

NATIONAL TECHNICAL UNIVERSITY
"KHARKIV POLYTECHNIC INSTITUTE"

METHODOLOGICAL GUIDELINES

for independent work in the discipline
"Trends in the Development of Self-Propelled Machines"
for full-time and part-time students
majoring in 274 "Automobile Transport"

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Methodological guidelines for independent work in the discipline **“Trends in the Development of Self-Propelled Machines”** for full-time and part-time students majoring in 274 **“Automobile Transport”** / comp. O.M. Agapov, O.O. Ostroverkh – Kharkiv: NTU “KhPI”, 2025. – ____p.

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INTRODUCTION

The modern stage of technological development is characterized by the intensive improvement and widespread implementation of self-propelled machines in various sectors of the economy and transportation. Self-propelled machines cover a wide range of equipment—from agricultural tractors and construction machinery to automobiles and specialized transport vehicles. Their development is driven by the introduction of advanced technologies, increased efficiency, improved safety, and environmental sustainability.

Studying the trends in the development of self-propelled machines allows students to understand the main directions of technological progress, evaluate global and domestic achievements in mechanical engineering, and gain an insight into the prospects of alternative energy sources, automation, and intelligent control systems.

The purpose of these methodological guidelines is to assist in organizing students' independent work, to form systematic knowledge about modern and prospective trends in the development of self-propelled machines, and to develop analytical skills and the ability to apply theoretical knowledge to solving practical tasks.

1. PURPOSE AND OBJECTIVES OF STUDENTS' INDEPENDENT WORK

Independent work is an essential component of higher education training.

The main objectives are as follows:

- development of skills in independent and creative work;
- acquisition of experience in planning and organizing working time;
- ability to solve complex professional tasks independently.

For full-time students, 72 hours of independent study are allocated for this discipline.

The discipline is an elective within specialized training. The course material introduces various aspects of trends in the development of self-propelled machines, tractors, and automobiles, as well as their individual units and on-board intelligent systems.

The aim of the course is to provide students with knowledge of the trends in the development of self-propelled machines, tractors, and automobiles, which will enable them to operate, maintain, and repair these vehicles effectively with rational material and energy costs.

2. GENERAL RECOMMENDATIONS

Independent work is a form of study that each student organizes individually.

It is important to make use of the following resources:

- the library and electronic catalog;
- periodicals and the NTU “KhPI” repository;
- electronic resources.

3. CONTENT OF TOPICS FOR INDEPENDENT STUDY

3.1. The Role of Self-Propelled Machines in the National Economy of Ukraine

Clarifying questions:

1. Which major industries use self-propelled machines?
2. How does the role of tractors differ from that of motor transport?
3. Which enterprises in Ukraine produce self-propelled machines?
4. How do self-propelled machines affect labor productivity?

Control questions:

5. What is the significance of self-propelled machines for the Ukrainian economy?
6. What types of self-propelled machines are used in agriculture?
7. How does the development of motor transport affect other sectors of the economy?

3.2. Military Self-Propelled Machines: Ukraine and NATO Countries

Clarifying questions:

1. What types of military self-propelled machines are used in Ukraine?
2. What examples of modern military machines exist in NATO countries?
3. What is the difference between combat and auxiliary self-propelled machines?
4. What modernization trends in military equipment have emerged in recent years?

Control questions:

5. What are the main tasks of military self-propelled machines?
6. How do Ukrainian designs differ from NATO counterparts?
7. What are the prospects for the development of military self-propelled transport?

3.3. Classification of Self-Propelled Machines**Clarifying questions:**

1. By which criteria are self-propelled machines classified?
2. What categories of machines exist by purpose?
3. What are universal and specialized self-propelled chassis?
4. How does classification affect the organization of operation?

Control questions:

5. What main categories of self-propelled machines do you know?
6. What is the difference between universal and specialized chassis?
7. Why is classification important for standardization of equipment?

3.4. Trends in the Development of Tractors and Self-Propelled Chassis**Clarifying questions:**

1. What new technologies are being introduced in tractor manufacturing?
2. Which types of self-propelled chassis are most common today?
3. How do universal chassis differ from specialized ones?
4. What innovations are related to tractor energy efficiency?

