Ministry of Education and Science of Ukraine
Sumy National Agrarian University
Faculty of Engineering and Technology
Department of Technical Service and Industrial Machinery Engineering

Work program (syllabus) of the educational component

Solving problems in Surface Engineering and Tribology
(selective)
Implemented within the educational program
"Agroengineering"
(name)
in the specialty 208 Agroengineering
(code, name)

at the first bachelor's level of higher education

Sumy – 2026

Developers: _____, Ievgen KONOPLYANCHENKO, Candidate of Technical Sciences, Associated Professor
(signature) (surname, initials) (academic degree and title, position)

Considered, approved and ratified at the meeting of the Department of Technical Service and Industrial Machinery Engineering (name of the department)	Protocol at 15.06.2026 № 17		
	Manager departments	_____ (signature)	Ievgen KONOPLYANCHENKO (last name, initials)

Agreed:

Guarantor of the educational program _____ (signature) Bohdan SARZHANOV (Full name)

Dean of the Faculty _____ (signature) Svitlana KHURSENKO (Full name)

Review of the work program (attached) provided by: Oleksandr IVCHENKO (Full name)

Viacheslav TARELNYK (Full name)

Methodist DEQLA _____ N Baranik (signature)

Registered in the electronic database: date: 16.06 2026.

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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 department meeting minutes	Head of the Department	Educational program guarantor

1. GENERAL INFORMATION ABOUT THE EDUCATIONAL COMPONENT

1.	Name OK	Solving problems in Surface Engineering and Tribology			
2.	Faculty/department	Faculty of Engineering and Technology / Department of Technical Service and Industrial Machinery Engineering			
3.	Status OK	Selective			
4.	Program/Specialty (programs) of which the OK is a component (to be filled in for mandatory OKs)	Educational and scientific program "Agroengineering" in the specialty H7 "Agroengineering"			
5.	NRC level				
6.	Semester and duration of study	Full-time – 8 (c), 4th year Correspondence – 9 (o), 5th year			
7.	Number of ECTS credits	5			
8.	Total hours and their distribution 150 hours.	Contact work (classes)			Independent work
		Lectures	Practical / seminar	Laboratory	
		30	30	-	90
9.	Language of instruction	English			
10.	Teacher/Educational Component Coordinator	Ievgen KONOPLYANCHENKO, Candidate of Technical Sciences, Associated Professor, Head of Department of Technical Service and Industrial Machinery Engineering			
10.1	Contact information	(050)760-25-65; konoplyanchenko@ukr.net			
11.	General description of the educational component	The main focus of the educational component is on methodologies achieving operational properties of friction surfaces, assemblies and parts by due to strengthening effects of various physical nature and application of functional coatings.			
12.	Purpose of the educational component	Acquisition by applicants of the necessary amount of knowledge for studying tribology laws that operate during the life cycle of machines. Mastering design and technological methods for increasing the wear resistance of working surfaces of machine parts, in order to ensure the operability of machines at optimal cost of work.			
13.	Prerequisites for studying OK, connection with other educational components of OP	The educational component is based on knowledge and skills in solving applied scientific problems in the field of mechanical engineering using methods of modern science based on a systems approach, taking into account the complexity and uncertainty of the operating conditions of technological systems. The educational component is based on the disciplines: "Sketchy Geometry and Technical Drawing", "Materials Science and TCM", "Machine Parts and PTM", "Interchangeability, Standardization and Technical Measurements".			
14.	Academic Integrity Policy	The system of requirements that are placed on a higher education applicant when studying the educational component: • students completing assessment stages within the established deadlines; • completion and defense of written and practical work within the established deadlines; • compliance with the provisions on the prevention and detection of academic plagiarism in SNAU when performing written work (https://surl.li/ksidbs); • students' compliance with the SNAU code of academic integrity			

