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

Work program (syllabus) of the educational component
CC 4 – Methodology of Conducting Scientific Research
<u>(mandatory)</u>
Implemented within the educational program Industrial Machinery Engineering

<div align="center">(name)</div>

in specialty 133 "Industrial machinery engineering"

<div align="center">(code, name)</div>

third (educational and scientific level) level of higher education

Sumy – 2023

Developers: _[signature]_ , Tarelnyk V.B., Doctor of Technical Sciences, Professor, Head of
the Department of Technical Sciences

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

Reviewed, approved and ratified at a meeting of the Technical Service Department (name of the department)	protocol of June 05, 2023 No. 17		
	Head departments	_[signature]_ (signature)	Tarelnyk V.B. (last name, initials)

Agreed:

Guarantor of the educational program _____[signature]_____ V.B. Tarelnyk
(signature)   (full name)

Dean of the Faculty _____[signature]_____ V.M. Zubko
(signature)   (full name)

Review of the work program (attached) provided by: _[signature]_ V.M. Zubko
(Full name)

[signature] M.Yu.Dumanchuk
(Full name)

Methodologist of the Department of Educational Quality,
licensing and accreditation _____[signature]_____ N.M. Baranik
(signature)

Registered in the electronic database: date: _____06, 07_____ 2023.

Information on reviewing the work program (syllabus):

Educational the year in which are introduced changes	Number of the appendix to the work program with a description of the changes	Changes reviewed and approved		
		Date and number minutes of the meeting departments	Head of the Department	Guarantor educational programs

1. GENERAL INFORMATION ABOUT THE EDUCATIONAL COMPONENT

1.	Name CC	Methodology of Conducting Scientific Research
2.	Faculty/department	Faculty of Engineering and Technology/Department of Technical Service
3.	Status CC	Mandatory
4.	Program/Specialty (programs)	Educational and scientific program "Industrial machinery engineering" in specialty 133 "Industrial machinery engineering"
5.	CC can be offered for (to be filled in for selective CCs)	
6.	NQF level	Level 8
7.	Semester and duration study	Daily 2nd semester, 14 weeks
8.	Number of ECTS credits	3

9.	Total hours and their distribution	Contact work (classes)			Independent work
		Lectures	Practical /seminar	Laboratory	
		18	18		54

10.	Language of instruction	Ukrainian
11.	Teacher/ Coordinatoreducation al component	Tarelnyk Viacheslav Borysovych, Doctor of Technical Sciences, Professor, Head of the Department of Technical Service Consultation hours– every Monday from 10:00 to 12:00, room 302m
11.1	Contact information	viacheclav.tarelnyk@snau.edu.ua
12.	General description of the educational component	The discipline is aimed at forming in the students a system of theoretical knowledge on the methodology of scientific research, mastering the conceptual and categorical apparatus of scientific activity, mastering theoretical knowledge on the classification of sciences, scientific and technical potential, organization of scientific and research activity in Ukraine and the world. It will be useful for future specialists to acquire skills of critical thinking, search and processing of information from various sources, synthesis of complex ideas for solving theoretical and applied engineering problems in accordance with the topic of their own research.
13.	Purpose of the educational component	It consists in obtaining knowledge by applicants regarding the study of basic concepts of science and scientific knowledge, methodology, organization and features of scientific research in the field of mechanical engineering, choosing a topic for scientific research, searching for necessary sources of information, formalizing the results of scientific research, compiling a report on scientific work, requirements for various types of publications, and writing a doctoral thesis.
14.	Prerequisites for studying CC, connection with other educational components of ESP	The discipline is a prerequisite for CC 14 "Innovative technological solutions in industrial mechanical engineering" and CC 6 "Modeling and planning of a scientific experiment in engineering"

15.	Academic Integrity Policy	If a candidate submits another candidate's work as their own, such work is canceled and retaken. In case of cheating, retake the corresponding assignment. In case of using text borrowings without proper citation (academic plagiarism), the work will be canceled.
16.	Link to the course in Moodle system	https://cdn.snau.edu.ua/moodle/course/view.php?id=2184