Control questions:

5. What are the latest trends in tractor development?
6. Which industries need universal chassis the most?
7. How do innovations change the operational characteristics of tractors?

3.5. Modern Motor Transport and Freight Vehicles**Clarifying questions:**

1. What are the new trends in the development of passenger cars?
2. How do long-haul trucks differ from distribution trucks?

3. Which manufacturers are leaders in the freight transport sector?
4. How are requirements for freight vehicles changing in Europe?

Control questions:

5. What are the main challenges in freight transport development?
6. How does the use of long-haul and distribution trucks differ?
7. Which companies set global trends in the truck industry?

3.6. Innovations in Internal Combustion Engines (ICEs)

Clarifying questions:

1. What is the Skyactiv-G technology and what are its advantages?
2. What is the essence of variable compression ratio in ICEs?
3. Which companies implement cylinder deactivation systems?
4. What functions does the electronic throttle pedal perform?

Control questions:

5. What are the main directions of innovation in ICEs?
6. What advantages does variable compression ratio provide?
7. What is the significance of cylinder deactivation for fuel economy?

3.7. Supercharging and Boosters in Modern ICEs

Clarifying questions:

1. How does a mechanical supercharger work?
2. What are the features of the SAAB SVC prototype?
3. What types of high-efficiency superchargers exist?
4. What role does boosting play in reducing fuel consumption?

Control questions:

5. How does a mechanical supercharger differ from a turbocharger?
6. What tasks does boosting solve in modern ICEs?
7. Why did SAAB develop the SVC prototype?

3.8. Driverless Cars and Artificial Intelligence

Clarifying questions:

1. Which companies are developing autonomous cars?
2. What safety issues are associated with autonomous transport?
3. What difficulties arise in creating artificial intelligence?
4. What examples of accidents involving driverless cars are known?

Control questions:

5. What levels of vehicle autonomy exist?
6. What are the main risks of introducing driverless transport?
7. Which technologies are key for creating AI in transport?

3.9. Intelligent Systems in Automobiles

Clarifying questions:

1. How does the “Driver’s Mobile Assistant” system work?
2. What functions do on-board information systems perform?
3. How do multi-agent systems help regulate traffic?
4. What modern vehicle control systems exist?

Control questions:

5. What functions do intelligent vehicle systems perform?
6. How do they affect traffic safety?
7. What are the prospects for driver information systems?

3.10. Automated Passenger Transportation Systems

Clarifying questions:

1. What examples of automated transport systems exist worldwide?
2. Where are autonomous buses and shuttles being implemented?
3. What technical problems hinder their mass adoption?
4. What advantages do automated transport systems have over traditional ones?

Control questions:

5. What examples of driverless passenger systems are in operation today?
6. What advantages do they provide in urban conditions?
7. What are the prospects for their development in the next 10 years?

4. TEST QUESTIONS FOR MODULE WORK

1. What main types of self-propelled machines are used in Ukraine's economy?
2. Which industries depend most on tractors?
3. What is the significance of motor transport for Ukraine's economy?
4. What examples of military self-propelled machines exist in Ukraine?
5. How do combat and auxiliary self-propelled machines differ?
6. What military machines are standard in NATO countries?
7. By what criteria are self-propelled machines classified?
8. What belongs to universal self-propelled chassis?
9. What are the advantages of specialized chassis?
10. What modern technologies are being introduced in tractors?
11. How is the energy efficiency of agricultural machinery improved?
12. How do modern tractors differ from Soviet-era models?
13. What is a universal chassis?
14. Provide examples of specialized chassis.
15. In which sectors are universal chassis applied?
16. What are the main directions in the development of global motor transport?
17. What environmental requirements shape new automotive standards?
18. How does digitalization affect motor transport?
19. What are the differences between long-haul and distribution trucks?
20. What innovative solutions are used in modern trucks?
21. Name leading global manufacturers of freight vehicles.
22. What key challenges face Ukraine's freight transport?
23. How does electromobility affect the freight segment?
24. What are the prospects for logistics development in Ukraine?
25. What innovations increase ICE efficiency?
26. What is the essence of Skyactiv-G technology?
27. Which companies implement cylinder deactivation systems?
28. What features distinguish Skyactiv-G from conventional ICEs?
29. What fuel economy benefits does this technology provide?
30. Which companies developed Skyactiv-G?
31. What is variable compression ratio and why is it useful?
32. Which companies developed serial ICEs with this technology?
33. What is unique about SAAB's SVC prototype?
34. What types of superchargers are used in ICEs?
35. How does a turbocharger differ from a mechanical compressor?
36. What advantages do modern superchargers offer?
37. What is the purpose of cylinder deactivation in ICEs?
38. What benefits does the electronic throttle pedal provide?
39. How do these technologies affect fuel consumption?
40. What levels of vehicle autonomy exist?
41. What examples of driverless car accidents are known?

