Ministry of Education and Science of Ukraine

Sumy National Agrarian University

Faculty of Food Technology

Food Technology Department

Syllabus of an educational component

EC 9 SCIENTIFIC BASIS OF WASTE-FREE TECHNOLOGIES OF FOOD INDUSTRY

Under implementation in within the educational programs **«Food technologies»**

by specialty **181 «Food technologies»**

at the second (master's) level higher education

Sumy – 2025

Developer: _____ **Dmytro BIDIUK,** Ph.D., Senior Lecturer, Food Technology Department
(signature) (surname, initials) (academic degree and title, position)

Considered , approved and ratified at the meeting departments **technology food** (name departments)	minutes of 04.06.2025 No. 23
	Manager departments _____ (signature) Oksana MELNYK (last name , initials)

Agreed:

Guarantor educational programs Maryna SAVCHENKO
(signature) (first name LAST NAME)

Dean faculty,

where is being implemented educational program _____ Natalia BOLGOVA
(signature) (first name SURNAME)

Review on working program (attached) provided by: _____ Oksana MELNYK
(signature) (first name LAST NAME)

_____ Serhiy BOKOVETS
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Methodist department qualities education,

licensing and accreditation _____ Svitlana Kovalevets
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Registered in electronic base: date: 24.08. 2025

Information on reviewing the work program (syllabus):

Academic year in which changes are made	The number of the appendix to the work program with a description of the changes	The changes have been reviewed and approved		
		Date and number of the Protocol of the meeting of the department	Head of Department	Guarantor of the educational program

1. GENERAL INFORMATION ABOUT EDUCATIONAL COMPONENT

1.	Name of Educational Component	Scientific basis of waste-free technologies in the food industry			
2.	Faculty / Department	Food technology / Food Technology			
3.	Status of Educational Component	Mandatory			
4.	Program / Specialty (programs) that include an educational component for	Educational program: Food technologies / specialty: 181 « Food technologies »			
5.	An educational component may be offered for	241 «Hotel and restaurant business»			
6.	Level NQF	7 level			
7.	Semester and duration of study	Third semester Duration study – 15 weeks			
8.	Credits ECTS	5			
9.	General amount of hours and their distribution	Contact work (class)			Independent work
		Lectures	Practise / Seminars	Lab	
		2	-	0	148
10.	Language of educational	English			
11.	Teacher / Coordinator of the educational component	Dmytro BIDIUK			
11.1	Contacts	Working place: room 212 m, Mechanization Building tel. +38 (050) 781-20-27 E-mail: d.bidiuk@snau.edu.ua			
12.	General description of the educational component	The educational component is aimed at forming in students a systematic understanding of modern theoretical and practical approaches to the implementation of the principles of zero-waste production and circular economy in the food industry. The course combines scientific knowledge and real entrepreneurial experience in the implementation of Zero Waste and upcycling technologies, and also integrates innovative educational methods, digital tools and artificial intelligence capabilities. Special attention is paid to bioprocessing of food waste, the creation of value-added products, innovative solutions for packaging, storage and disposal of by-products. The course is aimed at training specialists who are able to combine scientific knowledge, entrepreneurial experience and global environmental practices to achieve the goals of sustainable development of the food industry.			
13.	The aim of educational component	The aim of studying the discipline is to form in students systemic knowledge and practical skills in the development and implementation of waste-free resource-saving technologies in the food industry, the study of bioprocessing of by-products and waste, the creation of innovative products with added value, and the use of modern educational and digital tools.			
14.	Prerequisites for studying EK, connection with other educational components of EP	The educational component is related to other educational components: "Theoretical foundations of food production", "Quality and safety management of food products", "Innovative technologies in industry enterprises"			
15.	Policy academic virtue	If copying or plagiarism is detected, the student's work is canceled and re-done.			
16.	Link to the course in the system Moodle	https://cdn.snau.edu.ua/moodle/enrol/index.php?id=5044			
17.	Keywords	Waste-free technologies, circular economy, sustainable development, food waste, by-products, environmental requirements			