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

Learning outcomes for CC: After studying the educational component, the applicant is expected to be able to...	Program learning outcomes that the CC aims to achieve (indicate the number according to the numbering given in the ESP)[1]					How is the LOA assessed?
	PLO					
	PLO1	PLO5	PLO7	PLO8	PLO9	
LOA1. Apply methodological foundations at all stages of scientific research, to formulate problems, reveal the topic and solve the tasks of the dissertation work.	X		X	X	X	Multiple choice test
LOA2. Search for the necessary information, process it, and summarize it using modern digital technologies.		X		X		Individual task
LOA3. Organize and carry out applied scientific research using standard methods.	X		X		X	Individual task
LOA4. Process the results of research and formulate conclusions.	X	X		X		Individual task
LOA5. Format the results of research work in accordance with the requirements for a report, publication, and dissertation.			X			Individual task Analytical review with presentation

PLO 1. Have conceptual and methodological knowledge in mechanical engineering and at the border of subject areas, as well as research skills sufficient to conduct scientific and applied research at the level of the latest world achievements in the relevant field, obtain new knowledge and/or implement innovations.

PLO 5. Apply modern tools and technologies for searching, processing and analyzing information, in particular, statistical methods for analyzing large-scale and/or complex data, specialized databases and information systems.

PLO 7. Be able to plan and carry out experimental and/or theoretical research in the field of mechanical engineering and related interdisciplinary areas using modern tools and adhering to the norms of professional and academic ethics, critically analyze the results of one's own research and the results of other researchers in the context of the entire complex of modern knowledge regarding the problem under study.

[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 OP I and II levels, for all (mandatory and selective CC) OP III

PLO 8. Apply general principles and methods of mathematics, natural and technical sciences, as well as modern methods and tools, digital technologies and specialized software to conduct research in the field of mechanical engineering.

PLO 9. Deeply understand the general principles and methods of mechanical engineering, as well as the methodology of scientific research, apply them in their own research in the field of industrial mechanical engineering and in teaching practice.

3. CONTENT OF THE EDUCATIONAL COMPONENT (COURSE PROGRAM)

Topic. List of issues to be addressed within the topic	Distribution within the general time budget				Recommended reading
	Classroom work			Independent work	
	Lec	PC	Lab		
Topic 1. Science and scientific research in the modern world. The emergence and evolution of science. Theoretical and methodological principles of science. Types and features of scientific research. Methodology and methods of scientific research. Organization of scientific activity in Ukraine.	2	-		6	1-4, 6-10, 16,17,20,23
Topic 2. Choosing a direction of scientific research and stages of research. The concept of a scientific problem. The concept of a research topic and its formulation. Defining the subject and object of research. The purpose and objectives of the research. The procedure for conducting scientific research. Stages of research.	2	-		6	3, 7-9, 19-21, 25, 29-33
Topic 3. Search, accumulation and processing of scientific information. General characteristics of information. Types of information sources. Information support for scientific research. Search for necessary information. Search for information in the library. Computer technologies for information search. Procedure for processing and grouping information.	2	6		6	5,7,16,20,22,29
Topic 4. Conducting theoretical research. Experimental research. The essence, purpose, tasks and stages of theoretical research. Methods of theoretical research. The use of mathematical methods in research. The essence, purpose, functions of a scientific experiment. Classification of experiments. Methodology of experimental research. General requirements for conducting an experiment. Typical errors in conducting an experiment. The experimenter's workplace and organization of the experiment.	4	6		8	1-4, 7-12, 14-18, 23, 29-32
Topic 5. Processing of research results. Fundamentals of the theory of random errors and methods for estimating random errors in measurements. Methods for graphical processing of experimental results. Analytical processing of experimental results. Elements of the theory of	2	4		6	1,2,7-9,16-18, 22, 24, 32

