KHMELNYTSKYI NATIONAL UNIVERSITY

APPROVED
Dean of IT Faculty
T. HOVORUSHCHENKO
11 09 2025

WORKING PROGRAMME OF THE EDUCATIONAL COMPONENT

Physics
Name of the course

Field of study: 12 – Information technology
Specialty: 121 – Software engineering
Level of Higher Education: First (Bachelor's) Level
Educational and Professional Programme: Software engineering (Full time study mode)
Course Load: ECTS credits – 6, ***Course Code:*** MGT.06
Language of Instruction - English
Course status: compulsory
Faculty – Information Technologies
Department – Higher Mathematics and Computer Applications

Study mode	Year	Semester	Total load		Number of hours						Course project	Course paper	Type of semester control	
					Classwork hours				Student's individual work	Student's independent work including individual work				
			ECTS credits	Hours	Total	Lectures	Laboratory works	Practical classes					Pass/ fail test	Examination
D	2	3	6	180	66	16	34	16		114				+

The working programme is based on the Educational and Professional Programme for bachelors majoring in "Software Engineering"

Program's author _____ A. TKACHUK
Signature Instructor(s)' initials, surname

Approved at the staff meeting of the Department of Higher Mathematics and Computer Applications

Protocol № 1 of 30 August 2025

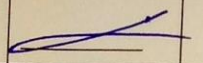
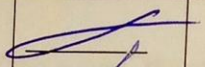
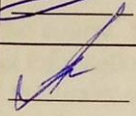
Head of the Department of Higher Mathematics and Computer Applications _____ A. RAMSKYI
Signature Initials, surname

The working programme was reviewed and approved by the Academic Council of the Faculty of Information Technologies

Chair of the Academic Council _____ T. HOVORUSHCHENKO
Signature Initials, surname

Khmelnytskyi 2025

APPROVED

Job title	Department	Signature	Name, surname
Head of the Department of Software Engineering, D. Sc., Professor.	Software Engineering		Leonid BEDRATIUK
Guarantor of the Educational and Professional Program, D. Sc., Professor.	Software Engineering		Leonid BEDRATIUK
Dean of the Faculty of International Relations and Law Ph.D., Associate Professor	International Communication and Political Sciences		Yurij MUDRYK

PHYSICS

Type of Educational Component	Compulsory
Level of Higher Education	First (Bachelor's) Level
Language of Instruction	English
Semester	Third
Number of ECTS Credits Assigned	6
Forms of Study the Course is Designed For	Full-time

Learning outcomes: upon successful completion of the course, the student should be able to: possess physical terminology; analyze, purposefully search for and select information and reference resources necessary for solving professional tasks; know the basic physical laws and the limits of their application; be able to analyze physical phenomena and processes, establish a connection between them and, based on physical laws, predict their further course; know and apply relevant mathematical concepts; independently find solutions to practical problems of physical content; formulate the goal, objectives and method of experimental research; draw up schemes of the experimental setup; analyze the results of the experiment, qualitatively and quantitatively evaluate the results using statistical processing methods; draw logical conclusions when solving the tasks set; generalize observations and facts, and give them scientific justification.

Course Content: fundamentals of mechanics: kinematics of translational and rotational motion, dynamics of translational and rotational motion. The basic forces in mechanics, work, energy, and conservation laws. Electricity: electric field strength and potential. Capacitance. Voltage, electromotive force, current. Ohm's law and Joule-Lenz's law. Magnetism: magnetic induction, Ampere's, Biot-Savart-Laplace's, Lorentz's laws. Law of electromagnetic induction.

Prerequisites – MGT.01 Linear Algebra and Analytical Geometry, MGT.02 Mathematical Analysis.

Postrequisites – MPT.07 Computer Network Organisation.

Planned Learning Activities: **t**he amount of classroom-based learning activities in one ECTS credit of an academic discipline is 11 hours per 1 ECTS credit (the minimum volume for the first (bachelor's) level of higher education in full-time education is 10 hours per 1 ECTS credit).

