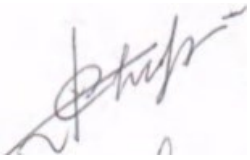
Ministry of Education and Science of Ukraine
Sumy National Agrarian University
Department of Food Technology and Safety

Work program (syllabus) of the educational component

MC 14 INFORMATION TECHNOLOGIES AND OPTIMIZATION OF TECHNICAL AND TECHNOLOGICAL FACILITIES OF THE PROCESSING INDUSTRY

Specialty	181 "Food Technology"
Educational program	Food technology
Level of higher education	Third (PhD)

Sumy – 2023

Developer:  **Anna HELIKH Candidate of Technical Sciences, Associate Professor, Department of Food Technology and Safety**

(surname, initials) (academic degree and title, position)

Reviewed and approved at the meeting of the Department of Food Technology and Safety_ (name of department)	protocol dated _12.06.2023 year_.№_16__
	Manager departments _____ _ **Marina SAMILYK**__ (signature) (last name, initials)

Agreed:
Guarantor of the educational program _____ _ Oksana MELNYK_____
(signature) (full name)

Acting Dean of the Faculty where
the educational program is implemented _____ Nataliia BOLHOVA_
(signature) (full name)

The review of the work program
was provided by _____ Ph.D., Assoc. Prof. Oksana MELNYK
(signature) (full name)

_____ Doctor of Engineering Sciences, Prof. Fedir PERTSEVOY
(signature) (full name)

Methodologist of the Department of Educational Quality,

licensing and accreditation _____(_____)
(signature) (full name)

Registered in the electronic database: date: _____07. 09._____2023 year.

Information on reviewing the work program (syllabus):

Academic year in which changes are made	Number of the appendix to the work program with a description of the changes	Changes reviewed and approved		
		Date and number of the minutes of the department meeting	Head of the Department	Educational program guarantor

1. GENERAL INFORMATION ABOUT THE EDUCATIONAL COMPONENT

1.	Name MC	Information technologies and optimization of technical and technological facilities in the processing industry		
2.	Faculty/department	Food Technology / Department of Food Technology and Safety		
3.	Status MC	Mandatory		
4.	Program/Specialty (programs) that include MC for (*filled in for mandatory* MC*)*	EP "Food Technologies", 181 Food Technologies		
5.	NQF level	Level 8		
6.	Semester and duration of study	2nd semester, 15 weeks		
7.	Number of ECTS credits	3		
8.	Total hours and their distribution	Contact work (classes)		Independent work
		Lectures 18	Laboratory 18	54
9.	Language of instruction	Ukrainian		
10.	Teacher/Educational Component Coordinator	Ph.D., associate professor Gelikh A.O.		
11.1	Contact information	Anna Oleksandrivna Helikh, Associate Professor of the Department of Technology and Safety, 317a, e - mail : anna . helikh @ snau . edu . ua		
11.	General description of the educational component	acquisition the ability to optimally select equipment and its operating modes (time, temperature, pressure, etc.); methods and modes of heat treatment, recipe composition, and to model the costs of producing products, which requires sufficiently accurate calculation methods and, thus, the use of modern computing tools .		
12.	Purpose of the educational component	Study of the principles of building mathematical models of food technology as objects of design, control and optimization. Verification of the validity and reliability of computer models of technological processes, among which two types can be distinguished: physicochemical (deterministic) models and empirical models based on the processing of experimental data.		
13.	Prerequisites for studying MC, connection with other educational components of EP	The educational component is the basis for the EP "Food Technologies": 2 Modern information technologies in scientific activities; MC 9 Methodology and organization of dissertation preparation and writing .		
14.	Academic Integrity Policy	It is not allowed to copy the conclusions of the laboratory work protocols from each other, in such a case the laboratory work will be considered unprotected and will require re-revision. In case of re-revision, the work will not be evaluated for the maximum score .		

