowledge and conclusions to both professionals and the general public, in a clear and well-reasoned manner • use and value scientific and occupational literature with the aim of lifelong learning and profession enhancement Graduate University Study Programme Bioprocess Engineering • use and value scientific and occupational literature with the aim of lifelong learning and profession enhancement
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	• analyse and argue how to overcome the disadvantages of the natural peptides (proteolytic instability, polarity, conformational freedom) by using adequately designed mimetics • analyse and identify peptide and non-peptide structures that mimic the secondary structural element (helix, sheet or turn) involved in molecular recognition • design and synthesis of ferrocene peptides as potential mimetics of peptide secondary structural elements • perform the conformational analysis of ferrocene peptidomimetics in solution by using standard spectroscopic techniques (IR, NMR and CD) with the aim to define their secondary structure • predict and evaluate the potential pharmacological and biotechnological application of peptidomimetics.
2.5. Course content (syllabus)	• Natural peptides: the role and structure. • Mimetics of alpha-helix. • Mimetics of turn. • Mimetics of beta-sheet. • Ferrocene peptidomimetics.

<table>
<tr><td></td><td colspan="9">• Carbohydrate peptidomimetics. Petidomimetics as artificial sweeteners.
• Structure and function of natural peptide mimetics (hormones, N-acetylglucosamine, apolipoproteins, etc)
• Conformational analysis in solution by using the spectroscopic techniques (IR, NMR and CD spectroscopy).</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="3">☒ lectures
☒ seminars and workshops
☒ exercises
☐ online in entirety
☐ partial e-learning
☐ field work</td><td colspan="3">☐ independent assignments
☐ multimedia and the internet
☒ laboratory
☐ work with mentor
☐ (other)</td><td colspan="3">2.7. Comments:</td></tr>
<tr><td rowspan="6">2.8. Monitoring student work</td><td>Class attendance</td><td></td><td>N</td><td>Research</td><td></td><td>N</td><td>Oral exam</td><td></td><td>N</td></tr>
<tr><td>Experimental work</td><td>Y</td><td></td><td>Report</td><td>Y</td><td></td><td>Seminarsko izlaganje uz PowerPoint prezentaciju</td><td>Y</td><td></td></tr>
<tr><td>Essay</td><td></td><td>N</td><td>Seminar paper</td><td></td><td>N</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td></td><td>N</td><td>Practical work</td><td>Y</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>N</td><td>Written exam</td><td></td><td>N</td><td>ECTS credits (total)</td><td colspan="2">3</td></tr>
<tr><td></td><td colspan="9"></td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Maximum number of points by activity type:
Exercises (practical work) 10
Seminar paper presentation (with PowerPoint) 20

Grading scale:
< 60 % fail (1)
≥ 60 % sufficient (2)
≥ 70 % good (3)
≥ 80 % very good (4)
≥ 90 % excellent (5)</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9">To pass the course, students have to:
• successfully do all the exercises in practical work
• attend lectures and seminars (a maximum of one unjustified absence is allowed)
• achieve a minimum of six points with exercises
• achieve a minimum of 12 points for the seminar paper presentation
• achieve a minimum of 18 points in total</td></tr>
<tr><td rowspan="2">2.11. Required literature (available in the library and/or via other media)</td><td colspan="6">Title</td><td>Number of copies in the library</td><td>Availability via other media</td></tr>
<tr><td colspan="6"></td><td></td><td></td></tr>
<tr><td>2.12. Optional literature</td><td colspan="9">• Trabocchi, A. Guarna, Peptidomimetics in Organic and Medicinal Chemistry: The Art of Transforming Peptides in Drugs, 2014 John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, United Kingdom.
• E. Ko, Ji.Liu, K. Burgess, Minimalist and universal peptidomimetics, Chemical Society Reviews 2011, 40, 4411–4421.
• L. Gentilucci, A. Tolomelli, F. Squassabia, Peptides and Peptidomimetics in Medicine, Surgery and Biotechnology, Current Medicinal Chemistry 2006, 13, 2449-2466.
• A. Grauer, B. König, Peptidomimetics – A Versatile Route to Biologically Active Compounds, European Journal of Organic Chemistry 2009, 5099–5111.</td></tr>
<tr><td>2.13. Exams</td><td colspan="9">Exam dates are published in Studomat.</td></tr>
<tr><td>2.14. Other</td><td colspan="9">-</td></tr>
</table>

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Lidija Barišić, PhD, Associate Professor Senka Djaković, PhD, Associate Professor Veronika Kovač, PhD, Associate Professor Jasmina Lapić, PhD, Assistant Professor Monika Kovačević, PhD Alma Filipović, dipl. ing.	1.8. Semester when the course is delivered	summer
1.2. Course title	Organic Chemistry	1.9. Number of ECTS credits allocated	6
1.3. Course code	37908	1.10. Number of contact hours (L+E+S+e-learning)	30 + 30 + 15 + 0
1.4. Study programme	Undergraduate university study programme Food Technology	1.11. Expected enrolment in the course	96
1.5. Course type	compulsory	1.12. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	1. 0 %
1.6. Place of delivery	Lectures in P2, seminars in P4, Laboratory exercises in the LOC	1.13. Language of instruction	Croatian
1.7. Year of study when the course is delivered	first	1. 14. Possibility of instruction in English	Y

2. COURSE DESCRIPTION	
2.1. Course objectives	The course aims is to acquire basic knowledge of organic chemistry and mastery of practical laboratory techniques used in synthesis, isolation and purification of organic compounds. The course program will provide students with the basic knowledge necessary for the monitoring and learning of biochemistry and related subjects.
2.2. Enrolment requirements and/or entry competences required for the course	-
2.3. Learning outcomes at the level of the programme to which the course contributes	• apply knowledge and skills from basic, applied and engineering scientific disciplines in the field of food technology • identify, analyse, solve simple problems, and do complex jobs in microbiological and physical-chemical control laboratories of food industry • collect and interpret results of laboratory food analyses • develop learning skills which are needed to continue studying at graduate levels and conscience about the need of lifelong learning
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	• recognize and name selected organic compounds (from simple hydrocarbons to compounds containing functional groups) • interpret the influence of structure on the physico-chemical properties and reactivity of selected organic molecules • describe and explain basic stereochemical concepts in simple examples of organic compounds • predicted and interpret the mechanisms of addition, substitution and elimination reactions on selected examples of organic compounds • classify selected biomolecules (carbohydrates, nucleic acids and lipids) and describe their chemical properties and reactivity • according to the given instruction, independently perform the simple purification and isolation procedures and the synthesis of organic compounds using conventional laboratory techniques
2.5. Course content (syllabus)	• Types, properties and nomenclature of organic compounds. • Organic-chemical reactions. • Resonance. • Stereochemistry. • Alkene and alkyne. Electrophilic addition reactions on unsaturated carbon. • Alkyl halides. Nucleophilic substitution reactions on saturated carbon.

<table>
<tr><td></td><td colspan="9">

Alkyl halides. Elimination reaction.
Aldehydes and ketones. Nucleophilic addition reactions on carbonyl group.
Carboxylic acids and derivatives. Nucleophilic substitution reactions on carbonyl group.
Acylation of enolate anions. -Carbanion.
Aromatic compounds. Electrophilic aromatic substitution.
Heterocyclic aromatic systems.
Carbohydrates.
Lipids.

</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="3">☒ lectures
☒ seminars and workshops
☒ exercises
☐ online in entirety
☐ partial e-learning
☐ field work</td><td colspan="3">☐ independent assignments
☐ multimedia and the internet
☒ laboratory
☐ work with mentor
☐ (other)</td><td colspan="3">2.7. Comments:</td></tr>
<tr><td rowspan="6">2.8. Monitoring student work</td><td>Class attendance</td><td></td><td>N</td><td>Research</td><td></td><td>N</td><td>Oral exam</td><td>Y</td><td></td></tr>
<tr><td>Experimental work</td><td>Y</td><td></td><td>Report</td><td>Y</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>N</td><td>Seminar paper</td><td></td><td>N</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td>Y</td><td></td><td>Practical work</td><td>Y</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>N</td><td>Written exam</td><td>Y</td><td></td><td>ECTS credits (total)</td><td colspan="2">6</td></tr>
<tr><td></td><td colspan="9"></td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">
The maximum number of points is 100:

Written exam: 60 points,
Oral exam: 30 points
Laboratory exercises: 10 points.

The prerequisite to taking the oral exam is achieving a minimum of 36 points (60%) on the written part. To pass the oral part, students must achieve a minimum of 18 points (60%).