experimental planning.					
Topic 6. Formatting the results of scientific work. Types of scientific publications. Scientific monograph. Scientific article. Abstracts of a scientific report (communication). Scientific report (communication). Rules for formatting publications. Using Microsoft Word to format large-scale scientific works (monographs, dissertations, abstracts, textbooks).	2	2		4	1-9, 16,19, 21, 25-28
Topic 7. Implementation and effectiveness of scientific research. Approbation and publication of scientific research results. Implementation of scientific research results. Effectiveness of scientific research.	2	-		6	1-4, 27, 28
Topic 8. Execution and defense of dissertations. Dissertation works and their types. General methodology for performing dissertation research. Designing a dissertation. Abstract of the dissertation and the methodology for its writing and design. Procedure for awarding the degree of Doctor of Philosophy. Preliminary examination (pre-defense) of the dissertation at the department (department). Procedure for submitting a dissertation to a specialized academic council. Public defense of the dissertation. Preparation of documents for submitting an attestation file.	2	-		12	1-9,13, 16, 19, 21, 26-28
Total	**18**	**18**		**54**	

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 learning activities should the student perform independently)	Number of hours
*LOA1.*Apply methodological foundations at all stages of scientific research, to formulate problems, reveal the topic, and solve the tasks of the dissertation.	Problem lecture, thematic discussion, "Round table", discussion of current issues.	6	Independent work with the textbook, study of theoretical material.	10
*LOA2.*Search for the necessary information, process it, and summarize it using modern digital technologies.	Multimedia lecture, teacher consultations, discussions current questions.	10	Independent work with the textbook, completion of individual tasks.	11
*LOA3.*Organize and carry out applied scientific research using standard methods.	Multimedia lecture, "brainstorming", discussion of current issues.	8	Personalized learning,independent work with the textbook, completion of individual tasks.	11
*LOA4.*Process the results of the research and formulate conclusions.	Flipped classroom, learning through action, teacher consultations, thematic discussion.	6	dependent work with the textbook, learning through research.	11
*LOA5.*To formalize the results of research work in accordance with the requirements for a report, publication, and dissertation.	Multimedia lecture, teacher consultations, discussion of current issues.	6	Independent work with the textbook, study of theoretical material.	11
Total hours		36		54

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.	Multiple choice test	*10 points / 10%*	*For 4 weeks*
2.	Completing an individual task	*25 points / 25%*	*At 8 weeks*
3.	Completing an individual task	*25 points / 25%*	*At 10 weeks*
4.	Completing an individual task	*25 points / 25%*	*At 12 weeks*
5.	Analytical review with presentation (credit)	*15 points / 15%*	*At 14 weeks*

5.2.2. Evaluation criteria

Component	Unsatisfactorily	Satisfactorily	Good	Perfectly
Multiple choice test	*<5 points*	*5-6 points*	*7-8 points*	*9-10 points*
	Less than 60% correct answers	60% - 74% correct answers	75% - 89% correct answers	100% correct answers
Execution of individual this task	*<11 points*	*11-15 points*	*16-21 points*	*22-25 points*
	Little awareness regarding the problem, a brief description is provided. Does not demonstrate independent thinking regarding the chosen topic.	The problem is mostly described (without analysis), the main points are not sufficiently substantiated, the argumentation is not sufficiently consistent, the presentation is absent or presented superficially. The literature reviewed is only recommended by the teacher	Demonstrated understanding, depth and/or detail of the problem; the main problematic aspects are well-founded, the arguments are consistent; different points of view are explored, the presentation is meaningful and consistent.	The problem is sufficiently deeply and/or in detail revealed, Different views on the problem are analyzed; all main points are stated, arguments are consistent and weighty; different points of view are analyzed, own proposals are given.
Analytical review with presentation (credit)	*<6 points*	*6-8 points*	*9-11 points*	*12-15 points*
	Task requirements not met	Majority requirements are met, but individual components are missing or insufficiently disclosed, there is no analysis of other approaches to the issue	All task requirements met	All task requirements have been met, creativity and thoughtfulness have been demonstrated, and an original solution to the problem has been proposed.