2. LEARNING OUTCOMES BY EDUCATIONAL COMPONENT AND THEIR RELATIONSHIP WITH PROGRAM LEARNING OUTCOMES

Learning outcomes for MC: After studying the educational component, the student is expected to be able to...	Program learning outcomes that the MC aims to achieve			How is **PLO** assessed?
	PLO 3	**PLO 9**	**PLO 11**	
DLO 1 The ability to formulate modeling problems, understand their essence, and break them down into separate stages to form an algorithm for developing mathematical models of technological processes.	**X**	**X**		Oral defense of laboratory work Final multiple-choice test (modular assessment, certification) Exam – multiple choice test
DLO 2 Ability to apply mathematical models and software functions of the MS Office Excel, MathCAD, STATISTICA working environment in engineering practice - as modern methods for solving optimization problems and their graphical interpretation for presentation and visual understanding.	**X**		**X**	Oral defense of laboratory work Final multiple-choice test (modular assessment, certification) Exam – multiple choice test
DLO 3. the ability to verify the validity and reliability of computer models of technological processes, among which two types can be distinguished: physicochemical (deterministic) models and empirical models based on the processing of experimental data. .	**X**			Oral defense of laboratory work Final multiple-choice test (modular assessment, certification) Exam – multiple choice test

LIST OF COMPETENCES THAT WILL BE IMPROVED/ACQUIRED IN THE PROCESS OF NON-FORMAL EDUCATION	
CASE STUDY: how to solve complex problems in business and life	
General: the presence of an innovative perception of the subject, specified in three types: perception of one's own innovations and innovations or discoveries in general, the ability to see elements of the new in the relatively stable, and the ability to propose a fundamentally new solution to the problem. **Professional:** possession of a system of theoretical and practical knowledge, a set of skills; experience in demonstrating competence in real situations of the technological process; the ability to creatively solve professional problems, the level of awareness of the technologist of his knowledge, abilities, skills, and capabilities necessary for the qualified implementation of innovative activities.	**Form for confirming learning results:** A certificate of successful completion of training with the number of hours. The authenticity of the certificate can be verified by using the link on it.

3. CONTENT OF THE EDUCATIONAL COMPONENT (COURSE PROGRAM)

Topic. List of issues to be addressed within the topic	Distribution within the overall time budget			Recommended reading[1]
	Classroom work		Wednesday	
	Luke	Lab. river.		
Module 1				
Lecture 1. **Content, purpose and main objectives of the discipline. General information about modeling. General concepts of optimization of technological processes.** 1. Main objectives of the course, its relationship with special training disciplines. 2. Formulation of modeling tasks. 3. The essence and stages of mathematical modeling. 4. Modeling objects. Generalized algorithm for developing mathematical models of technological processes. 5. Hierarchical structure of the modern food industry enterprises. General idea of the technological system. 6. General concepts of optimization of technological processes. ***Laboratory exercise 1. Approximation*** **of** *experimental data by linear equations.* **Independent work** Topic 1. Linear programming problems 1.1. Examples of linear modeling problems 1.2. General and basic linear programming problems 1.3. Geometric method for solving linear programming problems	2	2	10	[1,2,3,4 , 6 , 9 , 14 , 17 , 20]

[1] Specific source from the main or additionally recommended literature

***Lecture* 2. Software functions of the MS working environment Office Excel , MathCAD and STATISTICA used to solve practical problems of modeling food technologies.** 1. Application of mathematical models and software functions of the MS working environment in engineering practice Office Excel , MathCAD , STATISTICA – as modern methods for solving optimization problems and their graphical interpretation for presentation and visual understanding. Processing the results of the implementation of plans for full and fractional multifactorial experiments. Analysis of the results and their presentation. **Independent work** Topic 1. Linear programming problems 1.4 Methods for solving linear programming problems using modern computer technologies	2	2	10	[1,2,3,4,5,6,9,11,14,18,20]
***Lecture* 3. GENERAL information about the theoretical prediction of the experiment.** 1. Basic concepts and definitions of experimental factors. 2. Verification of the reproducibility of experiments. Calculation of experimental error. **Laboratory *exercise* 2.** *Approximation of experimental data by nonlinear equations.* **Independent work** Topic 1. Linear programming problems 1.5. Simplex method of finding a solution	2	2	10	[1,2,3,4,5,6,10,15,14,18,20]