Partial exams
Four exam terms are scheduled.
The first exam term is divided on two partial written exams and an oral exam. Students who achieve a minimum of 60% (36 points) on both partial exams can take the oral exam covering the entire syllabus.
Students who do not take partial exams or do not achieve a minimum of 60% (36 points) on both partial exams, take the written and oral exam consisting of the entire course content in three subsequent exam periods (two in the summer and one in autumn).
If the written part is passed, and the oral one failed, student retake the written exam on one of the subsequent exam periods.

Grading scale:

< 60 points fail
60 – 69 points sufficient
70 - 79 points good
80 - 89 points very good
90 - 100 points excellent

</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9">
To pass the course, students have to:

successfully do all exercises in practical work and pass the final preliminary exam
attend lectures and seminars (a maximum of one unjustified absence is allowed)
achieve a minimum of 36 points on the written exam
achieve a minimum of 18 points on the oral exam
achieve a minimum of 6 points with the exercises
achieve a minimum of 60 points in total

</td></tr>
</table>

	Title	Number of copies in the library	Availability via other media
2.11. Required literature (available in the library and/or via other media)	S. H. Pine, *Organska kemija (prijevod I. Bregovec i V. Rapić). Školska knjiga, Zagreb,*1994.	22	
	V. Rapić, *Nomenklatura organskih spojeva, III. izmijenjeno i obnovljeno izdanje,* Školska knjiga, Zagreb, 2004.	6	
	V. Rapić, Postupci priprave i izolacije organskih spojeva, II. obnovljeno i dopunjeno izdanje, Školska knjiga, Zagreb, 2008.	9	
	Nomenklatura ugljikohidrata i glikolipida: HDKI i HKD preporuke 2001., uređivački odbor Ž. Kurtanjek et al., Hrvatsko društvo kemijskih inženjera i tehnologa, 2001.	25	
	Glosar razrednih imena organskih spojeva i reaktivnih međuprodukata temeljen na strukturi: preporuke IUPAC 1995.: preporuke HDKI i HKD 2005., prijevod: D. Škare, T. Portada, L. Frkanec, Hrvatsko društvo kemijskih inženjera i tehnologa, 2005.	4	
	Osnovno stereokemijsko nazivlje: preporuke IUPAC 1996., priredio G.P. Mos, preveo M. Žinić, Hrvatsko društvo kemijskih inženjera i tehnologa, 2001.	3	
2.12. Optional literature	• P. Y. Bruice, Organic Chemistry. 4th Edition, Prentice Hall, 2004. • L. G. Wade, Organic Chemistry. 6th Edition, Prentice Hall, 2006. • J. McMurry, Fundamentals of Organic Chemistry. 7th Edition, Thomson, 2008. • D. Klein, Organic Chemistry, 2nd Edition, John Wiley & Sons, 2012.		
2.13. Exam dates	*Exam dates are published in Studomat.*		
2.14. Other	-		

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Mladen Brnčić, PhD, Full Professor Damir Ježek, PhD, Full Professor Sven Karlović, PhD, Assistant Professor Tomislav Bosiljkov, PhD, Assistant Professor Filip Dujmić, PhD, Assistant Professor	1.8. Semester when the course is delivered	summer
1.2. Course title	**Ultrasound in Food Engineering**	1.9. Number of ECTS credits allocated	5
1.3. Course code	66830	1.10. Number of contact hours (L+E+S+e-learning)	30 + 10 + 20 + 0
1.4. Study programme	Graduate university study programme Food Engineering	1.11. Expected enrolment in the course	30
1.5. Course type	optional B	1.12. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	1. 0 %
1.6. Place of delivery	LUO	1.13. Language of instruction	Croatian
1.7. Year of study when the course is delivered	second	1. 14. Possibility of instruction in English	Y
2. COURSE DESCRIPTION			
2.1. Course objectives	Introducing students of Food Technology with ultrasound applications in food processing and ultrasound as an analytical method in Food Engineering. Getting to know the principles of ultrasonic devices, ultrasound parameters and mechanism of action.		
2.2. Uvjeti za upis predmeta i / ili ulazne kompetencije	-		

potrebne za predmet (ako postoje)	
2.3. Learning outcomes at the level of the programme to which the course contributes	• apply knowledge and skills from basic, applied and engineering scientific disciplines in the field of food technology mainly ultrsound • apply acquired knowledge and skills from food engineering practically in the conduct of technological processes of food production and processing • apply and integrate the acquired knowledge and skills and participate in quality control work (quality control of production and food using ultrasound) • conceptualize and organize work and manage smaller technological production units of ultrasound food systems • identify problems in production and communicate them to their superior and subordinates • summarize conclusions based on research results from the field of ultrasound food technology • present plant, research, laboratory and business results in verbal and written form, using professional terminology • present contemporary trends in food technology and popularize the profession develop learning skills which are needed to continue studying at graduate levels and conscience about the need of lifelong learning
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	• independently use ultrasonic equipment in various applications of food engineering • explain mechanical effects of the cavitation mechanism in liquid systems • define ultrasound settings for certain applications • describe the knowledge acquired by practical work in laboratory conditions during work on high intensity ultrasound devices • investigate the application of high intensity ultrasound in food engineering for drying, extraction, homogenisation, purification, sieving, extrusion and inactivation of microorganisms • apply ultrasound as an non destrucive analytical method • define energy savings by applying ultrasound compared to classical technologies • describe use of Ultrasound in Food Engineering as an environmentally acceptable method
2.5. Course content (syllabus)	Lectures 1. Definition of acoustics, acoustic areas and separately abouth ultrasound. Innovativity of non-thermal technologies in production and in general food processing. Basic principles of innovative non-thermal technologies in food processing. The role of ultrasound as a new innovative food processing technology.- 4 hours 2. Definitions of ultrasonic parameters. Basic parts of ultrasonic setup. Basic principles and mechanisms of ultrasound as food processing technology. Influence of different ultrasound parameters (frequency, cycle, amplitude) on food processing. Output parameters and its values during and after ultrasound treatment (temperature, intensity, power, amplitude). 4 hours. 3. Raw materials (food) suitable for ultrasonic treatment. 4. Application of ultrasound in processing of nus-products and waste materials from the food industry. 2 hours 5. Use of ultrasound as extraction technique of bioactive compounds. 2 hours 6. Application of ultrasound as drying technique in food industry (pre-processing and complete processing). 2 hours. 7. Application of ultrasound in inactivation of microorganisms (independently and in combination with other innovative technologies - high hydrostatic pressures, pulsating electrical fields). 2 hours 8. Application of ultrasound in homogenization and emulsification. 2 hours. 9. Ultrasonic cleansing. 2 hours 10. Application of airborn high-intensity ultrasound in the food industry (defoaming, cutting, sieving). 2 hours. 11. Low intensity ultrasound in the food industry (non destructive ultrasound). Principles of work, various lineup. Mechanism of influence on sampleaction. Input and output parameters. 3 hours

	12. Aplication of low intensity ultrasound in food industry (Determination of undesirable foreign bodies; Determination of liquid column level; Determination of flow rate in pipelines). 3 hours Exercises 1. Geometry of different ultrasonic setups with directly immersed sonotrode (power generators, transducers, probes, volume of samples). Ultrasonic bath geometry (volumes, number of probes, multi-frequency mode) - 3 hours 2. Samples selections (raw materials) for treatment with ultrasonic setup with directly immersed sonotrodes. Determination of particle size distribution of the treated sample before and after processing. - 3 hours 3. Samples selections (raw materials) for treatment with multi-frequency ultrasonic bath. Determine particle size distribution of the treated sample before and after processing. - 2 hours 4. Selection of samples (raw material) for sieving. Conventional sieving. Sieving assisted by ultrasound. Determine particle size distribution of the treated sample before and after processing. - 2 hours Seminars 1. Calculations of the input and output parameters for the ultrasound. Calculate energy consumption by ultrasound processing. Comparison with conventional technologies. Material and energy balance. 2 hours 2. Preparation of seminar work for the selected ultrasound application in food engineering - 18 hours.