5.3. Formative assessment:

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

No.	Elements of formative assessment	Date
1	Written test with elements of problem tasks	4 - week
2	Verbal feedback from teacher and students while completing an individual task	During classes

3	Verbal feedback from teacher and students regarding the analytical review with presentation	14 - week

6. LEARNING RESOURCES (LITERATURE)

6.1. Main sources:

1. Methodology of scientific research [Text]: teaching aid. / V. S. Antonyuk, L. G. Polonsky, V. I. Averchenkov, Yu. A. Malakhov. – K.: NTUU "KPI", 2015. – 276 p.
2. Methodology and organization of scientific research: a textbook /O.I. Gutorov; Kharkiv National Agrarian University named after V.V. Dokuchaev – Kh.: KhNAU, 2017. – 272p.
3. Kalambet S.V. Methodology of scientific research: Textbook. / S.V. Kalambet, S.I. Ivanov, Yu.V. Pivnyak Yu.V. – Dn-vsk: Publishing house Makovetsky, 2015. – 191 p.
4. Bilukha M.T. Methodology of scientific research: Textbook. – Kyiv: ABU, 2002. – 480 p.: ill..
5. DSTU 3008:2015. Information and documentation. Reports in the field of science and technology. Structure and rules of design.
6. Yerina A.M., Zakhozhiy V.B., Yerin D.L. Methodology of scientific research: Textbook. – Kyiv: Center for Educational Literature, 2004. – 212 p.
7. Boon, Mieke. (2020). Scientific methodology in the engineering sciences. In: The Routledge Handbook of the Philosophy of Engineering (1st ed.). Michelfelder, DP, & Doorn, N. (Eds.). Routledge.https://doi.org/10.4324/9781315276502
8. Kumar, R. (2019). Research methodology: A step-by-step guide for beginners (5th. ed.), Thousand Oaks, CA, Sage, DOI:10.1080/15348431.2019.1661251
9. Patten ML, Routledge M. (2017) Understanding research methods: An overview of the essentials, tenth edition. Taylor & Francis Group, New York, 2017 – 352p.
10. Komarov M.S. Foundations of scientific research. – Lviv: Higher School. Publishing House near Lviv. University of Technology, 1982. - 128 p.
11. Ludchenko A. A., Ludchenko Ya. A., Primak T. AND. Fundamentals of scientific research: Textbook. Manual / Ed. AND. AND. Ludchenko. - K.: "Knowledge" Oblast, KOO, 2002. - 114 p.
12. Narynyan A.R. Foundations of scientific research. Study guide for universities. / Narynyan A.R. - K.: 2002. - 112 p.
13. Fundamentals of scientific research. Organization of independent and scientific work of a student: Textbook / Ya.Ya.Chornenkyi, N.V. Chornenka, S.B. Rybak and others. – K.: VD "Professional", 2006. – 208 p.
14. Foundations of scientific research. Study guide for universities. \ Frumkin R.A. – Alchevsk., 2001 -201 p.
15. Sidenko V. M., Grushko I. M. Fundamentals of Scientific Research. – Kharkiv, Higher School, 2002 – 200 p.
16. Sheiko V. M. Organization and methods of scientific research activity [Text]: a textbook for students of higher education institutions / Sheiko Vasyl

Mykolayovych, Kushnarenko Natalia Mykolayivna. — 5th ed., ed. — K. : Znannya, 2006. — 307 p. — Bibliography: p. 305-307.7.

17. Yerina A.M. Methodology of scientific research [Text]: a textbook / A.M. Yerina, V.B. Zakhozhai, D.L. Yerin. – K.: TsNL, 2004. – 212 p.