42. What are the main safety issues of autonomous transport?
43. What tasks does AI perform in driverless vehicles?
44. What are the key challenges in developing transport AI?
45. Which companies lead in AI for transport?
46. How does the “Driver’s Mobile Assistant” system work?
47. What functions do driver information systems perform?
48. How are multi-agent systems used in traffic management?
49. Which companies lead in creating autonomous vehicles?
50. What technologies are used for autonomous vehicle navigation?
51. Which countries first introduced driverless taxis?
52. What examples of automated transport systems exist worldwide?
53. Where have autonomous buses been implemented?
54. What are the advantages of automated passenger transport?
55. What are the main global trends in the development of self-propelled machines?
56. How do environmental standards affect ICE design?
57. What are the prospects for electric transport in Ukraine?
58. What challenges arise in implementing driverless vehicles?
59. How do intelligent systems affect road safety?
60. What transport innovations will define the next decade?

5. REFERENCE WORK (REPORT)

Purpose of the abstract/report work:

To consolidate and deepen knowledge from the lecture course through independent study of additional sources (scientific articles, monographs, reference literature, Internet materials), including:

1. Development of analytical skills in information processing—selection, summarization, systematization, and critical evaluation of obtained data.
2. Improvement of skills in logical written presentation and reasoned argumentation of one’s own viewpoint.
3. Application of theoretical knowledge to analyzing current issues and future prospects in the development of self-propelled machines.
4. Fostering professional competence of future specialists in the field of motor transport and mechanical engineering.

6. REQUIREMENTS FOR THE CONTENT AND FORMAT OF THE ABSTRACT/REPORT

The explanatory note of the abstract/report is to be prepared using a text editor (e.g., MS Word) with the possibility of inserting fragments from other programs.

Formatting sequence:

- 1 – Title page;
- 2 – Table of contents;
- 3 – Main text (topic development);
- 4 – List of references.

The explanatory note must be presented in printed form on A4 sheets. Font – *Times New Roman*, size – 14 pt, line spacing – 1.5. The abstract length: 10–15 pages. Text must be justified. Formatting must comply with NTU “KhPI” standard [10].

The abstract must include text and explanatory material in the form of drawings, photographs, comparative tables, graphs, and diagrams. If presented as a report, a PowerPoint presentation (pptx format) with text, illustrations, diagrams, and photographs must be provided.

7. SAMPLE TOPICS FOR ABSTRACTS/REPORTS

1. History of the development of self-propelled machines in Ukraine and worldwide.
2. Current trends in the development of tractors and agricultural machinery.
3. Prospects for freight transport development in Ukraine.
4. Electric vehicles: global experience and Ukrainian realities.
5. Hydrogen engines and their place in the transport of the future.
6. Innovative technologies in ICEs: variable compression ratio, cylinder deactivation.
7. Turbocharging and high-efficiency superchargers: current state and prospects.
8. Driverless cars: problems and prospects of implementation.
9. Intelligent driver assistance systems (ADAS).
10. Automated passenger transport systems: European and Asian experience.
11. The role of artificial intelligence in the development of motor transport.
12. State and prospects of bus manufacturing in Ukraine.
13. Military self-propelled machines: Ukrainian designs in the global context.
14. The impact of EU environmental standards on transport development.
15. Future mobility: integration of electric transport and “smart” infrastructure.
16. Development strategy of branded car service.
17. Evolution and prospects of car development on the example of Audi A6.