2.6. Format of instruction:	☒ lectures ☒ seminars and workshops ☒ exercises ☐ *on-line in entirety* ☐ partial e-learning ☐ field work	☐ independent assignments ☐ multimedia and the internet ☐ laboratory ☐ work with mentor ☐ (other)	2.7. Comments:

2.8. Monitoring student work	Class attendance	Y		Research		N	Oral exam	Y	
	Experimental work	Y		Report		N	(other)		
	Essay		N	Seminar paper	Y		(other)		
	Preliminary exam		N	Practical work	Y		(other)		
	Project		N	Written exam		N	ECTS credits (total)	5	

2.9. Assessment methods and criteria	The prerequisite for taking the written exam is mandatory class attendance (a minimum of 60% or lectures and seminars and 100% of exercises). Absence caused by illness must be justified with doctor's note. The final grade is given based on the oral exam (70%) and seminar paper (30%).
2.10. Student responsibilities	To pass the course, students have to: • attend classes regularly (a minimum of 60% or lectures and seminars and 100% of exercises); absence caused by illness must be justified with doctor's note • pass the oral exam

	Title	Number of copies in the library	Availability via other media
2.11. Required literature (available in the library and/or via other media)	Koubaa, M., Roselló-Soto, E., Šic Žlabur, J., Režek Jambrak, A., Brnčić,M., Grimi, N., Boussetta,N., Barba, F.J. (2015) Current and New Insights in the Sustainable and Green Recovery of Nutritionally Valuable		YES, WEB, data basis, NUL, Laboratory for Thermodynamics

	Compounds from Stevia rebaudiana Bertoni. *Journal of Agricultural and Food Chemistry*. 63, 6835-6846.		
	Povey, J.W.M., Mason, T.J. (1998) Ultrasound in Food Processing. Blackie academic and professional, London.		YES, Laboratory for Thermodynamics
	Ninčević Grassino A., Brnčić M., Vikić-Topić D., Roca S., Dent M., Rimac Brnčić S. (2016) Ultrasound Assisted Extraction and Characterization of Pectin from Tomato Waste. *Food Chemistry*, 198, 93-100.		YES, WEB, data basis, NUL, Laboratory for Thermodynamics
	Dujmić F., Brnčić M., Karlović S., Bosiljkov T., Ježek D., Tripalo B., Mofardin I. (2013) Ultrasound-Assisted Infrared Drying of Pear Slices: Textural Issues, Journal of Food Process Engineering, 36, 397–406.		YES, WEB, data basis, NUL, Laboratory for Thermodynamics
	Zinoviadou K.G., Galanakis, C.M, Brnčić, M., Grimi, N., Boussetta, N., Mota, M.J., Saraiva, J., Patras, A., Tiwari, B.K., Barba, F.J. (2015) Fruit juice sonication: Implications on food safety, physicochemical and nutritional properties. Food Research International, 77 (4) 743-752. (ISSN: 0963-9969)		YES, WEB, data basis, NUL, Laboratory for Thermodynamics
	Roselló-Soto, E., Galanakis, C.M., Brnčić, M., V. Orlien, Trujillo F. J., Mawson, R., Knoerzer, K., Tiwari, B.K., Barba, F.J. (2015) Clean Recovery of Antioxidant Compounds from Plant Foods, By-Products and Algae Assisted by Ultrasounds Processing: Modeling approaches to optimize processing conditions. Trends in Food Science & Technology. 42, 134-149.		YES, WEB, data basis, NUL, Laboratory for Thermodynamics
2.12. Optional literature	• Leadley, C., Williams, A. (2002). Power ultrasound – current and potential applications for food processing. Campden & Chorleywood Food Research Association Group, UK.		
2.13. Exams	*Exam dates are published in Studomat.*		
2.14. Other	-		

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Višnja Bačun Družina, PhD, Full Professor Ksenija Durgo, PhD, Full Professor Ana Huđek, mag. ing.	1.8. Semester when the course is delivered	summer
1.2. Course title	**Mechanisms of Evolution**	1.9. Number of ECTS credits allocated	3
1.3. Course code	53256	1.10. Number of contact hours (L+E+S+e-learning)	20 + 0 + 15 + 0
1.4. Study programme	Graduate university study programme Molecular Biotechnology	1.11. Expected enrolment in the course	10
1.5. Course type	optional A	1.12. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2. 0 %
1.6. Place of delivery	lectures in P5, exercises in the LBMG	1.13. Language of instruction	Croatian
1.7. Year of study when the course is delivered	first	1.14. Possibility of instruction in English	Y
2. COURSE DESCRIPTION			
2.1. Course objectives	This course is directed toward studying the evolution of prokaryotic and eukaryotic genomes, including their size, composition, variability and organization. An understanding		

	of the evolutionary process that leads to differences in genomes will shed light on how species themselves differentiate. Students are introduced to the basics of taxonomy and evolutionary systematics as well as to phylogeny and methods of research. Evolutionary inventions and innovations, followed by vertical and horizontal gene transfer are studied.
2.2. Enrolment requirements and/or entry competences required for the course	-
2.3. Learning outcomes at the level of the programme to which the course contributes	
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	• explain the evolutionary tree and the three domains of life on Earth and explain the difference between the last universal common ancestor (LUCA) and the last eukaryotic common ancestor (LECA) • compare processes during the evolution of prokaryotic cells and the formation of the first eukaryotic cell • explain the difference between the basic processes of evolution: variation, natural selection (selection), genetic deflection, genetic flux and hereditary genetic variants such as mutations, recombination and transfer genes and genomes • explain the origin of the virus through three hypotheses, then the connection between the virus and the origin of the three domains, and to explain, through existing viruses, the path from RNA to the DNA of the world and the daily role of virus in cell evolution • compare the effects of selective amplification through innovation, amplification and / or divergence and duplication during the occurrence of new genes in prokaryotes and eukaryotes • explain the evolution of gene regulatory network in bacterial genomes, ortiologic and parental genes, structure and evolution of trans-acting elements, cis-acting elements and bacterial operons • explain the endosimbiotic theory of evolution of eukaryotic cells and to link the moving genetic elements and the evolution of the mammalian genome • explain the difference between the cladogram and the filogram and explain the research plan in molecular filogeny, the choice of support for phylogenetic trees and program for phylogenetic analysis
2.5. Course content (syllabus)	• Evolution and history of life • Basic Evolutionary Processes • Population genetics and evolution • Taxonomy, systematics and phylogeny • Evolution of the gene • Evolution of the genome • Origin of the virus • Evolution of prokaryotes • Evolution of eukaryotes • Experimental evolution
2.6. Format of instruction	☒ lectures ☐ seminars and workshops ☒ exercises ☐ *online in entirety* ☐ partial e-learning ☐ field work ☒ independent assignments ☐ multimedia and the internet ☐ laboratory ☐ work with mentor ☐ (other)
	2.7. 2.7. Comments:

2.8. Monitoring student work	Class attendance	Y		Research	Y		Oral exam		N
	Experimental work	Y		Report		N	(other)		
	Essay		N	Seminar paper		N	(other)		

	Preliminary exam	Y		Practical work		N	(other)		
	Project		N	Written exam	Y		ECTS credits (total)	3	
2.9. Assessment methods and criteria	1. The written exam consists of five desriptive questions, each graded with one point. 2. Grading scale: < 60 % fail (1) ≥ 60 % sufficient (2) ≥ 70 % good (3) ≥ 80 % very good (4) ≥ 90 % excellent (5)								
2.10. Student responsibilities	To pass the course, students have to: • successfully do all the exercises in practical work and hand in a written report consisting of an introduction, results and conclusions • attend all lectures (a maximum of one unjustified absence is allowed for exercises, and two for lectures) • achieve a minimum of 60% of points on the written exam								
2.11. Required literature (available in the library and/or via other media)	**Title**						**Number of copies in the library**	**Availability via other media**	
	Višnja Bačun-Družina (2017): Mehanizmi evolucije, Script						0	YES, Merlin and/or web pages	
	Ana Huđek, Višnja Bačun-Družina, Ksenija Durgo (2018) Mechanisms of Evolution, Practical Work, Script							YES, Merlin and/or web pages	
2.12. Optional literature	• Fox C.W. and Wolf J.B. (2006) Evolutionary Genetics: Concepts and Case Studies, Oxford University Press, UK • Krebs J.E. et al. (2014) Lewin's GENES XI, Jones & Bartlett Publishers, USA • Primrose S. B., Twyman R.M. (2007) Principles of Gene Manipulation and Genomics, Wiley-Blackwell, Oxford, UK								
2.13. Exams	*Exam dates are published in Studomat.*								
2.14. Other	-								

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Josip Ćurko, PhD, Assistant Professor Marin Matošić, PhD, Full Professor Vlado Crnek, mag. ing.	1.8. Semester when the course is delivered	summer
1.2. Course title	**Mineral, Spring and Table Water**	1.9. Number of ECTS credits allocated	3
1.3. Course code	53668	1.10. Broj sati u semestru (P+V+S+T)	15 + 22 + 0 + 0
1.4. Study programme	Graduate university study programme Food Safety Management	1.11. Expected enrolment in the course	10
1.5. Course type	optional A	1.12. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	1. 5 %
1.6. Place of delivery	Lectures in P3, laboratory exercises in the laboratoryu on the 3rd floor, field exercises in Jamnica d.d.	1.13. Language of instruction	Croatian
1.7. Year of study when the course is delivered	second	1.14. Mogućnost izvođenja na stranom jeziku	Y