		(https://surl.li/yzxgnv). Written works prepared for assessment must be original and completed independently by the higher education applicant. Written works that are completed and submitted after the deadlines without good reason are evaluated with a score lower than the result obtained. Works that are completed with a low level of uniqueness or are a copy of "someone else's" work will be evaluated with a score of "zero" with subsequent performance of the work according to another original individual task. Re-submission of written works occurs after repeated performance or revision. Copying from various sources of information (including using mobile devices and gadgets) during exams is prohibited. If the fact of copying is detected, the student's work is canceled and the exam is retaken. Re-taking of the exam is carried out with the permission of the dean's office within the specified time limits after re-learning the material from the educational component.
15	Link to the course in Moodle	https://cdn.snau.edu.ua/moodle/course/view.php?id=3717
16	Keywords	Coating, electrospark alloying technology, roughness, hardening, friction, wear, surface

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

Learning outcomes for OK: After studying the educational component, the applicant is expected to be able to...	How is the LOA assessed?
LOA 1. Develop technological processes for forming parts of components and assemblies of agricultural machinery	Execution and defense of reports on practical work according to the individual version. Written survey (testing) of the assimilation of lecture material. Intermediate computer certification - multiple choice test.
LOA 2. Substantiate design and technological methods for increasing the wear resistance of machine parts	Execution and defense of reports on practical work according to the individual version. Written survey (testing) of the assimilation of lecture material. Intermediate computer certification - multiple choice test.
LOA 3. Choose rational methods for ensuring the operational properties and quality of the working surfaces of machine parts	Execution and defense of reports on practical work according to the individual version. Written survey (testing) of the assimilation of lecture material. Intermediate computer certification - multiple choice test.

3. CONTENT OF THE EDUCATIONAL COMPONENT (COURSE PROGRAM)

Topic. List of issues to be addressed within the topic	Distribution within the totaltime budget				Recommended reading
	Classroom work			independent work	
	Lecture	Pr. / semin.	Lab.		
Topic 1. Methodological aspects of tribology materials science.	2	2		20	[1-8], [10], [13], [14]

General information. Basic terms and concepts. Influence of the main parameters of surface geometry on the wear resistance of machine parts. General requirements for friction pair materials. Main problems of tribology materials science and ways to solve them. Plastic deformation, recrystallization and mechanical properties. Criteria for ensuring the operability of materials in friction pairs. Distribution of materials in friction pairs. Methodology and criteria for selecting friction pair materials.					
Topic 2. Analysis of types of wear of working surfaces. Analysis of the main reasons for the decrease in reliability and durability of parts. Wear of metal surfaces. Abrasive wear. Types and characteristics of wear. Cavitation wear. Wear during fretting corrosion and other types of wear. Properties of the surfaces of parts. Residual stresses, structural and phase transformations. Physicochemical properties of surfaces. Adsorption effect of strength reduction (Rebinder effect). Contacting of parts.	4	4		10	[1-10], [12-14], [17]
Topic 3. No wear and tear effect. Classification of parts of rotary machines for which surface layer quality control is relevant. General information about wear of rotor parts. Mechanical seals. Sliding bearings. Impellers. Effect of non-wear. Energy criteria of friction and wear. Analysis of existing criteria for wear of metal surfaces. Development of a mathematical model of wear of coatings on metal surfaces of parts.	4	4		10	[1], [4], [5], [9-12], [14], [17]
Topic 4. Design methods for increasing the wear resistance of parts. Wear of working parts of machines. Friction in a sliding bearing. Rolling friction. Basic concepts of the wear mechanism of friction pairs. The wear mechanism of metal surfaces. The wear mechanism of polymers and rubber. Stages of wear of friction pairs.	4	4		10	[1-5], [7], [9-12], [14], [20]
Topic 5. Lubrication of machine parts. Materials for friction pairs.About the arrangement of friction pairs by hardness. Lubrication of connecting parts. Physico-chemical characteristics of lubricants. Deposits on parts in the lubrication system. Selection of lubricants. Control and safety devices. Lubrication of components during operation.	4	4		10	[1], [2], [6-8], [12], [14]