Forms (Methods) of Instruction: the learning process for the course is based on the use of both traditional and modern teaching technologies and methods, in particular: ***lectures*** (using visualisation methods, problem-based and interactive learning, motivational techniques, and information and communication technologies); ***laboratory works*** (using training exercises, problem situation analysis, explanation, discussions, etc.); ***practical classes*** (using instruction, demonstration, solving typical and applied problems, analysing situational tasks, discussion elements, etc.); ***independent work*** (study of theoretical material, preparation for laboratory works, ongoing and final assessment), with the use of information and computer technologies and distance learning technologies (Zoom online conferencing service, Modular learning environment, etc.).

Assessment Methods: Laboratory work defence, Testing, Individual Homework Assignments.

Form of Final Assessment: Exam

Learning Resources:

1. Urone P.P. College Physics/ Paul Peter Urone, Roger Hinrichs.–Houston:OpenStax College, 2020. – 836 p. https://d3bxy9euw4e147.cloudfront.net/oscms-prodcms/media/documents/Physics-WEB_Sab7RrQ.pdf

2. Halliday D. Fundamentals of Physics/ Jearl Walker, David Halliday, Robert Resnic.-12th ed., Volume 1 - Cleveland: John Wiley & Sons, 2022. – 717 p. https://dl.icdst.org/pdfs/files4/39e1817b05cf155433309dbb2f3289fe.pdf

3. Nolan P.J. Fundamentals of College Physics/ Peter J. Nolan. – 5th ed. –Boston: Pearson Custom Publishing. – Vol.1- 2014. – 560 p. https://kfe.khmnu.edu.ua/wp-content/uploads/sites/69/2024/11/nolan_modern_physics.pdf

4. Serway R. College Physics/ Raymond A. Serway, Jerry S. Faughn, Chriss Vuille. – 9th ed. - Boston: Cengage Learning.-2014 - 1622 p.

https://physics.fe.uni-lj.si/publications/pdf/Serway_Physics_for_Scientists_Engineers_Modern%20Physics_9th%20Ed_Serway_Jewett.pdf

5. Modular Learning Environment. [Electronic resource]. – Access: https://msn.khmnu.edu.ua/course/view.php?id=10107

6. Course of Lectures by Walter Lewin, MIT Physics (*Massachusetts Institute of Technology*). *Classical Mechanics, Electricity, Magnetism:* https://www.youtube.com/watch?v=wWnfJ0-xXRE&list=PLyQSN7X0ro203puVhQsmCj9qhlFQ-As8e

7. Electronic Library of the University. [Electronic resource]. – Access: http://library.khmnu.edu.ua/

8. Institutional Repository of Khmelnytskyi National University. [Electronic resource]. – Access: https://elar.khmnu.edu.ua/home

3. EXPLANATORY NOTE

Introduction: Physics is a fundamental natural science and is one of the mandatory disciplines of general training that form the basis of theoretical and practical education of future specialists. Physics serves as a theoretical basis for all technical sciences and plays the role of the basis without which the successful activity of an engineer in any field of modern technologies is impossible. Therefore, the conscious and confident use of physical laws is a necessary part of the practical skills of young specialists.

The discipline is taught to students of the first (bachelor's) level of the full-time form of higher education, who study in the Educational and Professional Programme "Software Engineering" within the framework of specialty 121 "Software Engineering".

Prerequisites – MGT.01 Linear Algebra and Analytical Geometry, MGT.02 Mathematical Analysis.

Postrequisites – MPT.07 Computer Network Organisation.

According to the Standard of higher education in the specified specialty and Educational Programme, the discipline contributes to the development of

competences: IC – the ability to solve complex specialized tasks or practical problems of software engineering, characterized by complexity and uncertainty of conditions, using theories and methods of information technologies; GC1 - ability for abstract thinking, analysis, and synthesis; GC2 - ability to apply knowledge in practical situations; GC9- desire to preserve the environment; PC8 - ability to apply fundamental and interdisciplinary knowledge to resolve software engineering tasks successfully; PC9 - ability to evaluate and consider economic, social, technological, and ecological factors affecting the professional activity field; PC14 - ability for algorithmic and logical thinking;

programme learning outcomes: PLO1 - to analyse, purposefully search for, and select the necessary information, reference resources, and knowledge for solving professional tasks, considering modern scientific and technical achievements; PLO5 - to understand and apply relevant mathematical concepts, domain and system methods, object oriented analysis, and mathematical modelling for software development; PLO8 - to have the skills to develop a human-machine interface.

