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

WORK PROGRAM OF EDUCATIONAL DISCIPLINE (SYLLABUS)

SC 2 Energy management and energy audit of processing plants and food industry

Specialties	G13 «Food Technologies»
The educational program	«Food Technologies»
level of higher education	at the second (master's) level of higher education

:

Sumy - 2025

Developer:_____Maryna SAVCHENKO

Ph.D., Associate Professor of the Nutrition Technology Department

Considered, approved and approved at the meeting of the nutrition technology department	protocol No.23 from 04.06.2025		
	Head department	_____ (signature)	**Oksana MELNYK** (surname, initials)

Agreed:

Guarantor of the educational program _____ __ Maryna SAVCHENKO
(signature) (surname)

Dean of the Faculty,
where the educational program is implemented _____Nataliia BOLHOVA
(signature) (surname)

Review of the work program (attached) provided by: Oksana MELNYK
(surname)

Nataliia BOLHOVA
(surname)

Methodist of the Education Quality Department,
licensing and accreditation _____ (_____)
(signature) (surname)

Registered in the electronic database: date: _____2025.

Information on viewing the work program (syllabus):

The academic year in which the changes are made	The number of the annex to the work program with a description of the changes	The changes were 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 THE EDUCATIONAL COMPONENT

<table>
<tr><td>1.</td><td>The name is EC</td><td colspan="4">Energy management and energy audit of processing and
food enterprises</td></tr>
<tr><td>2.</td><td>Faculty/department</td><td colspan="4">Food technology / Nutrition Technology</td></tr>
<tr><td>3.</td><td>The status is EC</td><td colspan="4">Selective</td></tr>
<tr><td>4.</td><td>OK can be offered for (to be completed for selective ECs)</td><td colspan="4">Educational program: Food technologies/specialty: G13 "Food technologies"</td></tr>
<tr><td>5.</td><td>NRK level</td><td colspan="4">7th level</td></tr>
<tr><td>6.</td><td>Semester and duration of study</td><td colspan="4">Semester two
The duration of study is 15 weeks</td></tr>
<tr><td>7.</td><td>Number of ECTS credits</td><td colspan="4">5 credits</td></tr>
<tr><td rowspan="2">8.</td><td rowspan="2">The total number of hours and their distribution (full-time study/part-time study)</td><td colspan="3">Contact work (class)</td><td>Independent work</td></tr>
<tr><td>Lectures

2</td><td>Practical/seminar</td><td>Laboratory</td><td>148</td></tr>
<tr><td>9.</td><td>Language of education</td><td colspan="4">English</td></tr>
<tr><td>10.</td><td>Teacher/Coordinator of the educational component</td><td colspan="4">The teacher is Ph.D., associate professor of the Nutrition Technology Department , Savchenko Maryna Yuriivna</td></tr>
<tr><td>11.1</td><td>Contact Information</td><td colspan="4">Auditorium of the department 314m, building #4, phone: 0993834398, E-mail: marina.saw4encko2011@gmail.com , consultation hours: every Monday from 1 to 2 p.m.</td></tr>
<tr><td>11.</td><td>General description of the educational component</td><td colspan="4">Familiarization with methods of assessment, analysis and planning in energy use, development of energy-saving measures at the enterprise, drawing up and development of energy-saving programs that take into account technical, economic, financial and administrative factors. Students should also familiarize themselves with the problems of choosing and justifying a more rational type of energy carriers, investing and financing in energy saving, the energy load of the enterprise, issues of information support for energy management; providing future specialists with knowledge of calculation methods and conducting energy audits of technological equipment, power supply systems, refrigeration equipment, pumping, compressor, lighting, electrothermal and other installations, and heat-using systems.</td></tr>
<tr><td>12.</td><td>The purpose of the educational component</td><td colspan="4">Formation of the volume of theoretical and practical knowledge and skills necessary in the professional activity of future highly qualified specialists in the field of energy management, energy saving and energy audit in the food industry.</td></tr>
<tr><td>13.</td><td>Prerequisites for studying EC, connection with other educational components of EP</td><td colspan="4">The educational component is connected with other educational components " Automation of production processes of processing enterprises and restaurant establishments ", "Processes and devices of food production", "Technological equipment of food production", "Innovative engineering"</td></tr>
<tr><td>14.</td><td>Policy of academic integrity</td><td colspan="4">If the fact of writing off is discovered during the exam, the student's work is canceled and the exam is retaken. Code of academic integrity
(http://surl.li/khyd)</td></tr>
<tr><td>15.</td><td>Link to the electronic resource</td><td colspan="4">Link in Moodle: https://cdn.snau.edu.ua/moodle/course/view.php?id=3693</td></tr>
<tr><td>16.</td><td>Keywords</td><td colspan="4">Energy management, energy audit, measurements, food enterprises</td></tr>
</table>