18. Kovalchuk V. V. Fundamentals of scientific research [Text]: a manual for students of higher education, recommended by the Ministry of Education and Science of the Republic of Kazakhstan/ Kovalchuk V.V., , Moiseyev L.M. – 3rd ed., revised and supplemented – K.: Professional, 2005.– 240 p.

6.2. Additional sources:

19. Klymenyuk O. V. Presentation and presentation of the results of scientific research [Text]: author's textbook / Oleksandr Valerianovich Klymenyuk.– Nizhyn: Aspek-Poligraf, 2007.– 398 p.

20. Krushelnytska O. V. Methodology and organization of scientific research [Text]: a manual for higher education institutions / Olga Volodymyrivna Krushelnytska. – K.: Kondor, 2004.– 192 p.

21. Naumovets A. G. You are face to face with the audience: Something about the "technology" of scientific reports, popular lectures, dissertation speeches and competitive projects / Naumovets Anton Grigorovich; NAS of Ukraine; Institute of Physics. – K.: Naukova Dumka, 2003. – 56 p. : fig. – Bibliography: p. 52-53. - (Project "Scientific Book").

22. Pilyushenko V. L. Scientific research: organization, methodology, information support [Text]: teaching aid for students of higher education, recommended by the Ministry of Education and Science of Ukraine / Pilyushenko Vitaliy Lavrentiyovych, Shkrabak Iryna Volodymyrivna, Slavenko Edvin Igorovich. – K.: Libra, 2004. – 344 p. : ill. — Bibliography: p. 343.

23. Ruzavin G.I. Methodology of scientific research. Study guide for universities. / Ruzavin G.I. - M.: 1999. - 317 p.

24. Methodology of scientific research in the field: workshop [Electronic resource]: teaching aids for students of specialty 151 "Automation and computer-integrated technologies" / compiled by: N.I. Burau, V.S. Antonyuk, D.O. Pivtorak. – Electronic text data (1 file: 0.4 MB). – Igor Sikorsky Kyiv Polytechnic Institute, 2021. - 58 p.

25. Bilukha M.T. Fundamentals of Scientific Research: A Textbook for Students of Economic Specializations at Universities. – Kyiv: Higher School, 1997. – 271 p.

26. Law of Ukraine "On Higher Education"

27. Law of Ukraine "On Scientific and Scientific-Technical Activities"

28. Law of Ukraine "On Innovation Activity"

29. Kolesnikov A. Internet: for the user. - K.: Izdatelskaya gruppa BHV, 2000. - 304 p.

30. Krasnoboky Yu.M., K.M. Lemkivsky. Dictionary-reference book for a novice scientist. – Kyiv: National Central Higher Education Institute, 2001. – 72 p.

31. Methodology of scientific research. Study guide for universities. \ Ruzavin G.I. - M., 1999 - 317 p.
32. Fundamentals of scientific research: Textbook. for technical universities / V.I. Krutov, I.M. Hrushko, V.V. Popov and others; Ed. YOU. Krutova, V.V. Popova - M.: Higher. Shk., 1989. - 400 p.

6.3 English-language Internet sources

Search engines

BibSonomy– Share bookmarks and lists of literature.

Biohunter– Literature search, data statistics, reading, sorting, storing, field expert identification, journal finder.

CaptoMe– Metadata platform with rich biomedical content and information management tools for research.

CiteUlike– Search, organize, and share scholarly papers.

Colwiz– Create citations & bibliography and set up research groups on the cloud to share files & references.

ContentMine– Uses machines to liberate 100,000,000 facts from the scientific literature.

Data Elixir– A weekly collection of the best data science news, resources, inspirations from around the web.

DeepDyve– Instant access to the journals you need.

EvidenceFinder– Enriches literature exploration by suggesting questions alongside search results.

F1000Prime– Leading biomedical experts helping scientists to discover, discuss and publish research.

Google Scholar– Provides a way to broadly search for scholarly literature across disciplines and sources.

Labia– A suite of web apps for researchers, an online app for finding, commenting, rating, managing papers.