2. COURSE DESCRIPTION

2.1. Course objectives	Objective of the course is to familiarize student with characteristics of mineral, spring and table waters. Through the course student will acquire skills to distinguish physical-chemical and microbiological composition and basics of hydrogeological characteristics and bottling processes of natural waters. Through acquired skills, students will be competent for working in production, trade and quality assurance of mineral, spring and table waters.
2.2. Enrolment requirements and/or entry competences required for the course	-
2.3. Learning outcomes at the level of the programme to which the course contributes	• establish, manage, control and supervise food safety system in the production chain, and manage its potential risks • define principles and strategy of product quality, organize and manage quality system in food industry • establish, manage, control and supervise food production processes • do complex food analyses in microbiological and physical-chemical control and research laboratories • independently analyse, make conclusions and present results of conducted analyses • independently solve problems in new or unknown situations • independently study and interpret results, and make conclusions and solutions • manage or participate in interdisciplinary teams, which create or implement new methods with the aim of improving food safety and quality system from field to table • apply ethical principles, legal regulations and standards related to specific requirements of the profession
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	• define and explain differences between natural mineral, spring, table and tap water based on EU legal regulations. • discuss about health and nutritive effects from consumption of mineral water • compare different packing materials used for bottling • describe applicable technologies for natural water treatment • perform sanitation of water cooler
2.5. Course content (syllabus)	• Classification of mineral, spring and table waters • Physical, chemical and microbiological characteristics • National and international legislation • Nutritional, pharmacological and clinical characteristics • Basic requirements for production and trade for spring, mineral and table waters • Packing materials • Modern processes of safe bottling of spring, mineral and table waters • Environmental impact of bottling industry

2.6. Format of instruction:		2.7. Comments:
☒ lectures ☐ seminars and workshops ☒ exercises ☐ *on-line in entirety* ☐ partial e-learning ☒ field work	☐ independent assignments ☐ multimedia and the internet ☒ laboratory ☐ work with mentor ☐ (other)	

2.8. Monitoring student work									
	Class attendance	Y		Research		N	Oral exam	Y	
	Experimental work		N	Report		N	(ostalo upisati)		
	Essay		N	Seminar paper	Y		(other)		
	Preliminary exam		N	Practical work	Y		(other)		
	Project		N	Written exam		N	ECTS credits (total)	3	

2.9. Assessment methods and criteria	Seminar paper: 30% Practical work: 30%

	Oral exam: 30%		
2.10. Student responsibilities	To pass the course, students have to: • successfully do all the exercises in practical work and seminars • attend all lectures (a maximum of three unjustified absences is allowed) • make a seminar paper • pass the oral exam		
2.11. Required literature (available in the library and/or via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	I. Mijatović, M. Matošić: Tehnologija vode (internal script)	0	YES, Merlin and web pages
	Dege, Nicholas, ed. Technology of bottled water. John Wiley & Sons, 2011.	0	YES, Merlin and web pages
2.12. Optional literature	-		
2.13. Exams	*Exam dates are published in Studomat.*		
2.14. Other	-		

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Marin Matošić, PhD, Full Professor Josip Ćurko, PhD, Assistant Professor Vlado Crnek, mag. ing.	1.8. Semester when the course is delivered	summer
1.2. Course title	**Membrane Bioreactors in Environment Protection**	1.9. Number of ECTS credits allocated	3
1.3. Course code	53729	1.10. Number of contact hours (L+E+S+e-learning)	15 + 15 + 7 + 0
1.4. Study programme	Graduate university study programme Food Safety Management	1.11. Expected enrolment in the course	10
1.5. Course type	optional A	1.12. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	1. 5 %
1.6. Place of delivery	Pierottijeva 6	1.13. Language of instruction	Croatian
1.7. Year of study when the course is delivered	second	1. 14. Possibility of instruction in English	Y
2. COURSE DESCRIPTION			
2.1. Course objectives	Course gives an overview of use of membrane bioreactors in wastewater treatment. Through the course students will acquire skills necessary technologicaly design a membrane bioreactor and operate membrane filtration. Acquired skills can be used to evaluate suitability of membrane bioreactor for treatment of a specific wastewater, choose an appropriate mebrane type and design and operate the treatment process.		
2.2. Enrolment requirements and/or entry competences required for the course	-		
2.3. Learning outcomes at the level of the programme to which the course contributes	• establish, manage, control and supervise food production processes • independently analyse, make conclusions and present results of conducted analyses • independently solve problems in new or unknown situations • independently study and interpret results, and make conclusions and solutions • make decisions and solve problems in due time • have the ability to integrate results, make judgements based on incomplete or restricted information and manage complex food safety systems • apply ethical principles in relationships to coworkers and employer		

<table>
<tr><td></td><td colspan="9">• apply ethical principles, legal regulations and standards related to specific requirements of the profession
• use and value scientific and occupational literature with the aim of lifelong learning and profession enhancement</td></tr>
<tr><td>2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)</td><td colspan="9">• operate membrane bioreactor for wastewater treatment
• choose aprropriate membrane type for a membrane bioreactor
• caclulate volume of the bioreactor, amount of air for aeration and excess sludge production based on characteristics and amount of wastewater
• choose an optimal working regime for a membrane bioreactor to mitigate mebrane fouling
• compare membrane bioreactor technology with other biological processes for wastewater treatment</td></tr>
<tr><td>2.5. Course content (syllabus)</td><td colspan="9">• Principle and characteristics of membrane bioreactor operation
• Membranes for MBR
• Wastewater characterization
• Designing an MBR
• Wastewater treatment in MBR</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="4">☒ lectures
☒ seminars and workshops
☒ exercises
☐ on-line in entirety
☐ partial e-learning
☐ field work</td><td colspan="3">☒ independent assignments
☐ multimedia and the internet
☐ laboratory
☐ work with mentor
☐ (other)</td><td colspan="2">2.7. Comments:</td></tr>
<tr><td rowspan="5">2.8. Monitoring student work</td><td>Class attendance</td><td>Y</td><td></td><td>Research</td><td></td><td>N</td><td>Oral exam</td><td>Y</td><td></td></tr>
<tr><td>Experimental work</td><td>Y</td><td></td><td>Report</td><td></td><td>N</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>N</td><td>Seminar paper</td><td>Y</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td></td><td>N</td><td>Practical work</td><td></td><td>N</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td>Y</td><td></td><td>Written exam</td><td></td><td>N</td><td>ECTS credits (total)</td><td colspan="2">3</td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Maximum number of points by activity type:
• Making a membrane bioreactor seminar project 70%
• Final exam (oral) 30%

Grading scale:
• < 50 fail (1)
• 50 - 60 sufficient (2)
• 60 - 75 good (3)
• 75 - 90 very good (4)
• ≥ 90 excellent (5)</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9">To pass the course, students have to:
• attend all lectures (a maximum of three justified absences is allowed)
• Successfully do all laboratory exercises (a maximum of three justified absences is allowed)
• make a membrane bioreactor seminar project
• pass the oral exam</td></tr>
<tr><td rowspan="2">2.11. Required literature (available in the library and/or via other media)</td><td colspan="5">Title</td><td colspan="2">Number of copies in the library</td><td colspan="2">Availability via other media</td></tr>
<tr><td colspan="5">M. Matošić, Membranski bioreaktori u zaštiti okoliša, internal script</td><td colspan="2">0</td><td colspan="2">YES, Merlin</td></tr>
<tr><td>2.12. Optional literature</td><td colspan="9">• Judd, S. (2006) The MBR book, Elsevier Ltd., Oxford, UK
• Henze, M., van Loosdrecht, M.C.M., Ekama, G., Brdjanovic, D. Biological Wastewater treatment, IWA Publishing, 2008, London, UK</td></tr>
</table>

	• 3. Metcalf&Eddy (2003) Wastewater Engineering - Treatment and Reuse (4th edition) McGraw-Hill, New York
2.13. Exams	*Exam dates are published in Studomat.*
2.14. Other	-