2. LEARNING RESULTS UNDER THE EDUCATIONAL COMPONENT AND THEIR RELATIONSHIP WITH PROGRAM LEARNING OUTCOMES

The results study for EC: After studying the educational component, the student is expected to be able to..."	Program learning outcomes, which the EC aims to achieve (indicate the number according to the numbering given in the EP)[1]					The result of learning the discipline is evaluated
	PLO 1	PLO 2	PLO 5	PLO 10	PLO 15	
DLO1. Find information about the essence of energy management, energy enterprise strategy in the matter of energy efficiency, implementation energy management systems at the enterprise; energy management matrix, management energy use, methods research on the efficiency of the use of energy resources	x					Control work on theoretical material. Execution and protection of practical works.
DLO2. Be able to justify the method of thermal calculation of technological heat-consuming equipment of the food industry; methods of determining energy characteristics of equipment and technological processes; Methods calculation of energy consumption for the equipment of processing enterprises.		x				
DLO3. Develop methods for determining heat balances of food industry enterprises; methods calculation loss of energy resources; basics rational operation of heat and power supply systems.			x			
DLO4. Conduct research on methods of using secondary energy resources and alternative and renewable energy sources; energy saving methods; a general approach when conducting an energy audit.				x		
DLO5. Implement types of energy audit; main stages of energy audit; methods of determining and reducing losses of various types of energy in technical and technological objects.					x	

[1]It must correspond to the Matrix of ensuring the programmatic learning outcomes by the relevant components of the educational program, it is specified for the compulsory educational components of EP I and II level, for all (mandatory and selective EC)

3. CONTENTS OF THE EDUCATIONAL COMPONENT (CURRICULUM PROGRAM)

Topic. List of issues to be considered within the topic	Distribution within the general time budget			Re commended Books
	Auditory work		Independent work	
	Lc	Pc		
Topic 1. Concept of energy management. Energy conservation and energy audit. Introduction to energy management. Concepts and objects of energy management. Basics of energy saving and energy audit. Legislative basis of energy survey.	2	-	30	[1-3]
Topic 2. Energy management. Energy consumption accounting. The essence, purpose, tasks, functions, principles of energy management. Matrix of energy management. The procedure for conducting an energy audit of the energy management system.	-	-	30	[4-6]
Topic 3. Conducting an energy audit. Assessment of energy saving potential. Main stages of energy audit. The cost and duration of the energy audit. Energy audit report. Assessment of energy consumption. Analysis of the efficiency of energy use. Environmental aspect of energy audit.	-	-	30	[7-10]
Topic 4. Use of secondary energy resources and alternative and renewable energy sources, as a way of saving energy and increasing energy saving of enterprises. Criteria for rational operation of heat and power supply systems. Methods of energy supply from the point of view of energy saving. Evaluation of the efficiency of energy use. Characteristics of secondary energy resources. Characteristics of alternative and renewable energy sources.	-	-	30	[11-16]
Topic 5. The method of thermal calculation of technological heat-consuming equipment of the food industry. Calculation of the heat balance of heat-consuming devices of meat and milk processing enterprises. Determination of the heat transfer coefficient. Calculation of coolant consumption. Calculation of heat-consuming devices of periodic action.	-	-	28	[17-25]
In total	**2**	**0**	**148**	

