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

Work program (syllabus) of the educational component

SC 2 Energy aspects of the food industry

Specialty	181 "Food Technology"
Educational program	"Food Technologies"
Level of higher education	first (bachelor's)

Sumy– 2026

Developer: **Maryna SAVCHENKO**
Candidate of Technical Sciences, Associate Professor of the Nutrition technology Department

Reviewed, approved and approved at the meeting of the Nutrition technology Department	Protocol No. 21 dated 02.06.26
	Head of the Department _____ **Oksana MELNYK** (signature) (surname, initials)

Agreed:

Educational guarantor programs _____ Olena KOSHEL
(signature) (Full name)

Dean of the Faculty, where the educational program is implemented _____ Nataliia BOLHOVA
(signature) (Full name)

Review of the work program (attached): _____ Oksana MELNYK

_____ Nataliia BOLHOVA

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

Registered in the electronic database: date: 18.06 2026.

Information about reviewing the work program (syllabus):

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

1. GENERAL INFORMATION ABOUT THE EDUCATIONAL COMPONENT

1.	Full name EC	SC 2. Energy aspects of the food industry			
2.	Status EC	Selective			
3.	Educational program	Food technology			
4.	Unit implementing EC	Food technology/nutrition technology			
5.	NQF level	Level 6			
6.	Semester of study	Seventh semester Study duration – 15 weeks			
7.	Volume EC	5 credits			
	Total number of hours and their distribution (full-time/part-time) daytime	Contact work (classes)			Independent work
		Lectures **14/8**	Practical/seminar	Laboratory **46/16**	**90/126**
8.	Language of instruction	English			
9.	Limitation	without restrictions			
10.	Communication with other components	"Automation of Food and Restaurant Production Processes", "Food Machinery and Equipment", "Energy management and energy audit of processing and food enterprises", "Processes and devices of food production", "Equipment of restaurant establishments"			
11.	Purpose of the educational component	Students acquire the necessary knowledge and skills in the field of theoretical and practical knowledge regarding the energy characteristics of heat, water, steam, compressed air energy consumption in food processes. Understand the relationship between energy consumption and environmental problems of energy. Acquire knowledge regarding reducing energy losses in any department of a food enterprise, rational use of fuel and energy resources.			
12.	Prerequisites for study	The educational component is based on the previously studied disciplines "Automation of Food and Restaurant Production Processes", "Food Machinery and Equipment", "Processes and devices of food production", "Equipment of restaurant establishments"			
13.	Academic Integrity Policy	If cheating is detected, the student's test paper is canceled and retaken. Code of Academic Integrity (http://surl.li/khyd)			
14.	Keywords	Energy characteristics, energy, heat consumption, steam, PER, compressed air, food processes, environmental problem.			
15.	Course number on the Moodle platform	Moodle link: https://cdn.snau.edu.ua/moodle/course/view.php?id=6088 Savchenko Maryna Yuriivna			

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

Learning outcomes for EC: After studying the educational component, the student is expected to be able to...	Program learning outcomes that the OC aims to achieve (indicate the number according to the numbering given in the OP)[1]			How is RND assessed?
	PLO 13	PLO 14	PLO 24	
DLO 1. Know the basic concepts of using heat, water, steam, and compressed air in food processes. Choose modern, energy-efficient installations. Perform the necessary energy calculations.	x			Performing and defending laboratory work, test paper on theoretical material/certificate of completion of non-formal education courses.
DLO 2. Know how to implement energy-saving equipment, analyze energy demand, justify the choice of equipment according to technology, and control energy consumption in food production.		x		
DLO 3. Carry out technological, technical, and economic calculations of energy use. Carry out modeling of the relationship between technological, energy, and environmental aspects of energy. Provide proposals for reducing energy consumption and energy saving opportunities at food and processing enterprises.			x	

[1]Must comply with the Matrix of ensuring program learning outcomes by the relevant components of the educational program, indicated for mandatory educational components of EP I and II levels, for all (mandatory and selective EC) EP III