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

Learning results for EK: After studying the educational component, the student will be able to…	Program learning outcomes that are directed to EK (indicate the number according to the number given in OP)				As the LOE is estimated
	PLO5	PLO6	PLO14	PLO15	
LOE 1. Select and implement effective waste-free technologies and modern equipment in production processes, taking into account global trends in the development of food technologies.	X				Oral defense of lab Multiple choice test (modular assessment) Differential credit
LOE 2. Develop and implement programs for the sustainable development of food industry and restaurant enterprises, analyze their economic, environmental and social efficiency.		X			
LOE 3. Apply knowledge and practical skills in waste bioprocessing, innovative methods of preserving and storing food products, introduce bioplastics and other environmentally friendly materials for packaging.			X		
LOE 4. Organize the work of food enterprises and restaurant establishments in compliance with the principles of life safety, resource conservation and environmental safety.				X	
LOE 5. Integrate international practices and innovative educational approaches (Zero Waste, upcycling, digital technologies, artificial intelligence) into the process of making professional decisions in the field of waste-free food technologies.	X	X	X	X	

3. CONTENT OF THE EDUCATIONAL COMPONENT (PROGRAM OF THE COURSE)

Topic. List questions that will be considered within topics	Distribution in within general budget time			Recommended literature
	Class work		Independent work (IW)	
	Lectures	Lab		
Topic 1. Modern approaches to the implementation of waste-free technologies in the food industry: theoretical foundations and practical solutions 1. The concept of waste-free technologies and their place in the concept of a circular economy. 2. World experience and Ukrainian realities of the implementation of resource-saving technologies. 3. Examples of innovations in the food industry: utilization of by-products and obtaining products with added value. 4. The experience of the rekava startup as an example of the practical implementation of the principles of upcycling and zero waste. 5. The role of scientific research in the formation of practical solutions for the industry. IW1. Food industry waste and by-products for industrial use. By-products of the meat and poultry processing industry. By-products of the dairy industry By-products from the grain processing industry. Fruit and vegetable by-products. By-products of seafood processing. Lab 1. Study of organoleptic, physicochemical and functional-technological indicators of by-products of the food industry	2	-	28	[1-16]
Topic 2. Bioprocessing of waste from the meat and poultry processing industry 1. Main by-products in the processing of beef, pork, chicken and	-	-	30	[1-16]

eggs. 2. Modern methods of utilization: biogas complexes, feed products, pharmaceutical ingredients. 3. Valorization of bones, blood, fats into new products. 4. Ukrainian examples of enterprises implementing utilization technologies. 5. Mentoring experience at the Zero Waste Academy: practices for implementing waste-free solutions in business and public initiatives. IW 2. Various by-products and waste from beef and pork processing. Valorization of beef and pork processing waste. Proteins and peptides obtained from by-products of chicken waste processing. Valorization of egg waste. Lab 2. Use of by-products of the food industry as part of food products				
Topic 3. Bioprocessing of waste from the beverage industry. 1. Coffee processing. By-products and waste from coffee processing. Utilization of coffee by-products and waste. 2. Tea processing and production. Tea by-products and waste and their utilization. 3. Global and Ukrainian startups in the field of coffee and tea waste reuse. 4. Personal experience of the co-founder of rekava in creating products based on recycled coffee grounds. 5. Global and local approaches to implementing the principles of sustainable development and Zero Waste in the food industry IW 3. Global practices of beverage industry market leaders. By-products and waste from other food industries. Lab 3. Use of spent coffee grounds in biodegradable packaging technology for food products	-	-	30	[1-16]
Topic 4. Innovative approaches to storage, packaging and marketing of ecological products 1. New materials for packaging using food waste. 2. How to correctly position innovative waste-free products on the market. 3. The role of financial literacy in the scaling and sustainability of ecological business models. IW 4. Technologies for preserving and extending the shelf life of products taking into account environmental requirements. Use of waste in the creation of functional ingredients and new types of food products. Lab 4. Obtaining extracts and flour from citrus peel and their use in food technology	-	-	30	[1-16]
Topic 5. Artificial intelligence and digital technologies in the development of waste-free food production. 1. Using digital tools and AI in modeling food waste recycling processes. 2. Optimizing bioprocessing technologies using big data, IoT, and machine learning algorithms. 3. Examples of using AI in predicting waste volumes and creating circular business models. IW 5. Experience in using artificial intelligence in training food technology specialists. Prospects for integrating digital platforms into sustainable food business. Lab 5. Studying the process of composting food waste using AI elements	-	-	30	[1-16]
Total	**2**	**-**	**148**	