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Natka Ćurko, PhD, Assistant Professor Karin Kovačević Ganić, PhD, Full Professor Marina Tomašević, PhD	1.8. Semester when the course is delivered	summer
1.2. Course title	**Production of Predicate and Sparkling Wines**	1.9. Number of ECTS credits allocated	3
1.3. Course code	53744	1.10. Number of contact hours (L+E+S+e-learning)	20 + 8 + 7 + 0
1.4. Study programme	Graduate University Study Programme Food Engineering, Graduate University Study Programme Bioprocess Engineering, Graduate University Study Programme Nutrition, Graduate University Study Programme Molecular Biotechnology	1.11. Expected enrolment in the course	18
1.5. Course type	optional B	1.12. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	1. 0 %
1.6. Place of delivery	Lectures and seminars in P4, excercises as field work	1.13. Language of instruction	Croatian
1.7. Year of study when the course is delivered	first	1. 14. Possibility of instruction in English	N

2. COURSE DESCRIPTION	
2.1. Course objectives	Production of "special wines" in world production takes a significant place. These wines are technologically more demanding to produce because they seek knowledge that is applied in the usual production processes, as well as the specificity depending on the type of wine. In this segment, it is particularly important to define wine by the regional rules. Students will learn to recognize the differences in production technology and the organoleptic specificities of different wines, and also will be closer to the "production philosophy" with special emphasis on the critical points of the production. After completing the course, students will be able to upgrade their knowledge from other basic wine-making courses, and will be prepared to overcome the technological problems in such production.
2.2. Enrolment requirements and/or entry competences required for the course	-
2.3. Learning outcomes at the level of the programme to which the course contributes	Graduate University Study Programme Food Engineering • recognize the importance of all segments of food production (raw material features, technology applied, production and packaging conditions , effect of processing and preservation on chemical composition of food products, potential effects of packaging, quality assurance) • analyse and assist in creating legal regulations from the standpoint of the subject involved in food production • give a final opinion about the results of conducted physical, chemical and microbiological analyses of raw materials and final products

	Graduate University Study Programme Bioprocess Engineering • recognize problems in production, make corrective decisions • interpret laboratory analysis results • present plant, research, laboratory and business results in verbal and written form, using professional terminology Graduate University Study Programme Nutrition • understand and have knowledge of general skills in basic and applied disciplines • understand and have knowledge of basic and specific disciplines of the profession • understand and acquire knowledge of general skills in particular interdisciplinary disciplines through elective modules Graduate University Study Programme Molecular Biotechnology • integrate knowledge acquired from the fields of microbiology, microbe physiology, molecular biology, genetics and bioinformatics with the aim of producing traditional and modern biotechnological products
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	• explain the legal framework for the production of predicate and sparkling wines • explain microbiological risks that emerges during wine production • understand the technology of Sherry, Port and Madeira production and know how to evaluate the organoleptic characteristics of these wines • evaluate organoleptic profile of Prošek and interpret physical/chemical composition of Prošek • explain organoleptic characteristics of Tokay and predicate wines • evaluate potential of young wine to be used in sparkling wine production • understand influence of secondary fermentation in bottles and wine aging in bottles on sparkling wine quality • evaluate organoleptic characteristics of sparkling wines
2.5. Course content (syllabus)	• Regulations, legislation, specifications and quality control in the production of predicate and sparkling wines • Wine technology with an emphasis on microbiology • Technology for production of fortified wines (Sherry, Port and Madeira) with its specific characteristics • Technology for production of Prošek with its specific characteristics • Technology for production of Tokay and predicate wines • Technology for production of sparkling wines and its specific characteristics in comparison to classical wine production

2.6. Format of instruction			2.7. Comments:
	☒ lectures ☐ seminars and workshops ☒ exercises ☐ *on-line in entirety* ☐ partial e-learning ☐ field work	☐ independent assignments ☐ multimedia and the internet ☒ laboratory ☐ work with mentor ☐ (other)	

2.8. Monitoring student work									
	Class attendance	Y		Research		N	Oral exam		N
	Experimental work		N	Report		N	(other)		
	Essay		N	Seminar paper		N	(other)		
	Preliminary exam	Y		Practical work	Y		(other)		
	Project		N	Written exam	Y		ECTS credits (total)	3	

2.9. Assessment methods and criteria	Assessment will be carried out through two written partial exams. The written exam consists of 10 questions from which students can achieve a maximum of 20 points (10 times 2). The grade obtained through the written exam can be increased by one grade on the oral exam.

	Grading scale: < 12 points - fail (1) 12 - 14 points - sufficient (2) 14 - 16 points - good (3) 16 - 18 points - very good (4) 18 - 20 points - excellent (5)
2.10. Student responsibilities	To pass the course, students have to: • successfully do all the exercises in practical work and seminars • attend all lectures (a maximum of three unjustified absences is allowed) • achieve a minimum of 12 points (60%) points on partial exams

2.11. Required literature (available in the library and/or via other media)	Title	Number of copies in the library	Availability via other media
	Boulton, R. B., Sigelton, V. L., Bisson, L. F., Kunkee, R. E. (1995) Principles and practice of winemaking, Chapman & Hall, New York, pp 65-98, 102-181, 244-273, 448-470	0	YES, Merlin
	Jackson, R. S. (2008) Wine Science: Principles and Applications, 2nd. ed., Academic Press, New York., pp 281-354, 434-481	0	YES, Merlin
	Mencarelli, F. & Tonutti, P. (2013) Sweet, Reinforced and Fortified Wines: Grape Biochemistry, Technology and Vinification, 1st ed., John Wiley & Sons, Ltd, Chichester., pp 29-71, 189, 215-277, 285-327	0	YES, Merlin

2.12. Optional literature	• Halliday J. & Johnson, H. (2013) The Art and Science of Wine, 1st ed., Octopus publishing group, London, pp. 112-136, 175-191. • Jackson, R. (2002) Wine Tasting: A Professional Handbook, 1st ed., Academic Press, New York, pp. 219-224.
2.13. Exams	*Exam dates are published in Studomat.*
2.14. Other	-

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Zoran Herceg, PhD, Full Professor Anet Režek Jambrak, PhD, Associate Professor Kata Galić, PhD, Full Professor Tomislava Vukušić, PhD, Assistant Professor Višnja Stulić, mag. ing.	1.8. Semester when the course is delivered	winter
1.2. Course title	**Food Process Engineering 2**	1.9. Number of ECTS credits allocated	5
1.3. Course code	53280	1.10. Number of contact hours (L+E+S+e-learning)	20 + 30 + 15 + 0
1.4. Study programme	Graduate university study programme Food Safety Management	1.11. Expected enrolment in the course	52
1.5. Course type	compulsory	1.12. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	1. 0 %
1.6. Place of delivery	P2, LFPE (room 29)	1.13. Language of instruction	Croatian

1.7. Year of study when the course is delivered	first	1. 14. Possibility of instruction in English	N
2. COURSE DESCRIPTION			
2.1. Course objectives	The main course objective is to enable students to apply various innovative food preservation techniques and to use the appropriate devices as well as to apply the appropriate processes in the development of new food industry products.		
2.2. Enrolment requirements and/or entry competences required for the course	-		
2.3. Learning outcomes at the level of the programme to which the course contributes	• know key aspects of food production and food industry • recognize the importance of all segments of food production (raw material features, technology applied, production and packaging conditions , effect of processing and preservation on chemical composition of food products, potential effects of packaging, quality assurance) • know new food processing techniques and processes and methods used for quality control of food • conceptualize and carry out improvement of existing technological procedures • select and purchase new equipment and production lines, and work on their implementation in order to improve company's business • conceptualize and carry out production of new products • present modern food technology trends • make decisions about development and expansion of production		
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	• explain and present the specifics of new food processing methods and define the concept of minimally processed food • know and apply innovative techniques and processes in food processing and preservation • create material and energy balances of innovative processes • analyze the impact of applied processing and conservation on the chemical composition of food products and the potential impact of packaging • recommended new production process parameters to improve production and improve existing technology processes • propose the purchase of new process equipment and production lines in order to improve the business of the company • select the specific packaging material needed to food package obtained by new processing methods		
2.5. Course content (syllabus)	Material and energy balance of thermal processes (pasteurization, sterilization, evaporation). Cooling and freezing processes: material and energy balance. Basic membrane separation – heat and mass transfer (equipment and application).. Extrusion - heat and mass transfer. Effect on foods. Heat processing by direct and radiated energy. Dielectric heating – theory, equipment, applications. Ohmic heating - theory, equipment, applications. Infrared heating - theory, equipment, applications. Processing foods using pulsed electric field - theory, equipment. Processing foods using high hydrostatic pressure - theory, equipment. Processing foods using ultrasound - theory, equipment. Processing foods using pulsed light - theory, equipment. Specific preparations of food. Packaging of food – theory, types of packaging materials, interactions between packaging and foods, environmental considerations. Food handling, storage and distribution. Practices and seminars: Extrusion (field work), Heat and mass transfer of extrusion (seminar), Infrared heating of foods, Influence of ultrasound on foods. Specific preparations of food (field work), High-bay warehouse (field work). Problems of handling equipments and distributions of foods (seminar)		
2.6. Format of instruction	☒ lectures ☒ seminars and workshops ☒ exercises ☐ *on-line in entirety*	☒ independent assignments ☐ multimedia and the internet ☒ laboratory	2.7. Comments:

<table>
<tr><td></td><td colspan="3">☐ partial e-learning
☐ field work</td><td colspan="3">☐ work with mentor
☐ (other)</td><td colspan="3"></td></tr>
<tr><td rowspan="6">2.8. Monitoring student work</td><td>Class attendance</td><td>Y</td><td></td><td>Research</td><td></td><td>N</td><td>Oral exam</td><td>Y</td><td></td></tr>
<tr><td>Experimental work</td><td>Y</td><td></td><td>Report</td><td>Y</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>N</td><td>Seminar paper</td><td>Y</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td>Y</td><td></td><td>Practical work</td><td></td><td>N</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>N</td><td>Written exam</td><td>Y</td><td></td><td>ECTS credits (total)</td><td colspan="2">5</td></tr>
<tr><td></td><td colspan="9"></td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Class attendance 2
Written exams or oral exam 80
Exercises 6
Seminar assignments (3) 12
Total 100

Grading scale:
< 60 % fail (1)
≥ 60 % sufficient (2)
≥ 70 % good (3)
≥ 80 % very good (4)
≥ 90 % excellent (5)</td></tr>
<tr><td>2.10. Student responsibilities</td><td colspan="9">To pass the course, students have to:
successfully do all the exercises in practical work and seminars
make all laboratory exercises reports
make all seminar assignments
attend lectures (absences are tolerated, but influence the grade)
achieve a minimum of 60% of points on each partial exam or pass the oral exam</td></tr>
<tr><td rowspan="2">2.11. Required literature (available in the library and/or via other media)</td><td colspan="5">Title</td><td>Number of copies in the library</td><td colspan="3">Availability via other media</td></tr>
<tr><td colspan="5">Z. Herceg, Procesi konzerviranja hrane - novi postupci, Golden marketing, Tehnička knjiga, Zagreb, 2009.</td><td>9</td><td colspan="3"></td></tr>
<tr><td>2.12. Optional literature</td><td colspan="9">R. Paul Singh, Dennis R. Heldman: Introduction to Food Engineering, Academic Press, San Diego, California, USA, 2001.
P.J. Fellows: Food processing technology, principles and practice, second edition, Woodhead Publishing Limited and CRC Press LLC, Boca Raton, USA, 2000 .</td></tr>
<tr><td>2.13. Exams</td><td colspan="9">Exam dates are published in Studomat.</td></tr>
<tr><td>2.14. Other</td><td colspan="9">-</td></tr>
</table>

<table>
<tr><th colspan="4">1. GENERAL INFORMATION</th></tr>
<tr><td>1.1. Course lecturer(s)</td><td>Duška Ćurić, PhD, Full Professor
Dubravka Novotni, PhD, Assistant Professor
Nikolina Čukelj, PhD, Assistant Professor
Bojana Voučko, dipl. ing.</td><td>1.8. Semester when the course is delivered</td><td>winter</td></tr>
<tr><td>1.2. Course title</td><td>Chemistry and Technology of Cereals</td><td>1.9. Number of ECTS credits allocated</td><td>10</td></tr>
</table>

1.3. Course code	53289	1.10. Number of contact hours (L+E+S+e-learning)	60 + 45 + 15 + 0
1.4. Study programme	Graduate university study programme Food Engineering	1.11. Expected enrolment in the course	20
1.5. Course type	optional A	1.12. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	1. 5 %
1.6. Place of delivery	lectures and seminars in P5, exceercises in the LCCT, field excercises – visits to Podravka, Mlinar, Bivita and Kraš	1.13. Language of instruction	Croatian
1.7. Year of study when the course is delivered	first	1.14. Mogućnost izvođenja na stranom jeziku	Y

2. COURSE DESCRIPTION

2.1. Course objectives	On completion of this course, students will understand: chemical composition, functional and biochemical properties of commercially important cereals; Effects of processing on the chemical and physicochemical properties of cereal products; Technology of processing of cereals.
2.2. Enrolment requirements and/or entry competences required for the course	Click here to enter text.
2.3. Learning outcomes at the level of the programme to which the course contributes	• know key aspects of food production and food industry • recognize the importance of all segments of food production (raw material features, technology applied, production and packaging conditions , effect of processing and preservation on chemical composition of food products, potential effects of packaging, quality assurance) • select and purchase raw materials and packaging materials, and conduct quality control of raw materials and products • supervise and manage the quality management system for production processes in food production • conceptualize and carry out improvement of existing technological procedures • select and purchase new equipment and production lines, and work on their implementation in order to improve company's business • conceptualize and carry out production of new products do highly-complex jobs in microbiological, physical and chemical control and development laboratories of food industry • make conclusions about selection and purchasing of raw materials, packaging and equipment • give a final opinion about the results of conducted physical, chemical and microbiological analyses of raw materials and final products • make decisions about development and expansion of production • manage a team or work in a team, which is in charge of a particular business activity in food industry or a related institution • present modern food technology trends • use and value scientific and occupational literature with the aim of lifelong learning and profession enhancement
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	• perform analyses of main quality parameters of cereal products • identified key aspects of grain storage • define steps in cereals milling • describe changes that occur during cereals processing • select technology of breadmaking, pasta production, biscuits and crackers, and snack production. • develop new cereal products • apply legislation and norms related to specific requirements for cereal processing • use scientific and professional literature for the purpose of lifelong learning

<table>
<tr><td>2.5. Course content (syllabus)</td><td colspan="10">1. Introduction to cereal chemistry and technology
2. Grain morphology, microscopic structure and chemical composition of cereal grains;
3. Cereal enzymes. Determination of foreign matter, hectolitre mass, grain vitreousness, sedimentation value, and wet gluten content.
4. Dough rheology – fundamental and empirical. Measurement of dough rheology on farinograph and extensograph.
5. Storage of cereals. Determination of flour amylase activity on amylograph and by falling number method.
6. Dry milling of cereals. Industry visit – silo and mill.
7. Cereal milling. Bread baking test, sensory analysis of wheat bread, determination of bread yield and specific volume.
8. Criteria of flour quality. Bakery industry visit.
9. Specific criteria of flour and cereal products quality. Baking tests. Partial exam.
10. Bread-making technologies, steps and equipment. Bake-off technology. Industry visit – biscuit production. Seminars
11. Bread quality parameters and staling. Bread improvers. Sourdough. Biscuits standard baking test.
12. Puff pastry, laminated, phylo and short dough. Determination of pasta quality by sensory method. Determination of oat flakes water absorption.
13. Pasta production. Industry visit – oat flakes factory. Seminars.
14. Soft wheat products – biscuits, crackers and cakes. Seminars.
15. Production of snack food and breakfast cereals. Seminars.
16. Partial exam.</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="4">☒ lectures
☒ seminars and workshops
☒ exercises
☐ on-line in entirety
☐ partial e-learning
☒ field work</td><td colspan="3">☐ independent assignments
☐ multimedia and the internet
☒ laboratory
☐ work with mentor
☐ (other)</td><td colspan="3">2.7. Comments:</td></tr>
<tr><td rowspan="5">2.8. Monitoring student work</td><td>Class attendance</td><td></td><td>N</td><td>Research</td><td></td><td>N</td><td>Oral exam</td><td>Y</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>N</td><td>Report</td><td></td><td>N</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>N</td><td>Seminar paper</td><td>Y</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Preliminary exam</td><td></td><td>N</td><td>Practical work</td><td>Y</td><td></td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>N</td><td>Written exam</td><td>Y</td><td></td><td>ECTS credits (total)</td><td colspan="2">10</td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="10">1. Maximum number of points by activity type:
1. Partial exam 20
2. Partial exam 20
Seminar paper 40
Exercises 20
Total 100

2. Partial exams
In the exam period, the failed partial exam is taken. If students do not pass the course via partial exams, taking the exam in the exam period is considered to be the first examination. Passing prior partial exams is not a prerequisite for taking the subsequent ones.