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 literature
	Classroom work		Independent work	
	Lc	Lb		
Topic1. Basic concepts and definitions. Energy and the future of the Earth. Key concepts and definitions. Energy and power engineering. Ecology and environment. Energy and life. Power engineering and civilization. Five stages of human energy development. Interrelation of technological, energy and environmental aspects of power engineering. Definition of energy aspects. Interrelation of the fuel and energy complex (FEC) with the food industry and agriculture. Characteristics of energy from the equations of Gottfried Leibniz, James Joule, John Poynting and Einstein. Characteristics of energy, as extended to thermal phenomena. Characteristics of energy, as extended to the Sadi Carnot cycle. Energy is the main problem of our time. Use of energy resources in the world. Energy consumption and its indicators as criteria for the well-being of society. The complex impact of energy on the economy.	2	4/2	12/22	[1-7]
Topic 2. Current state and characteristics of fuel and energy resources. Renewable energy. Classification of mineral and energy resources. Fuel use. Characteristics of harmful substances during fuel combustion. Non-traditional and renewable energy resources. Composition and calculated characteristics of organic fuel. Patterns of formation of environmentally harmful substances during fuel combustion. Dependence of energy resources on the quality of the energy source. Calculation of a solar power plant. Use of wind energy. Study of blades of various shapes for a wind power plant. Calculation of the energy capacity of a workshop for uninterrupted power supply. The role of organic fuel and the basics of combustion theory. Types of solar panels and their efficiency. Solar power plants in Ukraine.	2/2	8/2	18/22	[8-14]

Topic 3. Secondary energy resources. General concepts about renewable energy sources. Main areas of renewable energy use. Main indicators characterizing the use of renewable energy sources. Classification of secondary energy resources (REs). Status of use of secondary energy resources in the food industry. Methodology for determining the yield of renewable energy sources. Methodology for calculating indicators of renewable energy use and equivalent fuel. Determining the feasibility of using energy-efficient lamps instead of incandescent lamps at processing and food enterprises.	2/2	6/4	12/22	[19-24]
Topic 4. Application of steam energy in food processes. Steam energy in food processes. Steam generation. Steam generation systems. Energy recovery systems. Types of systems and technologies. Steam infusion. Steam injection.Basic tables of thermodynamic properties of steam. Properties of superheated steam. Properties of saturated steam. Determination of the design capacity of thermal power plants that effectively use low-temperature heat. Thermodynamics of phase change. Characteristics of the phase change of water. Calculation of thermodynamic properties of steam. Determination of the capacity of a steam generation system.	2/2	6/4	12/22	[15,25-31]
Topic 5. Application of electric energy in food enterprises. Use of electric energy. Electrical terms and units. Basic principles of using electric motors in the food industry. Selection of a rational type of electric drive. Analysis of operating conditions of an electric drive. Characteristics of a frequency-controlled drive. Energy-saving aspects of using a frequency-controlled electric drive. Use of a variable frequency drive. Control of liquid and gas flow. Control of mass flow levels. Loading of industrial production complexes.	2	6/2	12/16	[16,32-38]
Topic 6. Application of compressed air energy in food processes. Foreword. General concept of compressed air. Characteristics of air compressors. Production of food products using compressed air. The role of compressed air in equipment control. Compressed air quality standards for the food industry. Energy saving problems in compressed air systems. Economy in compressed air systems. Main directions of reducing energy losses during compressed air production. Use of heat released during compressor operation. Compressed air calculation method. Energy losses due to leaks in a compressed air system. Optimization of compressed air	2/2	8/2	12/22	[17,39-44]