Topic 6. Technological methods for increasing the wear resistance of parts. Surface hardening. Cementation. Nitriding. Ion nitriding. Boriding. Other methods of increasing the wear resistance of parts.	4	4		10	[1], [3-5], [10], [11], [13-9]
Topic 7. Combined technologies for strengthening and repairing parts surfaces. Combined technologies for strengthening the surfaces of parts. Multilayer electric spark coatings. Electric spark alloying (ESD) followed by PPD. ESD followed by ion nitriding. ESD followed by epilaminating.	4	4		10	[3], [5], [10], [11], [13-20]
Topic 8. Wear resistance of friction units under operating conditions. Increasing the reliability and durability of parts under operating conditions. Changing the quality of lubricants. Machine running-in. Machine testing. The influence of operating conditions on the intensity of wear.	4	4		10	[1], [2], [4-8], [9], [12], [14], [20]
Total	30	30		90	

4. TEACHING AND LEARNING METHODS

LOA	**Teaching methods**(work that will be carried out by the teacher during classroom lessons, consultations)	**Number of hours**	**Teaching methods**(what types of educational activities should a postgraduate student perform independently)	**Number of hours**
LOA 1	Showing examples of solving production problems using an interactive method during lectures and practical classes	20	Preparing for the lecture by reviewing the previous material. Studying the material for independent mastery. Completing the practical work tasks, the implementation of which was started in the practical lesson.	30
LOA 2	Showing examples of solving production problems using an interactive method during lectures and practical classes	20	Preparing for the lecture by reviewing the previous material. Studying the material for independent mastery. Completing the practical work tasks, the implementation of which was started in the practical lesson.	30
LOA 3	Showing examples of solving production problems using an interactive method	20	Preparing for the lecture by reviewing the previous material. Studying the material for independent	30

	during lectures and practical classes		mastery. Completing the practical work tasks, the implementation of which was started in the practical lesson.	

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

Correspondence form of study

No.	Summative assessment methods	Points / Weight in the overall score	Date of compilation
1.	Performing practical work	*70 points / 70%*	during the session
2.	Intermediate computer-based testing - multiple choice test	*30 points / 30%*	exam session deadline

5.2.2. Evaluation criteria

Correspondence form of study

Component	***Unsatisfactorily***	***Satisfactorily***	***Good***	***Perfectly***
Performing graphic works	*<50 points*	*51-54*	*55-57 points*	*58-70 points*
	Task requirements not met	*Most requirements are met, but some components are missing or insufficiently disclosed*	*All task requirements have been met, but there are minor comments regarding the design.*	*All task requirements have been met, and your own solution to the task has been proposed.*
Intermediate computer-based testing - multiple choice test	*<9 points*	*9-19*	*20-28 points*	*29-30 points*
	Less than 9 out of 30 correct answers	*Correct answers from 9 to 19 out of 30*	*Correct answers 20 to 26 out of 30*	*Correct answers 29 to 30*

5.3. Formative assessment:

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

No.	**Elements of formative assessment**	**Date**
1	Verbal feedback from the teacher and students regardingindividual task iconography	Within 2 weeks
2	Verbal feedback from the teacher and students regardingindividual task iconography	Within 4 weeks
3	Verbal feedback from the teacher and students regardinganalytical review with presentation	Within 6 weeks