***Lecture class* 4. Experimental and statistical models. Full multivariate experiment.** 1. Mathematical description 2. Planning an extreme experiment Full factorial experiment **Laboratory *lesson* 3.** *Regression equation of a multivariate experiment and its statistical analysis.* **Independent work** Topic 1. Linear programming problems 1.6. Artificial basis method	4	4	12	[1,2,3,4,5,7,12,13 , 14,17 , 20]
Total for module 1	10	10	42	
Module 2				
***Lecture class* 5. Application of the main types of mathematical models to describe technological processes .** 1. The steep method ascent. 2. Simplex method. **Laboratory *lesson* 4.** *Analysis of the regression equation by finding the gradient of free ascent.* **Independent work** Topic 1. Linear programming problems 1.7 The concept of a degenerate solution 1.8 Modified simplex method	4	4	6	[1,2,3,4,5,6,9,11,13,14,18,20]
***Lecture class* 6. Research into the area of optimal conditions** 1. Orthogonal central composite planning. 2. Rototable planning. 3. Contour-graphic analysis. **Laboratory *lesson* 4.** *Analysis of the regression equation by finding the gradient of free ascent.* **Independent work** Topic 2. Conceptual principles for modeling functional food compositions and culinary products 2.1 Theoretical justification production culinary products 2.2 Practical principles creation culinary products functional appointment	4	2	6	[1,2,3,4,5,6,9,11,13,14,18,20]

Non-formal education (Prometheus)				
CASE STUDY: how to solve complex problems in business and life **Course program:** Introduction: What the course is about and why Where to start solving a case Problem structuring: decision tree and the MESE principle Working with hypotheses Brainstorming Analysis tools How to conduct research and draw conclusions How to prioritize Developing recommendations	10			https :// prometheus . org . ua / prometheus - plus / case - study /
Total	18	18	54	

4. TEACHING AND LEARNING METHODS

DRN	**Teaching methods** (work that will be carried out by the teacher during classroom lessons , consultations)	**Number of hours**	**Teaching methods** (what types of learning activities should the student perform independently)	Number of hours
DRN 1. The ability to formulate modeling tasks, understand their essence and divide them into separate stages to form an algorithm for developing mathematical models of technological processes.	**Problem lectures** (questions are raised regarding the material covered by the teacher, but the lecturer answers them himself, to focus students' attention on the main point) **Presentations** (demonstration of information on the topic of lectures)	6	**Laboratory classes** (performing tasks according to methodological instructions) **Brainstorming** while doing lab work **Individual tasks** (independent processing of the information proposed by the teacher)	6 10
DRN 2. Ability to apply mathematical models and software functions of the MS Office Excel, MathCAD, STATISTICA working environment in engineering practice - as modern methods for solving optimization problems and their graphical interpretation for presentation and visual understanding.	**Problem lectures** (questions are raised regarding the material covered by the teacher, but the lecturer answers them himself, to focus students' attention on the main point) **Presentations** (demonstration of information on the topic of lectures)	6	**Laboratory classes** (completion of tasks in accordance with methodological instructions) **Brainstorming** while doing lab work **Individual tasks** (independent processing of the information proposed by the teacher)	6 20

DRN 3. the ability to verify the validity and reliability of computer models of technological processes, among which two types can be distinguished: physicochemical (deterministic) models and empirical models based on the processing of experimental data.	**Problem lectures** (questions are raised regarding the material covered by the teacher, but the lecturer answers them himself, to focus students' attention on the main point) **Presentations** (demonstration of information on the topic of lectures)		**Laboratory classes** (performing tasks according to methodological instructions) **Brainstorming** while doing lab work **Individual tasks** (independent processing of the information proposed by the teacher)	6 12

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5. EVALUATION BY EDUCATIONAL COMPONENT

5.1.Diagnostic assessment (indicated as needed)

5.2.Summative assessment

5.2.1. To assess the expected learning outcomes, there are

No.	Summative assessment methods	Points / Weight in the overall score	Date of compilation
1.	Laboratory work defense (1,2,3 laboratory work 6 points) total 18 Laboratory work 4 (7 points)	25 / 2 5%	within 5 days after class
2.	Completion of training on Prometheus	30 / 30 %	Up to 14 weeks
3.	Midterm testing (multiple choice test)	15/ 1 5%	Week 7
4.	Exam (multiple choice test)	*30 points / 30%*	15 week