4. TEACHING AND LEARNING METHODS

Learning outcomes by educational component	**Teaching methods** (work to be done by the teacher during classes, consultations)	**Number of hours**	**Teaching methods** (what types of educational activities the student must perform independently)	**Number of hours**
LOE 1. Select and implement effective waste-free technologies and modern equipment in production processes, taking into account global trends in the development of food technologies.	Lectures with analysis of world and Ukrainian practices, demonstration of equipment operation in laboratory classes, invited guest lectures from representatives of enterprises, consultations on the selection of modern technological solutions.	10	Independent search and analysis of information about modern technologies and equipment in scientific databases and technical literature, preparation of comparative reviews of global and Ukrainian practices, analysis of video materials and online resources on the operation of equipment.	20
LOE 2. Develop and implement programs for the sustainable development of food industry and restaurant enterprises, analyze their economic, environmental and social efficiency.	Problem-oriented lectures, analysis of cases of international and Ukrainian enterprises, modeling of development strategies in laboratory classes, individual consultations on assessing economic and environmental efficiency.	10	Completion of individual tasks on the development of sustainable development strategies, work on business process modeling projects, independent study and critical analysis of international strategies	20
LOE 3. Apply knowledge and practical skills in waste bioprocessing, innovative methods of preserving and storing food products, introduce bioplastics and other environmentally friendly materials for packaging.	Laboratory classes on bioprocessing technologies, use of bioplastics as packaging materials, consultations on technological solutions at operating enterprises.	10	Independent performance and defense of laboratory work, analysis of patent and scientific literature on innovations in packaging and storage, search and evaluation of examples of bioplastics and new materials on the market, performance of mini-studies on the impact of biodegradable packaging on the shelf life of products.	20
LOE 4. Organize the work of food enterprises and restaurant establishments in compliance with the principles of life safety, resource conservation and environmental safety.	Interactive lectures with an emphasis on the regulatory framework, practical classes on modeling production situations, consultations on organizing safety management systems and environmental	10	Preparation of individual cases on modeling production situations, independent study of regulatory documents	20
LOE 5. Integrate international practices and innovative educational approaches (Zero Waste, upcycling, digital technologies, artificial intelligence) into the process of making professional decisions in the field of waste-free food technologies.	Lecture-discussions with analysis of world cases, demonstration of digital tools and examples of AI application, master classes on Zero Waste and upcycling methods, consultations on the use of educational and digital innovations in students' practice.	10	Analysis of international cases in the field of Zero Waste and upcycling, independent processing of materials on digital tools and AI capabilities, performance of mini-studies on waste forecasting and modeling of food waste utilization, preparation of presentations on innovative practices in the industry	20

5. ASSESSMENT BY EDUCATIONAL COMPONENT

5.1. Summative assessment

5.1.1. For the assessment of expected learning outcomes, the following is provided:

№	Methods of summative assessment	Points / Weight in the overall score	Date of compilation
1	Performance and defense of lab (5 Lab of 5 points)	*25 points / 25%*	Within a week after the LR
2	Module 1 - multiple choice test	*25 points / 25%*	According to the approved schedule
3	Independent work within module 1, completion of an individual task	*15 points / 15%*	By the end of module 1 according to the approved schedule
4	Module 2 - multiple choice test	*25 points / 25%*	According to the approved schedule
5	Independent work within module 2, completion of an individual task	*10 points / 10%*	By the end of module 2 according to the approved schedule

5.1.2. Evaluation criteria

Component	**Unsatisfactorily**	**Satisfactorily**	**Good**	**Exellent**
1. Performance and defense of lab	*0 points*	*1-2 points*	*3-4 points*	*5 points*
	Laboratory work not completed.	Laboratory work tasks partially completed, no conclusions and personal recommendations.	Laboratory work tasks fully completed, no conclusions and personal recommendations.	Laboratory work tasks fully completed and comprehensive answers provided, conclusions and personal recommendations made.
2. Module 1 - multiple choice test	The test includes 25 questions, each of which is worth 1 point			
3. Independent work within module 1, individual task	*<5 points*	*5-9 points*	*10-14 points*	*15 points*
	Independent work is performed at a very low level, there is no scientific justification for the tasks and recommendations on the problem under consideration	Independent work is performed at a satisfactory level, there is no scientific justification for the tasks, no personal recommendations are provided on the problem under consideration	Independent work is performed at a sufficient level, the tasks are partially justified, brief personal recommendations are provided on the problem under consideration	Independent work is performed at a professional level, the tasks are scientifically justified, a personal vision and recommendations are provided on the problem under consideration
4. Module 2 - multiple choice test	The test includes 25 questions, each of which is worth 1 point			
5. Independent work within module 1, individual task	*<4 points*	*4-6 points*	*7-9 points*	*10 points*
	Independent work is performed at a very low level, there is no scientific justification for the tasks and recommendations on the problem under consideration	Independent work is performed at a satisfactory level, there is no scientific justification for the tasks, no personal recommendations are provided on the problem under consideration	Independent work is performed at a sufficient level, the tasks are partially justified, brief personal recommendations are provided on the problem under consideration	Independent work is performed at a professional level, the tasks are scientifically justified, a personal vision and recommendations are provided on the problem under consideration