3. Grading scale:
< 60 % fail (1)
≥ 60 % sufficient (2)
≥ 70 % good (3)
≥ 80 % very good (4)
≥ 90 % excellent (5)</td></tr>
</table>

2.10. Student responsibilities	To pass the course, students have to: • successfully do all the exercises in practical work and achieve a minimum of 12 points with exercises • attend all lectures (a maximum of two unjustified absences is allowed) • achieve a minimum of 12 points on each partial exam • give an oral presentation of a seminar paper and achieve a minimum of 24 points with the seminar paper • achieve a minimum 60 points in total		
2.11. Required literature (available in the library and/or via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Course materials	0	YES, Merlin
2.12. Optional literature	• Hoseney, R.C. (1994) Principles of Cereal Science and Technology. AACC, St. Paul, Minnesota, SAD. • Bozzini A. i sur. (1988) Durum Wheat Chemistry and Technology, AACC, St. Paul, Minnesota, SAD. • Manley, D. (2000) Technology of Biscuits, Crackers and Cookies, Woodhead Publishing Limited and CRC Press LLC, Cambridge CB1 6AH, England and Boca Raton Fl 33431 USA • Klarić, F. (prevoditelj) 2012: Tehnologije proizvodnje pekarskih i slastičarskih proizvoda, Biblioteka Kruh za život, TIM ZIP doo Zagreb ; Original: Schunemann, C., Treu, G. (2009): Technologie der Backwarenherstellung, Gildebuchverlag GmbH&Co.KG, Deutschland • Kulp i Ponte (2010) Handbook of Cereal Science and Technology. Marcel Dekker.		
2.13. Exams	*Exam dates are published in Studomat.*		
2.14. Other	Obavijesti o predavanjima, vježbama i ispitima se objavljuju na mrežnoj stranici http://moodle.srce.hr/2016-2017/course/view.php?id=12861		

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Ivan Krešimir Svetec, PhD, Full Professor Anamarija Štafa, PhD, Assistant Professor Marina Svetec Miklenić, PhD, Assistant Professor Bojan Žunar, PhD	1.8. Semester when the course is delivered	summer
1.2. Course title	**Genetic Engineering**	1.9. Number of ECTS credits allocated	4
1.3. Course code	39804	1.10. Number of contact hours (L+E+S+e-learning)	27 + 27 + 0 + 0
1.4. Study programme	Undergraduate university study programme Biotechnology	1.11. Expected enrolment in the course	60
1.5. Course type	compulsory	1.12. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	2. 5 %
1.6. Place of delivery	Lectures in P1 and P2; Exercises in the Laboratory for Biology and Microbial Genetics	1.13. Language of instruction	Croatian
1.7. Year of study when the course is delivered	third	1.14. Possibility of instruction in English	Y
2. COURSE DESCRIPTION			
2.1. Course objectives	The objective of the course is to familiarize students with the principles and methods of genetic engineering and to transfer the knowledge and skills required for students to implement individual methods and techniques on their own. These include: DNA isolation and purification, DNA electrophoresis and isolation of DNA from the gel, application of restriction and modification enzymes, construction of recombinant plasmids, transformation of E. coli, PCR, RAPD, restriction mapping and construction and analysis of gene bank.		

2.2. Enrolment requirements and/or entry competences required for the course	To enrol in this course, the following courses must be completed: • Molecular Genetics • Biochemistry 1
2.3. Learning outcomes at the level of the programme to which the course contributes	• define and explain the principles of basic scientific disciplines, such as mathematics, physics, chemisty, biochemistry and biology with particular emphasis on microbiology and molecular genetics, and apply these skills and knowledge to the field of biote • select and apply in practice basic biochemical engineering knowledge and skills, manage biotechnological and genetic engineering processes • select and use laboratory equipment and appropriate computer tools • conduct analyses and biotechnological procedures in chemical, biochemical, microbiological, molecular-genetic, process and development laboratories, and recognize and solve simple problems in these laboratories • interpret routine laboratory analyses in biotechnology • report on laboratory, production plant and business results in verbal and written way, using specific professional terminology • develop knowledge and skills which are needed to continue studies on higher levels, primarily on graduate studies of Bioprocess Engineering and Molecular Biotechnology
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	• explain the importance and application of genetic engineering in biotechnology and support the explanations by concrete examples • explain basic concepts related to genetic engineering such as genetic modification, recombinant DNA, cloning, GMOs, genes, transgenes, cDNAs, ORFs, clones, cloning, vector, inserts, transformations, homologous / heterologous expression, libraries / gene bank ... • apply enzymes for cleavage and modification of nucleic acids such as restriction enzymes, DNA ligases, DNA and RNA polymerases, RNase and DNase, and phosphatase and kinase, for the purpose of constructing and analysing recombinant plasmids, construction of gene bank and genetic material analysis • explain the principle, procedure and application of the following methods: DNA electrophoresis, restriction analysis of DNA, isolation of DNA from gel, PCR, qPCR (using "TaqMan probes"), RAPD, RFLP, VNTR, AFLP, SSCP, DGGE, FISH, DNA sequencing (dideoxy), S1 mapping, Southern blotting, Northern blotting, two hybrid system, plasmid isolation in singlestranded form and targeted mutagenesis in vitro (by Kunkel method and PCR) • explain the principle and procedure of cloning and construction of a genomic bank in some vectors such as plasmids, viral vectors, phagmids, cosmids, BACs, PACs and YACs • plan and propose strategies for the introduction of targeted genetic modification in yeast S. cerevisiae • explain the principle and procedure for the genetic modification of plants and genetic modification and cloning of animals • plan and carry out the construction of the plasmid and the gene bank, carry out restriction analysis of plasmid or DNA fragment and perform methods such as PCR, RAPD and RFLP • interpret the results of molecular genetic analysis
2.5. Course content (syllabus)	• Introduction to Genetic Engineering - Basic concepts in genetic engineering, application scope and implications for human society; comparison of classic breeding methodology and methods of genetic engineering; specific examples of expression of human proteins in E. coli • Restriction enzymes and recombination "in vitro" • nucleic acid electrophoresis • Enzymes for modification of nucleic acids (ligases, polymerases, nucleases, kinases, phosphatases, transferases ...) • Methods of PCR, qPCR, RAPD and targeted mutagenesis in vitro • Vectors and hosts in genetic engineering and the construction and search of a gene bank • Labelling of nucleic acids and application of hybridization methods • Methods for detection and analysis of DNA polymorphisms • DNA sequencing and postgenomic research

<table>
<tr><td></td><td colspan="9">• Genetic engineering of S. cerevisiae yeast
• Genetic modifications of plants and animals</td></tr>
<tr><td>2.6. Format of instruction</td><td colspan="3">☒ lectures
☐ seminars and workshops
☒ exercises
☐ online in entirety
☒ partial e-learning
☐ field work</td><td colspan="3">☐ independent assignments
☐ multimedia and the internet
☒ laboratory
☐ work with mentor
☒ rasprava na forumu u sustavu Merlin</td><td colspan="3">2.7. Comments:
Students attend lectures in the first half of the semester, and practical laboratory exercises in the second half. During classes, students have a chance to answer questions and participate in Merlin forum discussions about topics from genetic engineering and with this activity they get additional „bonus points“ affecting the final grade.</td></tr>
<tr><td rowspan="6">2.8. Monitoring student work</td><td>Class attendance</td><td></td><td>Y</td><td>Research</td><td></td><td>N</td><td>Oral exam</td><td>Y</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Y</td><td>Report</td><td></td><td>Y</td><td>3 partial exams</td><td>Y</td><td></td></tr>
<tr><td>Essay</td><td></td><td>N</td><td>Seminar paper</td><td></td><td>N</td><td>Participating in Merlin forum discussions</td><td>Y</td><td></td></tr>
<tr><td>Preliminary exam</td><td></td><td>N</td><td>Practical work</td><td></td><td>N</td><td>(other)</td><td></td><td></td></tr>
<tr><td>Project</td><td></td><td>N</td><td>Written exam</td><td>Y</td><td></td><td>ECTS credits (total)</td><td colspan="2">4</td></tr>
<tr><td></td><td colspan="9"></td></tr>
<tr><td>2.9. Assessment methods and criteria</td><td colspan="9">Students can pass the course through three partial exams (two covering lectures and one covering exercises), each one bringing a maximum of 100 points. Students can take the successive partial exam if they achieve a minimum of 10 points on the previous one. In addition, with forum activities (answering questions and discussion) during lectures and exercises, students can collect „bonus points“. A maximum of 60 bonus points can be collected and these points are added to points achieved on partial exams. Based on the total of achieved points on the first exam period (3rd partial exam) a final grade is formed according to the following:

GRADE POINTS
excellent (5) 271 - 300
very good (4) 241 - 270
good (3) 211 - 240
sufficient (2) 181 - 210
fail (1) 0 - 180