5.2.2. Evaluation criteria

Component	***Unsatisfactorily***	***Satisfactorily***	***Good***	***Perfectly***
Oral defense of laboratory work *(For the 1st laboratory work)*	*< 2 points* *Task requirements not met*	*3-4* *Most requirements are met, but individual components are missing or insufficiently disclosed, there is no analysis of other approaches to the issue*	*5 points* *All task requirements met*	*6-7 points* *Fulfilled all the requirements of the task, demonstrated creativity, thoughtfulness, proposed their own solution to the problem*
Certification (multiple choice test)	*The test includes 15 questions, each of which is worth 1 point.*			
Midterm testing (multiple choice test)	*The test includes 1 to 5 questions, each of which is worth 0.3 points.*			
Exam (multiple choice test)	*The test includes 30 questions, each of which is worth 1 point.*			
Training on Prometheus	*If you have a certificate – 30 points*			

5.3.Formative assessment:

To assess current progress in learning and understand areas for further improvement,

No.	Elements of formative assessment	Date
1	Oral survey after studying all topics, during laboratory classes	within 5 days after class
2	Feedback in the form of a discussion of the final testing	7, 15 weeks
3	Feedback in the form of a discussion of exam testing	Week 15
4	Feedback in the form of a discussion of the non-formal education course	after listening to the course

6. LEARNING RESOURCES (LITERATURE)

Methodological support

1. **Gelikh A.O.** Information technologies and optimization of technical and technological facilities in the processing industry. Textbook for students of the Doctor of Philosophy degree in specialty 181 "Food Technologies" of full-time and part-time forms of study // Sumy: SNAU, 2023, 104 p.

2. **Gelikh A.O.** Information technologies and optimization of technical and technological facilities in the processing industry. Course of lectures for students of the degree of Doctor of Philosophy in specialty 181 "Food Technologies" of full-time and part-time forms of study // Sumy: SNAU, 2021, 45 p.

3. **Gelikh A.O.** Information technologies and optimization of technical and technological facilities in the processing industry Methodological recommendations for laboratory classes for students of the degree of Doctor of Philosophy in specialty 181 "Food Technologies" of full-time and part-time forms of study // Sumy: SNAU, 2021, 42 p.

Recommended reading

Basic

4. Gelikh A.O. Optimization of the recipe composition of minced meat products based on mollusks of the genus Anodonta according to the criterion of nutritional balance for essential nutrients. Food Science and Technology. 2018. Issue 4. Vol. 12. Pp. 86–94.

5. Helikh A. Scientific rationale of the technology of pastes based on freshwater hydrobionts and enriched with selenium. Food science and technology. 2020;14(1):110-117.

6. Gelikh A.O. Optimization of yogurt quality indicators with the addition of fillers. Scientific notes of the V.I. Vernadsky Tavrichesky National University Series: Technical Sciences. Volume 31 (70) No. 1: 2020 Part 2. P. 102-108.

7. Gelikh A.O. Modeling the recipe composition of protein-carbohydrate semi-finished products. Hotel, restaurant and tourism consulting. Volume 3 No. 1: 2020. P. 25-36.

8. Gelikh A.O. Optimization of ultrasonic alkaline extraction of protein flour isolate from pumpkin seeds using response surface methodology. Scientific Notes of the V.I. Vernadsky Tavrichesky National University Series: Technical Sciences. Volume 31 (70) No. 1: 2020 Part 2. P. 44-49.

9. Ostapchuk M.V., Stankevych G.M. Mathematical modeling on a computer: Textbook. — Odesa: Druk, 2018.-313 p.

10. Gao, D., Helikh, A., Duan, Z., Shang, F., Liu, Y. (2022). Development of pumpkin seed meal biscuits. Eastern-European Journal of Enterprise Technologiesthis, 2 (11-116), 36–42. https://doi.org/10.15587/1729-4061.2022.254940

11. Helikh, A. , Gao D. , Zhenhua D. (2022). Study on application of pumpkin seed protein isolate in sausage production process. Technology audit and production reserves — No. 2/3(64). r. 19-23. https://doi.org/10.15587/2706-5448.2022.255785