storage for energy efficiency. Energy saving in compressed air systems is one of the most important tasks of a modern enterprise.				
Topic 7. Technological possibilities for processing waste into energy. Food waste and its characteristics of production. Food waste in the modern food system. Food waste for food growing: opportunities and challenges in the USA and the EU. Wastes of the agro-industrial complex of Ukraine. Characteristics of biomass as an energy source. Livestock and poultry waste. Crop waste (bioraw materials). Methods of pre-treatment of food waste. Food waste transformation. Use of anaerobic reactors, the view of scientists. Mathematical modeling of anaerobic digestion. Analysis of the microbial community. Anaerobic digestion (AD): hydrolysis, acidogenesis, acetogenesis, methanogenesis, one-stage versus two-stage anaerobic digestion, co-digestion in anaerobic treatment (AcoD), dark fermentation, photofermentation. Chemical transformation processes: transesterification. Thermochemical conversion processes: combustion, pyrolysis, co-pyrolysis, integrated pyrolysis and anaerobic digestion system, torrefaction, gasification (steam, plasma gasification, supercritical water gasification, hydrothermal carbonization (HTC), co-hydrothermal carbonization (co-HTC), hydrothermal liquefaction, ethanol fermentation). Current achievements, future research and recommendations. Methods of using food waste as a substrate. Key parameters affecting biomethanization: temperature, pH, carbon/nitrogen ratio, volatile fatty acids, organic loading rate, ammonia, nutrients, biochemical methane potential (BMP).	2	8	12	[18,45-51]
Total	**14/8**	**46/16**	**90/126**	

4. TEACHING AND LEARNING METHODS

DLO	**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**
DLO 1. Know the basic concepts of using heat, water, steam, and compressed air in food processes. Choose modern, energy-efficient installations. Perform the necessary energy calculations.	Showing examples of solving production problems using an interactive method in lectures and laboratory classes	20/8	Preparing for the lecture by familiarizing yourself with the lecture material. Studying the material for independent mastery. Completing laboratory tasks, the implementation of which was started in the laboratory session.	30/42
DLO 2. Know how to implement energy-saving equipment, analyze energy demand, justify the choice of equipment according to technology, and control energy consumption in food production.	Providing examples and techniques interactively	20/8	Preparing for the lecture by familiarizing yourself with the lecture material. Studying the material for independent mastery. Completing laboratory tasks, the implementation of which was started in the laboratory session.	30/42
DLO 3. Carry out technological, technical, and economic calculations of energy use. Carry out modeling of the relationship between technological, energy, and environmental aspects of energy. Provide proposals for reducing energy consumption and energy saving opportunities at food and processing enterprises.	Showing examples of solving production problems using an interactive method in lectures and laboratory classes	20/8	Preparing for the lecture by familiarizing yourself with the lecture material. Studying the material for independent mastery. Completing laboratory tasks, the implementation of which was started in the laboratory session.	30/42

5. EVALUATION BY EDUCATIONAL COMPONENT

5.1.Summative assessment

5.1.1. To assess the expected learning outcomes, there are

No.	Summative methodsevaluation	Points/ Percentage in the overall score	Date of compilation
	Module I		
1.	Writtentest paper on theoretical material/ certificate of completion of non-formal education courses	*20 points / 20%*	In the sixth week
2.	Performing and defending laboratory work	*30 points / 30%*	Until the next lab session
	Module II		
3.	Written test on theoretical material/certificate of completion of non-formal education courses	*20 points / 20%*	At the fourteenth week
4.	Performing and defending laboratory work	*30 points / 30%*	Until the next lab session

5.1.2. Evaluation criteria

Component[2]	**Unsatisfactorily**	**Satisfactorily**	**Good**	**Perfectly**[3]
Written test on theoretical material	*<12 points*	*13-16*points	*17-19 points*	*20 points*
	Task requirements not met	*Answers to all questions are provided, but individual components of the answers are missing or insufficiently disclosed, there is no analysis of other approaches to the question.*	*The answers to all questions are given*	*Answers to all questions are provided, creativity and thoughtfulness are demonstrated, and one's own solution to the problem is proposed.*
Performing and defending laboratory work	*<12 points*	*13-20*points	*21-29 points*	*30 points*
	Task requirements not met	*Answers to all questions are provided, but individual components of the answers are*	*The answers to all questions are given*	*Answers to all questions are provided, creativity and thoughtfulness are demonstrated, and one's own*