LazyScholar– Chrome extension to help literature search.

LiteracyTool– Educational platform (discovery, understanding, and exploration of scientific topics of interest).

Mendeley– A unique platform comprising a social network, reference manager, article visualization tools.

Microsoft Academic Search– Find information about academic papers, authors, conferences, journals.

MyScienceWork– Diffuse scientific information and knowledge in a free and accessible way.

Nowomics– Follow genes, proteins and processes to keep up with the latest papers relevant to research.

Paperity- Aggregator of open access papers and journals.

Paperscape– Visualize the arXiv, an open, online repository for scientific research papers.

PubChase– Life sciences and medical literature recommendations engine.

Pubget– Search engine for life-science PDFs.

PubNiche– A scientific research news curator.
PubPeer– Search for publications and provide feedback and/or start a conversation anonymously.
ReadCube– Read, manage & discover new literature.
Research Professional– Source of intelligence on funding opportunities and research policy.
Scicurve– Transforms systematic literature review into interactive and comprehensible environment.
Sciencescape– Innovation in the exploration of papers and authors.
Scientific Journal Finder(SJFinder) – A collection of tools including a journal search engine and rating.
SciFeed– Uses various data sources and natural language processing to identify important scientific advances.
SciVal Funding– Comprehensive source of funding information.
Scizzle– Curator that automatically finds new and relevant research papers.
Sparrho– Personalized recommendation engine for science.
SSRN– Multi-disciplinary online repository of scholarly research and related materials in social sciences.
Stork– Notifies users of new publications and grants based on the users' own keywords.
Symplur– Connecting the dots in healthcare social media.
Wiki Journal Club– Open, user-reviewed summaries of the top studies in medical research.
Zotero– Helps you collect, organize, cite, and share research sources.

Online organizers

Docollab– Helps to manage scientific research, collaborate with colleagues and publish findings.
Elabftw– Electromic lab notebook made by researchers, for researchers, with usability in mind.
ELabJournal– GLP-compliant Electronic Lab Notebook and lab management tool.
Evernote– A place to collect inspirational ideas, write meaningful words, move important projects forward.
Findings App– Lab notebook app that allows to organize experiments, keep track of results, manage protocols.
Hivebench– Hosted numeric laboratory notebook tool to manage protocols, experiments, share with team.
Journal Lab– A community of scientists who share open summaries and peer review of articles.
LabArchives– Web-based product to enable researchers to store, organize, and publish their research data.
Labfolder– Simple way to document research and to organize protocols and data (blog post).
LabGuru– Supports day to day activities of a research group (vision, execution, knowledge, logistics).

[Laboratory Logbook](#)– Document projects running in a lab, manage experimentally obtained data, metadata.

[sciNote](#)– Open source lab notebook with workflows and modular functionalities ([blog post](#)).

[Sumatra](#)– Automated electronic lab notebook for computational projects.

Tools for collaborative experimentation

[Emerald Cloud Lab](#)– A web-based life sciences lab, developed by scientists for scientists.

[ScienceExchange](#)– Marketplace for shared lab instrumentation.

[TetraScience](#)– Allows you to monitor & manage experiments from anywhere.

[Transcript](#)– A remote, on-demand robotic life science research lab with no hardware to buy or software to install.

[Addgene](#)– Plasmid sharing platform.

[Antibody Registry](#)– Gives researchers a way to universally identify antibodies used in the course of research.

[Biospecimens](#)– Platform for biospecimen-based research.

[Duke human heart](#)– Repository for cardiovascular research scientists, including tissue samples.

[ELabInventory](#)– Web laboratory inventory management system designed for life science research labs.

[Nanosupply](#)– Platform facilitating sourcing and sharing of advanced materials for research and education.

[Sample of Science](#)– Peer-Sharing Platform for Scientific Samples.

Electronic laboratories

[BioBright](#)– For better understanding of experimental conditions by connecting sensors to instruments.