4	Written test with elements of problem tasks	During the 8th week

6. LEARNING RESOURCES (LITERATURE)

6.1. Main sources:

1. Stachowiak G., Batchelor A. W. Engineering Tribology. 5th ed. Elsevier, 2025. Посилання: https://shop.elsevier.com/books/engineering-tribology/stachowiak/978-0-443-34149-6
2. Ajimotokan H. A. Principles and Applications of Tribology. Springer Cham, 2024. DOI: https://doi.org/10.1007/978-3-031-57409-2
3. Al-Samarai R. A., Al-Douri Y. Friction and Wear in Metals. Springer Singapore, 2024. DOI: https://doi.org/10.1007/978-981-97-1168-0
4. Walia R. S., Murtaza Q., Pandey S. M., Tyagi A. (eds.). Surface Engineering: Methods and Applications. CRC Press, 2023. Посилання: https://www.routledge.com/Surface-Engineering-Methods-and-Applications/Walia-Murtaza-Pandey-Tyagi/p/book/9781032333700
5. Katiyar J. K., Rao T. V. V. L. N., Rani A. M. A., Sulaiman M. H., Davim J. P. (eds.). Tribology in Sustainable Manufacturing. CRC Press, 2023. DOI: https://doi.org/10.1201/9781003363576
6. Gevorkyan E. S., Rucki M., Nerubatskyi V. P., Żurowski W., Siemiątkowski Z., Morozow D., Kharatyan A. G. Remanufacturing and Advanced Machining Processes for New Materials and Components. Taylor & Francis, 2022. DOI: https://doi.org/10.1201/9781003218654
   Haponova O., Tarelnyk V., Mościcki T., Tarelnyk N. Hybrid Surface Treatment Technologies Based on the Electrospark Alloying Method: A Review. Coatings. 2025. Vol. 15(6), 721. https://doi.org/10.3390/coatings15060721
7. Haponova O.P., Tarelnyk V.B., Konoplianchenko Ie.V., et al. Study of Antifriction Electrospark Coatings with MoS_2 for Face Seal Elements of Nuclear Power Plants. Journal of Nano- and Electronic Physics. 2025. Vol. 17(5), 05005. https://doi.org/10.21272/jnep.17(5).05005
8. Sun Y., et al. Surface Engineering and Coating Technologies for Improving Wear Resistance of Metallic Materials. Materials. 2025. Vol. 18(19), 4472. https://doi.org/10.3390/ma18194472
9. Wang X., et al. A Review on Tribological Wear and Corrosion Resistance of Surface Coatings. Coatings. 2025. Vol. 15(11), 1314. https://doi.org/10.3390/coatings15111314
10. Xiao N., et al. Current research on the design, properties and applications of tribological materials. 2025. https://pmc.ncbi.nlm.nih.gov/articles/PMC12452821/
11. Gao S., et al. Research progress on friction reduction by surface texture control through subtractive manufacturing and related techniques: a review. Surface Science and Technology. 2026. https://doi.org/10.1007/s44251-025-00121-5
12. Haponova O., Tarelnyk V., Mościcki T., Tarelnyk N., et al. Investigation of the Structure and Properties of MoS_2 Coatings Obtained by Electrospark Alloying. Coatings. 2024. Vol. 14(5), 563. https://doi.org/10.3390/coatings14050563
13. Haponova O., Tarelnyk V., Marchenko S., Tarelnyk N., Konoplianchenko I. The Development of Nanostructuring Method Metal Surfaces by Electrospark Alloying. In: Nanocomposite and Nanocrystalline Materials and Coatings. Springer, 2024. https://doi.org/10.1007/978-981-97-2667-7_7
14. Haponova O., Tarelnyk V., Mościcki T., Tarelnyk N. Investigating the Effect of Electrospark Alloying Parameters on Structure Formation of Modified Nitrogen Coatings. Bulletin of the Polish Academy of Sciences: Technical Sciences. 2024. Vol. 72(5), e150802. https://doi.org/10.24425/bpasts.2024.150802
15. Tarelnyk V., Haponova O., Mościcki T., Tarelnyk N. Improving a Process for Completing a Positive Connection of Hub-Shaft Type Using Combined Methods. In: Lecture Notes in Mechanical Engineering. Springer, 2024. https://doi.org/10.1007/978-3-031-63720-9_34
16. Gaponova O.P., Tarelnyk V.B., Tarelnyk N.V., Myslyvchenko O.M. Nanostructuring of Metallic Surfaces by Electrospark Alloying Method. JOM. 2023. Vol. 75(9). P. 3400–3412. https://doi.org/10.1007/s11837-023-05940-1