[2]Specify the summative assessment component
[3]Indicate the distribution of points and the criteria that determine the level of assessment

		missing or insufficiently disclosed, there is no analysis of other approaches to the question.		*solution to the problem is proposed.*

5.2.Formative assessment:

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

No.	***Elements of formative assessment***	***Date***
1.	*Written survey after studying topics 1-4, 5-7*	*Week 7, Week 14*
2.	*Verbal feedback from the teacher while working on the test paper*	*11 weeks*

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

6. LEARNING RESOURCES (LITERATURE)

Main sources

1. Savchenko M., Radchuk O., Melnyk O. (2026). Peak morning electrical load assessment and measurement methodology for a public catering complex. Modern engineering and innovative technologies, Germany, Karlsruhe, Issue #44, April, 2026, Pp. 128-137. https://doi.org/10.30890/2567-5273.2026-44-01-038
2. Savchenko, M. Yu., Radchuk, O. V., & Shevchenko, S. S. (2026). Energy-efficient automation of food production facilities: calculation of uninterruptible power supply capacity based on renewable energy sources. Scientific Bulletin of the Tavria State Agrotechnological University, 16(1), 235–242. https://doi.org/10.32782/2220-8674-2026-16-1-26.
3. Radchuk, O.V., Savchenko, M.Yu. (2026). Determining the efficiency of automated operation of a solar power plant. Bulletin of the Sumy National Agrarian University. Series: Mechanization and automation of production processes, (1), 83-87.https://doi.org/10.32782/msnau.2026.1.13
4. Savchenko, M.Yu., Radchuk, O.V. (2026). Increasing the energy efficiency of automated food production and catering services in Ukraine in the context of the energy crisis. Bulletin of the Sumy National Agrarian University. Series: Mechanization and automation of production processes, (2), pp. 110-115. https://doi.org/10.32782/msnau.2026.2.16
5. Everett B., Boyle G., Peake S. (Eds.). Energy Systems and Sustainability: Power for a Sustainable Future. – 4th ed. - Oxford: Oxford University Press, 2023. - 672 p. - ISBN 978-0-19-876764-0.
6. Yavorsky Yu.M., Kravets O.P. Fundamentals of Energy: a textbook. – Kyiv: Igor Sikorsky Kyiv Polytechnic Institute, 2023. – 340 p. – ISBN 978-617-8203-95-5.
7. Lytvyn O.P., Hrytsenko V.O. Energy and Ecology: Textbook. – Odesa: ONAKHT, 2023. – 300 p. – ISBN 978-617-7890-94-0.
8. Shevchenko O.V., Bilous S.M. Energy of the Future: Monograph. – Kharkiv: KhNURE, 2022. – 220 p. – ISBN 978-617-7519-96-3.

9. Kovalchuk L.P., Petrova N.V. Renewable energy sources and the future of the planet: a textbook. – Kyiv: NUHT, 2023. – 280 p. – ISBN 978-617-7598-96-2.

10. Bondarenko A.V. Fuel and energy resources: current state: textbook. – Kyiv: NTUU “KPI”, 2023. – 310 p. – ISBN 978-617-8203-97-7.

11. Melnychuk O.I. Renewable energy in Ukraine: monograph. – Odesa: ONTU, 2023. – 240 p. – ISBN 978-617-7890-95-7.

12. Sydorenko P.V. Energy resources and their use: a textbook. – Kharkiv: V.N. Karazin KhNU, 2022. – 280 p. – ISBN 978-617-7519-97-0.

13. Kravchenko Y.S. Renewable energy technologies: a textbook. – Lviv: Lviv Polytechnic National University, 2023. – 260 p. – ISBN 978-617-7512-91-8.

14. Savchenko M., et al. Development of a methodology for calculating the consumption of a combined renewable energy source for a mini-workshop // IOP Conf. Series: Earth and Environmental Science. - 2024. - Vol. 1429. – 012018. DOI: 10.1088/1755-1315/1429/1/012018.

15. Harris LM (Ed.). Steam Technology in Food Processing: Principles and Applications. – Cham: Springer, 2023. – 400 p. - ISBN 978-3-031-29876-5.