4. TEACHING AND LEARNING METHODS

DLO	**Teaching methods** (work to be carried out by the teacher during classroom classes, consultations)	**Number of hours**	**Teaching methods** (what types of educational activities should the student perform independently)	**Number of hours**
DLO 1. Know the essence of energy management, the energy strategy of enterprises in the matter of energy efficiency, implementation of the energy management system at the enterprise; matrix of energy management.	To analyze the ways of selecting the necessary information regarding innovations in energy saving using the examples of scientific and technical literature	2	Preparation for the lecture by familiarization with the lecture material. Search for technical solutions in information sources. Studying the material for independent mastery. Preparation of theoretical material in the form of publications. Completion of tasks of practical work, the implementation of which began in the practical session.	30
DLO 2. To know the method of thermal calculation of technological heat-consuming equipment of the food industry; methods of determining energy characteristics of equipment and technological processes.	Giving examples and techniques using an interactive method	-		30
DLO 3. To know the methods of determining heat balances of a food industry enterprise; methods of calculating energy resource losses; basics of rational operation of heat and power supply systems.	Demonstration of examples of solving production problems using an interactive method in lectures and practical classes	-		30
DLO 4. Know the types of energy audit; main stages of energy audit; methods of determining and reducing losses of various types of energy in technical and technological objects.	Demonstration of examples of work in applied software products	-		30
DLO 5. Know ways to use secondary energy resources and alternative and renewable energy sources; energy saving methods; a general approach when conducting an energy audit.	Demonstration of examples of solving production problems using an interactive method in lectures and practical classes	-		28

5. EVALUATION BY THE EDUCATIONAL COMPONENT

5.1.Summative assessment

5.1.1. To assess the expected learning outcomes, it is provided

No	Summative methodsassessment	Points/ Percentage in the overall assessment	Compilation date
	Module I		
1.	writtencontrol work on theoretical material	*20 points / 20%*	In the sixth week
2.	Implementation and protection of practical	*30 points / 30%*	Until the next practical
	Module II		
3.	Written control work on the theoretical material	*20 points / 20%*	In the fourteenth week
4.	Implementation and protection of practical works	*30 points / 30%*	Until the next practical

5.1.2. Evaluation criteria

Component[1]	**Unsatisfactorily**	**Satisfactorily**	**Fine**	**Perfectly**[2]
Written control work on the theoretical material	*<12 points*	*13-16*points	*17-19 points*	*20 points*
	Task requirements not met	*Answers to all questions are given, but individual components of the answers are missing or insufficiently disclosed, there is no analysis of other approaches to the question*	*All questions are answered*	*Answers to all questions are given, creativity and thoughtfulness are demonstrated, and one's own solution to the problem is proposed*
Implementation and protection of practical works	*<12 points*	*13-20*points	*21-29 points*	*30 points*
	Task requirements not met	*Answers to all questions are given, but individual components of the answers are missing or insufficiently disclosed, there is no analysis of other approaches to the question*	*All questions are answered*	*Answers to all questions are given, creativity and thoughtfulness are demonstrated, and one's own solution to the problem is proposed*

[1]Specify the summative assessment component

[2]Specify the distribution of points and the criteria determining the level of assessment

5.8. Formative assessment:

To assess the current progress in learning and understand the directions for further improvement is provided

No	***Elements of formative assessment***	***Date***
1.	*Written survey after studying topics 1-5*	*according to the study plan*
2.	*Verbal feedback from the teacher while working on the control work*	*according to the study plan*

Self-assessment can be used as an element of summative assessment and formative assessment.