If students achieve a Sufficient, Good or Very good grade on the first exam period, they can take the oral exam to increase their grade (the exam will be held before the successive exam period). If students achieve a Fail grade, they can take make-up exam periods covering the entire syllabus. In this case, the grade is formed according to this table and bonus points are not taken in consideration:

GRADE POINTS
excellent (5) 91 - 100
very good (4) 81 - 90
good (3) 71 - 80
sufficient (2) 61 - 70
fail (1) 0 - 60

Exams can contain eliminatory questions (basic knowledge of biology and biochemistry that should have been acquired before enrolling in this course). After the written exam,</td></tr>
</table>

	students can be asked to take the oral exam (in case of problems with the eliminatory questions and/or in case of lacking a few points for a higher grade).		
2.10. Student responsibilities	To pass the course, students have to: • attend all lectures (a maximum of one unjustified absence is allowed) • attend all exercises and actively participate in carrying out assignments • achieve the minimal number of points needed for a sufficient grade (see section 2.9)		
2.11. Required literature (available in the library and/or via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Anamarija Štafa, Ivan Krešimir Svetec, Zoran Zgaga, Skripta za vježbe iz Genetičkog inženjerstva		YES, Merlin
	Metode u molekularnoj biologiji, Andreja Ambriović Ristov, IRB, 2007		YES, Laboratory
	Anthony JF Griffiths, An Introduction to Genetic Analysis, 2000		YES, Merlin
	Alberts, B., Molecular Biology of the Cell, 2002		YES, Merlin
2.12. Optional literature	• Primrose S.B. i Twyman R.M. (2006) Principles of gene manipulation and genomics, 7th edition, Blackwell Publishing, Oxford. • Brown T.A. (2006) Gene cloning and DNA analysis, 5th edition, Blackwell Publishing, Oxford. • Ausubel, F.M., Brent R., Kingston R.E., Moore D.D., Seidman J.G., Smith J.A. i Struhl K. (2002) Short protocols in molecular biology, 5th ed. Vols 1 and 2. Willey and Sons. • J. Sambrook, E. F. Fritsch, T. Maniatis. **Molecular cloning: A laboratory manual. 3rd ed.**, Cold Spring Harbor, New York, 2001.		
2.13. Exam dates	*Exam dates are published in Studomat.*		
2.14. Other	-		

1. GENERAL INFORMATION			
1.1. Course lecturer(s)	Ivan Krešimir Svetec, PhD, Full Professor Anamarija Štafa, PhD, Assistant Professor Marina Svetec Miklenić, PhD, Assistant Professor	1.8. Semester when the course is delivered	winter
1.2. Course title	**GMOs in Food Production**	1.9. Number of ECTS credits allocated	3
1.3. Course code	53261	1.10. Number of contact hours (L+E+S+e-learning)	20 + 0 + 15 + 0
1.4. Study programme	Graduate university study programme Molecular Biotechnology	1.11. Expected enrolment in the course	35
1.5. Course type	optional A	1.12. Level of application of e-learning (level 1, 2, 3), percentage of online instruction (max. 20%)	1. 0 %
1.6. Place of delivery	Lectures and seminars in P3	1.13. Language of instruction	Croatian
1.7. Year of study when the course is delivered	first	1.14. Possibility of instruction in English	Y
2. COURSE DESCRIPTION			
2.1. Course objectives	The objective of the course is to teach students what is GMO from a scientific and legislative point of view, what are the differences between edible plants produced by classical breeding and GM plants, which procedures are used in classical breeding and which during the construction of GM plants, what is the role of GMOs in food production, how relevant		

	this role is, and what are the principles, procedures, advantages and disadvantages of methods for detecting and quantifying GMOs in products and raw materials..		
2.2. Enrolment requirements and/or entry competences required for the course	Understanding the subject requires the knowledge of molecular genetics and genetic engineering		
2.3. Learning outcomes at the level of the programme to which the course contributes	• integrate knowledge acquired from the fields of microbiology, microbe physiology, molecular biology, genetics and bioinformatics with the aim of producing traditional and modern biotechnological products • apply knowledge acquired in order to construct genetically modified organisms of desired traits • participate in activities of advisory and legislative bodies in the field of molecular biotechnology • manage particular laboratory units in biotechnology, food and pharmaceutical industry and other institutions owing to their knowledge of contemporary biochemical, microbiological, molecular genetic and instrumental methods • use scientific literature in English, and present the existing results to experts and laymen, and convey their knowledge and skills to their peers • present, valorize and popularize modern accomplishments and courses of development of molecular biotechnology • participate actively in scientific paper discussion from the field of molecular biotechnology and related sciences • act in accordance with ethical principles and acquire new knowledge and skills, as a part of lifelong learning and profession promotion, including PhD studies in molecular biotechnology and other bio-sciences		
2.4. Expected learning outcomes at the level of the course (3 to 10 learning outcomes)	• explain GMO related concepts such as genetic modification, mutation, mutagen, mutagenesis, genetic engineering, transgenic organism, transgene, cisgene, heterologous gene expression, GM product, "pharming" • distinguish between the principle and methods and evaluate and discuss the advantages and disadvantages of genetic engineering and classical breeding • based on concrete examples, argue the reasons for GMOs use from the point of view of producers and consumers and compare US, EU and RH policies with the application of GMOs in food production • conclude whether certain claims about the ecological and economic consequences of breeding certain GM plants are true and to support the answers with argumentation • based on the knowledge of a particular biosynthetic pathway, propose the genetic modification that will result in a desired physiological change such as increased concentration of a metabolite, change in starch structure, fatty acid composition, etc. • conclude which genetic modification could have a positive or negative impact on certain technological and nutritional properties of certain plants (e.g. wheat, potatoes, oilseeds) • conclude and argue whether certain applications of GM-microorganisms are subject to the GMO Law in the Republic of Croatia • argue if some foodstuffs could be a GM product and to conclude whether, under the GMO Act, it should be labelled as a GM product • explain the principle, procedure and application of methods for detection and quantification of GMOs • review and present the original scientific paper covering a topic about the GMO issue in an understandable way or review and present an application for registration of a GM plant to colleagues, answer their questions and ask questions and participate in the discussion		
2.5. Course content (syllabus)	• Introduction to the course and the distribution of GMOs worldwide • Plant genomes, polyploid and hybrid plants • Transformation of plant cells and cell culture • Characteristics of GM plants • Dilemma about GM plants and the use of GM-microorganisms in food production • Methods for detection and quantification of GMOs, final discussion and conclusions		
2.6. Format of instruction	☒ lectures		2.7. 2.7. Comments:

	☒ seminars and workshops ☒ exercises ☐ *online in entirety* ☒ partial e-learning ☐ field work	☐ independent assignments ☐ multimedia and the internet ☐ laboratory ☐ work with mentor ☒ rasprava na forumu u sustavu Merlin	In the first half of classes, students attend lectures. In the second half they attend seminars and practical laboratory exercises. During classes, students have the opportunity to ask questions and participate in discussions about GMO themes on Merlin, gaining bonus points that affect the final grade.

2.8. Monitoring student work

Class attendance		N	Research		N	Oral exam	Y	
Experimental work		N	Report		N	discussion during seminar presentation	Y	
Essay		N	Seminar paper	Y		(other)		
Preliminary exam		N	Practical work		N	(other)		
Project		N	Written exam	Y		ECTS credits (total)	3	

2.9. Assessment methods and criteria

Maximum number of points by activity type

1. Written exam	40
2. Seminar paper	10
4. Oral exam	50
Total	100

Grading scale:

< 60 % fail (1)
≥ 60 % sufficient (2)
≥ 70 % good (3)
≥ 80 % very good (4)
≥ 90 % excellent (5)

Written exams can contain eliminatory questions (basic knowledge of biology and biochemistry that should have been acquired before enrolment in this course)

2.10. Student responsibilities

To pass the course, students have to:

- attend all lectures (a maximum of one unjustified absence is allowed)
- give a presentation of a seminar paper and attend all seminars
- achieve the minimal number of points needed for a sufficient grade (as described under 2.9)

2.11. Required literature (available in the library and/or via other media)

Title	Number of copies in the library	Availability via other media
Food and Agriculture Organization of the United Nations		YES, Merlin
GMO Compass		YES, Merlin
International Service for the acquisition of Agri-Biotech Applications		YES, Merlin

2.12. Optional literature

- Plant biotechnology and genetics: principles, techniques and applications. Ed. Neal C. Stewart. John Wiley & Sons, Hobken, 2008.
- Plant biotechnology: the genetic manipulation of plants. A. Slater, N. W. Scott, M. R. Fowler, 2nd ed. Oxford University Press, Oxford, 2008.

2.13. Exams

Exam dates are published in Studomat.

2.14. Other

-