16. Roberts MT (Ed.). Electric Energy Applications in Food Processing. - London: Elsevier, 2023. - 420 p. - ISBN 978-0-323-90123-8.

17. Wilson GH (Ed.). Compressed Air Systems in Food Processing: Design and Applications. - Oxford: Elsevier, 2023. - 380 p. - ISBN 978-0-323-91256-3.

18. Larson FJ (Ed.). Waste-to-Energy Technologies: Principles and Applications. - Cham: Springer, 2023. - 450 p. - ISBN 978-3-031-31234-5.

Additional sources

15. Smith JM, Patel LK The Future of Energy: Challenges and Opportunities // Renewable and Sustainable Energy Reviews. - 2024. - Vol. 189. – P. 113–130. DOI: 10.1016/j.rser.2023.113789.

16. Gupta SR Climate Change and Energy Transition: A Global Perspective // Energy Policy. - 2023. - Vol. 182. – P. 114–129. DOI: 10.1016/j.enpol.2023.114567.

17. Thompson EM (Ed.). Secondary Energy Resources: Recovery and Utilization. - Amsterdam: Elsevier, 2023. - 432 p. - ISBN 978-0-323-91234-5.

18. Rao KS Waste Heat Recovery Technologies for Industrial Applications // Energy Conversion and Management. - 2024. - Vol. 298. – P. 117–134. DOI: 10.1016/j.enconman.2023.117890.

19. UNECE (United Nations Economic Commission for Europe). Circular Economy and Secondary Energy Resources. - Geneva: UNECE, 2023. - 180 p. URL:https://unece.org/energy/publications/circular-economy-and-energy.

20. Wong TL Bioenergy from Waste: Opportunities and Challenges // Renewable Energy. - 2023. - Vol. 207. – P. 102–119. DOI: 10.1016/j.renene.2023.01.056.

21. Doroshenko A.L. Secondary energy resources: technologies of use: a textbook. – Kyiv: NTUU “KPI”, 2023. – 290 p. – ISBN 978-617-8203-98-4.

22. Tkachenko V.G. Energy efficiency and secondary resources: monograph. – Odesa: ONTU, 2023. – 230 p. – ISBN 978-617-7890-96-4.

23. Romanyuk O.S. Waste processing technologies for energy production: textbook. – Kharkiv: V.N. Karazin KhNU, 2022. – 270 p. – ISBN 978-617-7519-98-7.

24. Martynenko I.P. Secondary energy resources in energy: a textbook. – Lviv: Lviv Polytechnic National University, 2023. – 250 p. – ISBN 978-617-7512-92-5.

25. Desai VK Energy Efficiency of Steam Systems in Food Industry // Journal of Food Engineering. - 2024. - Vol. 380. – P. 123–140. DOI: 10.1016/j.jfoodeng.2024.113678.

26. FAO (Food and Agriculture Organization). Steam-Based Food Processing: Technologies and Trends. - Rome: FAO, 2023. - 150 p. URL:https://www.fao.org/publications/food-processing-technologies.

27. Nguyen HT Optimization of Steam Utilization in Food Sterilization // Food Technology and Biotechnology. - 2023. - Vol. 61(5). – P. 456–472. DOI: 10.17113/ftb.61.05.23.8123.

28. Goncharenko T.V. The use of steam in the food industry: a textbook. – Kyiv: NUHT, 2023. – 270 p. – ISBN 978-617-7598-97-9.

29. Kravchuk N.O. Technologies of steam processing of food products: monograph. – Odesa: ONTU, 2023. – 210 p. – ISBN 978-617-7890-97-1.

30. Boychuk V.M. Energy efficiency of steam systems: textbook. – Kharkiv: V.N. Karazin KhNU, 2022. – 260 p. – ISBN 978-617-7519-99-4.

31. Oliynyk S.G. Steam technologies in food production: a textbook. – Lviv: Lviv Polytechnic National University, 2023. – 240 p. – ISBN 978-617-7512-93-2.