18. The automobile industry of Japan.
19. Automotive oils.
20. Modern automotive painting technologies.
21. Analysis of the current state of batteries.
22. Analysis of the state and prospects of Ukraine's transport system.
23. Amphibious vehicles.
24. Aerodynamic drag of automobiles and ways to reduce it.
25. Operational factors and improving vehicle safety.
26. Current state and prospects of wheel and tire development.
27. Paths of freight transport development.
28. Innovations in long-haul and distribution trucks.
29. Automobiles and ecology.
30. Cars of the future.
31. Flying cars.
32. Alternative fuels for automobiles.
33. History and prospects of electric vehicles.
34. Current state and prospects of EV charging devices.
35. Classification and prospects of tractor development.
36. Military vehicles of the aggressor state – Russia.
37. Military vehicles of Ukraine.
38. Self-propelled artillery systems (SPGs) of the Ukrainian army.
39. Self-propelled artillery systems (SPGs) of the aggressor state – Russia.

8. LIST OF REFERENCES

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2. Podrigalo M.A., Sheludchenko V.V. *New in the Theory of Operational Properties of Automobiles and Tractors: Textbook*. Sumy: Sumy National Agrarian University, 2015. – 213 p.
3. Voityuk D.G., Dubrovin V.O., Ishchenko T.D., et al. *Agricultural and Reclamation Machines: Textbook*. Edited by D.G. Voityuk. Kyiv: Higher Education, 2004. – 544 p.: ill.
4. Dushchenko V.V. *Suspension Systems of Military Tracked and Wheeled Vehicles: Calculation and Synthesis: Textbook*. Kharkiv: NTU "KhPI", 2018. – 336 p.
5. Kyrychenko I.G. *Modular Concept of Designing Technological Machines for Construction Production*. Kharkiv: KhNAHU, 2002. – 119 p.
6. Polyakov V.M., Sakhno V.P. *Three-Link Road Trains. Maneuverability: Monograph*. Luhansk: Naukidns, 2014. – 206 p.
7. Kashkanov A.A., Rebidaylo V.M. *Specialized Rolling Stock of Motor Transport: Construction: Textbook*. Vinnytsia: VDTU, 2002. – 164 p.
8. Podrigalo M.A., Polyanskyi O.S., Dubinin E.O. *Handling and Stability of Tractors and Tractor Trains*. Kharkiv: KhNTUSG named after Petro Vasylenko, 2018. – 279 p.

9. Kalchenko V.V., Pasov G.V., Venzhega V.I. *Specialized Rolling Stock: Methodological Guidelines for Laboratory Work in the Discipline “Specialized Rolling Stock” for Students of Specialty 274 “Automobile Transport” (all forms of study)*. Chernihiv: ChNTU, 2019. – 34 p.
10. STZVO-KhPI-3.01-2021 CSONP. *Text Documents in the Field of Educational Process. General Requirements for Execution (with amendments)*. URL: <http://web.kpi.kharkov.ua/mto/wp-content/uploads/sites/200/2021/11/STZVO-KhPI-3.01-2021.pdf>

Additional Literature

1. *Trends in the Development of the Agricultural Machinery Market in Ukraine in 2024*. URL: <https://agroelita.info/tendentsii-rozvytku-rynku-silhosptekhniky-v-ukraini-v-2024-rotsi/> (accessed: 30.08.2025).
2. Kalinin O.M., Kostyuk V.V., Rusilo P.O., Varvanets Yu.V. *State and Prospects for the Development of Self-Propelled Remotely Controlled Machines for the Needs of the Armed Forces of Ukraine*. Bulletin of NTU “KhPI”. Series: Mechanical Engineering and CAD. Kharkiv: NTU “KhPI”, 2016, No. 39 (1211), pp. 79–85.
3. Ivanyshyn V.V. *Trends in the Development of the Global Agricultural Machinery Market*. Efficient Economy, No. 2, 2012. URL: <http://www.e>