5.2. Formative assessment:

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

№	Elements of formative assessment	Date
1.	Oral survey after completing lab	Within a week after the Lab
2.	Feedback in the form of a discussion of testing within the modules	According to the approved schedule
3.	Feedback in the form of a discussion of the completed individual task	Until the end of module 2 according to the approved schedule

6. EDUCATIONAL RESOURCE (LITERATURE)

6.1. Basic sources

1. Cecchi F., De Carolis M. Biobased Products from Food Sector Waste: Bioplastics, Biocomposites, and Biocascading. – 1st ed. – Cham: Springer, 2021. – 245 p. – ISBN 978-3-030-xxxxx-x.
2. Kumar Garg V., Kataria N. (Eds.) Bioeconomy for Sustainability. – Singapore: Springer, 2024. – 412 p. – ISBN 978-981-99-xxxxx-x.
3. Rahman M. et al. Transforming plant-based waste and by-products into valuable products using various “Food Industry 4.0” enabling technologies: A literature review // Science of the Total Environment. – 2024. – Vol. 923. – Art. 172373. – DOI: 10.1016/j.scitotenv.2024.172373.
4. Baldassarre F., García-Gómez H., Savioli L. et al. Food loss and waste reduction by using Industry 4.0 technologies: examples of promising strategies // International Journal of Food Science and Technology. – 2025. – Vol. 60, Iss. 1. – P. 41–57. – DOI: 10.1111/ijfs.16564.
5. Singh R., Sharma P., Yadav A. et al. Closing the loop: technological innovations in food waste valorisation for global sustainability // Discover Sustainability. – 2025. – Vol. 6, Art. 77. – DOI: 10.1007/s43621-025-01073-4.
6. Ali A., Yusof N., Zulkifli R. et al. A comprehensive review of food waste valorization for the sustainable management of global food waste // RSC Sustainable Food Technology. – 2024. – Vol. 4. – P. 1335–1355. – DOI: 10.1039/D3FB00156C.
7. Chaudhary A., Singh P., Verma S. et al. Valorization of food waste: A comprehensive review of individual technologies for producing bio-based products // Journal of Environmental Management. – 2024. – Vol. 356. – Art. 120239. – DOI: 10.1016/j.jenvman.2024.120239.
8. Gupta S., Prakash A., Singh R. et al. Sustainability in food-waste reduction biotechnology: a critical review // Bioresource Technology. – 2022. – Vol. 360. – Art. 127602. – DOI: 10.1016/j.biortech.2022.127602.
9. Costa M., Oliveira R., Fernandes M. et al. Functional Ingredients from Food Waste and By-Products: Processing Technologies, Functional Characteristics and Value-Added Applications // Foods. – 2025. – Vol. 14, Iss. 5. – Art. 847. – DOI: 10.3390/foods14050847.
10. Zhang H., Li Y., Wang J. et al. A sustainable waste-to-protein system to maximise waste resource utilisation for developing food- and feed-grade protein solutions // arXiv preprint. – 2022. – arXiv:2208.07703. – URL: https://arxiv.org/abs/2208.07703.

6.2. Information resources

11. Food Waste and Byproducts: An Opportunity to Minimize Malnutrition and Hunger in Developing Countries [Electronic resource] / Access mode: https://www.frontiersin.org/articles/10.3389/fsufs.2018.00052/full
12. Review: Food Industry By-Products used as a Functional Food Ingredients [Electronic resource] / Access mode: https://www.longdom.org/open-access/review-food-industry-byproducts-used-as-a-functional-food-ingredients-2252-5211-1000248.pdf
13. Agro -Food Byproducts as a New Source of Natural Food Additives [Electronic resource] / Access mode: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6471601/
14. Utilization of food processing by-products [Electronic resource] / Access mode: https://www.hilarispublisher.com/proceedings/utilization-of-food-processing-byproducts-8455.html
15. Valorization of Food Processing By-Products [Electronic resource] / Mode Access : https://www.semanticscholar.org/paper/Valorization-of-Food-Processing-By-Products-Chandrasekaran/f936da50bcdf015a83201e398faabc6f2db857ea
16. Food Byproducts as Sustainable Ingredients for Innovative and Healthy Dairy Foods [Electronic resource] / Access mode: https://pubmed.ncbi.nlm.nih.gov/30249001/