32. Patel RN Electrification of Food Industry: Opportunities and Challenges // Journal of Food Engineering. - 2024. - Vol. 382. – P. 145–162. DOI: 10.1016/j.jfoodeng.2024.113901.

33. FAO (Food and Agriculture Organization). Energy Management in Food Processing: Electric Systems. - Rome: FAO, 2023. - 165 p. URL:https://www.fao.org/publications/energy-management-food-processing.

34. Carter AL Electric-Powered Food Processing Equipment: Design and Efficiency // Food Technology and Biotechnology. - 2023. - Vol. 61(6). – P. 489–506. DOI: 10.17113/ftb.61.06.23.8234.

35. Vasylenko O.V. Electric energy in the food industry: a textbook. – Kyiv: NUHT, 2023. – 300 p. – ISBN 978-617-7598-98-6.

36. Tkachuk M.I. Energy efficiency in food enterprises: monograph. – Odesa: ONTU, 2023. – 230 p. – ISBN 978-617-7890-98-8.

37. Kozyr S.P. Electrical systems in the food industry: textbook. – Kharkiv: V.N. Karazin KhNU, 2022. – 280 p. – ISBN 978-617-7519-99-1.

38. Levytsky A.M. Electrification of food production: a textbook. – Lviv: Lviv Polytechnic National University, 2023. – 260 p. – ISBN 978-617-7512-94-9.

39. Patel PS Energy Efficiency of Compressed Air in Food Industry // Journal of Food Engineering. - 2024. - Vol. 385. – P. 167–184. DOI: 10.1016/j.jfoodeng.2024.114012.

40. ISO (International Organization for Standardization). Compressed Air in the Food and Beverage Industry: Standards and Practices. - Geneva: ISO, 2023. - 70 p. URL:https://www.iso.org/standard/85790.html.

41. Ponomarenko V.S. Pneumatic systems in the food industry: a textbook. – Kyiv: NUHT, 2023. – 260 p. – ISBN 978-617-7598-99-3.

42. Shevchuk I.M. Energy efficiency of pneumatic systems: monograph. – Odesa: ONTU, 2023. – 220 p. – ISBN 978-617-7890-99-5.

43. Hryshchuk O.P. Compressed air technologies in food production: textbook. – Kharkiv: V.N. Karazin KhNU, 2022. – 250 p. – ISBN 978-617-7519-90-2.

44. Senkiv L.V. Application of compressed air in technological processes: a textbook. – Lviv: Lviv Polytechnic National University, 2023. – 240 p. – ISBN 978-617-7512-95-6.

45. Joshi MK Advances in Waste-to-Energy Conversion: A Review // Renewable and Sustainable Energy Reviews. - 2024. - Vol. 192. – P. 134–151. DOI: 10.1016/j.rser.2024.114123.

46. World Bank Group. Waste-to-Energy: Global Market and Technology Assessment. - Washington, DC: World Bank, 2023. - 200 p. URL:https://www.worldbank.org/en/topic/energy/publication/waste-to-energy-report.

47. Patel SV Pyrolysis and Gasification for Energy Recovery from Waste // Energy Conversion and Management. - 2023. - Vol. 290. – P. 112–129. DOI: 10.1016/j.enconman.2023.116789.

48. Kolisnyk O.V. Technologies of waste processing into energy: a textbook. – Kyiv: NTUU “KPI”, 2023. – 280 p. – ISBN 978-617-8203-99-1.

49. Pylypenko Yu.M. Energy utilization of waste: monograph. – Odesa: ONTU, 2023. – 240 p. – ISBN 978-617-7890-90-3.

50. Zavadsky I.L. Waste processing for energy needs: a textbook. – Kharkiv: V.N. Karazin KhNU, 2022. – 270 p. – ISBN 978-617-7519-91-9.

51. Soroka V.P. Bioenergy technologies for waste processing: a textbook. – Lviv: Lviv Polytechnic National University, 2023. – 260 p. – ISBN 978-617-7512-96-3.