12. Gelikh A. O., Kryzhska T. A., Danylenko S. G., Semernya O. V. (2022). Optimization of rheological parameters of yogurt structure with the addition of hemp seed protein isolate. Food Resources. Issue No. 18. pp. 51-60. https://doi.org/10.31073/foodresources2022-18-05

13. Optimization of technological processes of the industry: methodical recommendations for studying the discipline and performing control work for students of special. 7.05170107, 8.05170107 "Technologies of storage, preservation and processing of fruits and vegetables" of full-time and part-time study / compiled by O.V. Tochkova – K.: NUHT, 2018– 35 p.
14. Helikh A. , Kryzhska T. , Girichenko S. (2021). Optimization of emulsion-type sauces with the addition of plant-based protein isolates **.** Food Resources. Issue No. 17. pp. 54-64. https://doi.org/10.31073/foodresources2021-17-06
15. Bondar, A.G. Mathematical modeling in chemical technology / A.G. Bondar- K.: Higher School, 2017. – 289 p.
16. Ladieva, L.R. Optimization of technological processes./ L.R. Ladieva. - K.: IVC "Publishing house "Polytechnica", 2016. - 192 p.
17. L. Sztangret, L. Rauch, J. Kusiak, P. Jarosz, and S. Małecki, "Modeling of the oxidizing roasting process of zinc sulphide concentrates using the artificial neural networks," *Computer Methods in Materials Science* , vol. 11, no. 1, pp. 122–127, 2017.
18. A. Stanisławczyk, J. Gawad, and J. Kusiak, "Multi scale modeling and optimization of production chains based on metal forming," in *Proceedings of the 8th Conference World Congress on Computational Mechanics (WCCM '08)* , Venice, Italy, 2018.
19. M. Pietrzyk, L. Madej, and R. Kuziak, "Optimal design of manufacturing chain based on forging for copper alloys, with product properties being the objective function," *CIRP Annals—Manufacturing Technology* , vol. 59, no. 1, pp. 319–322, 2019.
20. J. Kusiak, A. Danielewska-Tu lecka, and P. Oprocha, *Optimization. Selected Methods with Examples of Applications* , Polish Scientific Publishers, Warszawa, Poland, 2019, (Polish).
21. K. Deb, *Multi-Objective Optimization Using Evolutionary Algorithms* , John Wiley & Sons, London, UK, 2001.
22. K. Miettinen, *Nonlinear Multiobjective Optimization* , Springer, Berlin, Germany, 2019.
23. F. Flegiel, S. Sharma, and GP Rangaiah, "Development and multiobjective optimization of improved cumene production processes," *Materials and Manufacturing Processes* , vol. 30, no. 4, pp. 444–457, 2015.

Auxiliary

24. Optimization of technological processes of the industry: Method, instructions for studying the discipline and performing control work for students of special 7.091713 "Technology of sugar substances" correspondence form of study / Compiled by V.O. Miroshnyk. - Kyiv: UDUHT, 2019. - 48 p.
25. H. Fang, M. Rais-Rohani, Z. Liu, and MF Horstemeyer, "A comparative study of metamodeling methods for multiobjective crashworthiness optimization," *Computers & Structures* , vol. 83, no. 25-26, pp. 2121–2136, 2015.
26. SL Ho, S. Yang, G. Ni, EWC Lo, and HC Wong, "A particle swarm optimization-based method for multiobjective design optimizations," *IEEE Transactions on Magnetics* , vol. 41, no. 5, pp. 1756–1759, 2015.
27. AE Shiel, D. Weis, and KJ Orians, "Evaluation of zinc, cadmium and lead isotope fractionation during smelting and refining," *Science of the Total Environment* , vol. 408, no. 11, pp. 2357–2368, 2019.
28. RH Myers and DC Montgomery, *Response Surface Methodology: Process and Product Optimization Using Designed Experiments* , John Wiley & Sons, New York, NY, USA, 2018.

29. Poperechny A.M. Modeling of processes and equipment of food production. Textbook / A.M. Poperechny, V.O. Potapov, V.G. Korniychuk // - K.: Center for Educational Literature, 2012. – 312 p. 234.
30. Potapov V.O. Modeling of technological processes of food production. Textbook: - Kh.: KhDUKHT, 2008 – 148 p.

Information resources

31 https :// cdn . snau edu . ua / moodle / course / view . php ? ID = 4351