17. Tarelnyk V.B., Gaponova O.P., Tarelnyk N.V., Myslyvchenko O.M. Aluminizing of Metal Surfaces by Electric-Spark Alloying. Progress in Physics of Metals. 2023. Vol. 24(2). P. 282–318. https://doi.org/10.15407/ufm.24.02.282
18. Zhang Z., Konoplianchenko I., Tarelnyk V., Liu G., Du X., Yu H. The Characterization of Soft Antifriction Coating on the Tin Bronze by Electrospark Alloying. Medžiagotyra. 2023. Vol. 29(1). P. 40–47. http://dx.doi.org/10.5755/j02.ms.30610
19. Tarelnyk V.B., Gaponova O.P., Konoplianchenko Ye.V. Electric-Spark Alloying of Metal Surfaces with Graphite. Progress in Physics of Metals. 2022. Vol. 23(1). P. 27–58. https://doi.org/10.15407/ufm.23.01.027
20. Zhang Z., Konoplianchenko I., Tarelnyk V., Liu G., Xin D., Yu H. The Characterization of Running-In Coatings on the Surface of Tin Bronze by Electro-Spark Deposition. Coatings. 2022. Vol. 12(7), 930. https://doi.org/10.3390/coatings12070930

6.2. Additional sources:

1. Tarelnyk V.B. Tribotechnology of machine parts: a textbook / [Tarelnyk V.B., Konoplyanchenko E.V., Martsynkovsky V.S., Antoshevsky Bohdan]; edited by Prof. V.B. Tarelnyk.- Sumy: Publishing house "MakDen", 2010.- 264 p.
2. Fundamentals of Tribology: Textbook / Antipenko A.M., Belas O.M., Voitov V.A. and others / Edited by Voitov V.A. – Kharkiv: KhNTUSG, 2008.- 342 p.
3. Increasing the stability of cutting tools by technological methods: a textbook / [Tarelnyk V.B., Konoplyanchenko E.V., Martsynkovsky V.S. and others]; edited by Prof. V.B. Tarelnyk.- Sumy: University Book, 2011.- 189 p.
4. Tarelnyk V.B. Tribotechnical materials science and tribotechnology in problems / V.B. Tarelnyk- Sumy: University Book, 2014.- 192 p.
5. Tarelnyk V.B. Modern methods of shaping friction surfaces of machine parts: Monograph / Tarelnyk V.B., Martsynkovsky V.S., Antoshevsky B..- Sumy: Publishing house "MakDen", 2012.-280 p.
6. Bhushan B. Modern Tribology Handbook Vol. 1 - Principles of Tribology (2001). 1760 p.
7. Introduction to tribology / Bharat Bhushan. - Second edition. John Wiley & Sons (2013). 738 p.
8. The tribology handbook [electronic resource] / edited by MJ Neale. - 2nd ed. Butterworth-Heinemann, (1995), 640p.
9. Antoszewski B., Tarelnik W., Konopliaczenko J.Improvement of resistance to fretting wear in sprzęgłach with elastic metal elements. W: Wybrana Problematyka w Technologiach Inżynierii Mechanicznej: Monografie, Studia, Rozprawy, M 135. redakcija Radek N., Sęk P. Kielce, Wydawnictwo Politechniki Świętokrzyskiej, 2020, pp. 67-76.
10. Selected problems of surface engineering and tribology: Monografie, Studia, Rozprawy, M 85/ V. Martsynkovskyy, V. Tarelnyk, B. Antoszewski, Ie. Konoplianchenko, A. Zhukov and etc.; edited by B. Antoszewski, V. Tarelnyk - Kielce: Wydawnictwo Politechniki Świętokrzyskiej, 2016. – 111p.
11. V. Tarelnyk, V. Martsynkovskiy, Ie. Konoplianchenko. Electroerosive alloying modes optimization at formation of a special microrelief on bronze sliding bearings friction surfaces Selected problems of mechanical engineering and maintenance. Monograph, edited by Norbert Radek. - Wydawnictwo Politechniki Świętokrzyskiej. - Kielce, 2012. – 188 p. (P.98-103).http://bc.tu.kielce.pl/127/1/Radek_Selected.pdf
12. Tarelnyk V., Konoplianchenko Ie., Martsynkovskyy V., Zhukov A., Kurp P. Comparative Tribological Tests for Face Impulse Seals Sliding Surfaces Formed by Various Methods, In: Ivanov V. et al. (eds) Advances in Design, Simulation and Manufacturing. DSMIE 2018. Lecture Notes in Mechanical Engineering. Springer, Cham, (2019), 382,https://doi.org/10.1007/978-3-319-93587-4_40