6. EDUCATIONAL RESOURCES (LITERATURE)

1. Bańkowska, B., & Dzik, M. (2023). *Challenges of energy management in the food industry in Poland in the context of the objectives of the European Green Deal and the "Farm to Fork" strategy*. *Energies*, 15(23), 9090. https://doi.org/10.3390/en15239090.
2. Jagtap, S., Rahimifard, S., & Duong, L. N. K. (2022). Real-time data collection to improve energy efficiency: A case study of a food manufacturer. Journal of Food Process Preservation, 46(7), e14338. https://doi.org/10.1111/jfpp.14338
3. Al-Ali, A., Al-Ghandoor, A., & Al-Rifai, B. (2023). *Energy saving potential analysis applying factory scale energy audit – A case study of food production*. Heliyon, 9(1), e12846. https://doi.org/10.1016/j.heliyon.2023.e12846
4. Zhang, Y., & Wang, H. (2024). Energy auditing for decarbonization in the food industry: A lifecycle approach. Journal of Food Engineering, 369, 111234. https://doi.org/10.1016/j.jfoodeng.2024.111234
5. Taylor, E., & Patel, R. (2024). Life cycle assessment and energy auditing in food manufacturing: A synergistic approach. Environmental Science & Technology, 58(12), 5321–5332. https://doi.org/10.1021/acs.est.3c08976
6. Howard, D. A., Ma, Z. G., Engvang, J. A., Hagenau, M., Jorgensen, K. L., Olesen, J. F., & Nørregaard Jørgensen, B. (2024). *Energy flexibility potential in the brewery sector: A multi-agent based simulation of 239 Danish breweries*. *arXiv*. arXiv:2401.14903
7. M. Savchenko-Pererva & O. Radchuk (2022) Ways to improve energy conservation in educational institutions. In. Journal of Agriculture Innovation, Technology and Globalisation, Vol. 3, No. 1, Pp. 73-86. https://doi.org/10.1504/IJAITG.2022.126866
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9. Reddy, K. B., & Rajan, B. (2021). *Comprehensive Energy Audit of Food Processing Industry: A Case Study*. International Research Journal of Engineering and Technology (IRJET), 8(3), 231–236.
10. Moreno-García, B., & Morales-Corral, J. (2022). *Energy Audit in the Meat Processing Industry—A Case Study in Hermosillo, Sonora Mexico*. Sustainability, 14(18), 11235. https://doi.org/10.3390/su141811235
11. M Savchenko et al 2024 Development of a methodology for calculating the consumption of a combined renewable energy source for a mini–workshop. IOP Conf. Ser.: Earth Environ. Sci. 1429 012018. doi 10.1088/1755-1315/1429/1/012018

12. L. Rozhkova, M. Savchenko-Pererva, O. Radchuk, S. Sabadash and E. Kuznetsov (2022). Innovative Hybrid Power Plant Design. Lecture Notes in Mechanical Engineering. Proceedings of the 5th International Conference on Design, Simulation, Manufacturing: The Innovation Exchange, DSMIE-2022, June 7–10, 2022, Poznan, Poland – Volume 2: Mechanical and Chemical Engineering. V. Ivanov et al. (Eds.): DSMIE 2022, LNME, pp. 299–308, 2023. https://doi.org/10.1007/978-3-031-06044-1_29
13. Brown, T., & Lee, C. (2023). Renewable energy integration in food manufacturing: Energy audit insights. Renewable and Sustainable Energy Reviews, 188, 113845. https://doi.org/10.1016/j.rser.2023.113845
14. Rodriguez, E., & Martinez, P. (2023). Solar energy integration in food processing: Energy audit-driven feasibility studies. Renewable Energy, 216, 119123. https://doi.org/10.1016/j.renene.2023.119123
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17. Wilson, A., & Kumar, V. (2023). Energy audits for transitioning to renewable energy in food processing: A case study approach. Journal of Food Engineering, 372, 111567. https://doi.org/10.1016/j.jfoodeng.2023.111567
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21. International Energy Agency (IEA). (2024). Energy efficiency in the food and beverage sector: Best practices and case studies. IEA Publications. https://www.iea.org/reports/energy-efficiency-2024
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