Purpose of the discipline*:* formation of students' competencies in the process of learning to apply fundamental physical laws to describe natural phenomena and predict their evolution, and the acquisition of skills in experimental research of physical processes and their use in practical activities in the chosen speciality.

Subject of the discipline: basic fundamental physical concepts, quantities, and laws; properties and characteristics of the simplest forms of matter's motion, various types of physical interaction.

The objectives of the discipline: to provide students with the foundations of a sufficiently broad training in physics, which will allow them to navigate the flow of scientific and technical information and offer the opportunity to use physical phenomena and laws in those areas in which they will specialize; to develop students' scientific and technical thinking; to form the skills of conducting experimental research.

Learning outcomes: a student who has successfully completed the study of the discipline should be able: possess physical terminology; analyze, purposefully search for and select information and reference resources necessary for solving professional tasks; know the basic physical laws and the limits of their application; be able to analyze physical phenomena and processes, establish a connection between them and, based on physical laws, predict their further course; know and apply relevant mathematical concepts; independently find solutions to practical problems of physical content; formulate the goal, objectives and method of experimental research; draw up schemes of the experimental setup; analyze the results of the experiment, qualitatively and quantitatively evaluate the results using statistical processing methods; draw logical conclusions when solving the tasks set; generalize observations and facts, and give them scientific justification.

4 STRUCTURE OF THE COURSE CREDITS

Topic Title	Number of hours allocated to:			
	Lectures	Practical classes	Laboratory works	Independent work
Topic 1. Fundamentals of classical mechanics	6	6	16	40
Topic 2. Electrostatics and electric current.	6	6	8	40
Topic 3. Magnetism	4	4	8	34
Total:	**16**	**16**	**32**	**114**

5. COURSE PROGRAMME

5.1 CONTENT OF THE LECTURE COURSE

Lecture Number	*List of lectures topics, their annotations*	*Hours*
	Topic 1. Fundamentals of classical mechanics	**6**
1	**The subject of physics**. Physics as a fundamental discipline. The connection of physics with other sciences and its influence on the development of modern technology. The role of physics in the formation of the specialist. General structure and objectives of the physics course. The subject of mechanics. Kinematics, dynamics and statics. **Elements of kinematics.** Models in mechanics. Material point. System of material points, absolutely solid body Reference system. Trajectory, path, movement. Kinematics of rectilinear motion. Speed, acceleration. Curved trajectory motion. Normal and tangential acceleration. The movement of a point along a circle. Angular velocity and angular acceleration. Lit.: [1], p. 53-81, p. 93-99, p. 197-206, p. 212-215.	2
2	**Dynamics of translational motion**. Newton's first law. Inertial reference systems. Mass. Newton's second law. The momentum of the body. Force as a derivative of momentum over time. Newton's third law. The law of conservation of momentum. **Dynamics of rotational motion**. Torque. Moment of inertia. Fundamental equation of rotational dynamics. Kinetic energy of a rotating body. Angular momentum. Law of conservation of angular momentum. Lit.: [1], p. 115-134, p. 216-217.	2
3	**Work. Energy. Power.** Kinetic and potential energy. The law of conservation of mechanical energy. Collisions of absolutely elastic and inelastic bodies **Forces in nature.** Forces of elasticity, the force of friction, the force of gravity, weight. The law of universal gravitation. Gravitational field Lit.: [1], p. 229-240, p. 279-286.	2
	Topic 2. Electrostatics and electric current.	**6**
4	**Coulomb's law. Electric field.** The law of conservation of electric charge. Electrostatic field. Graphic representation of the electric field. The electric field of a point charge. Lit.: [1], p. 549-571.	2
5	**Potential of the electrostatic field.** Work in the electrostatic field. Equipotential surfaces. Potential difference. **Electrical capacitance.** Capacitors. Electrostatic field energy Lit.: [1], p. 572-590.	2
6	**Electric current.** Electric current, its characteristics, current density. **Electromotive force.** External forces. EMF. Ohm's and Joule-Lenz's laws in integral and differential forms. Kirchhoff's rules and their use. Lit.: [1], p. 603-636.	2
	Topic 3. Magnetism	**4**
7	**Magnetic field.** Magnetic field strength. Magnetic permeability. **The law of Biot and Savart** and its application for calculating the magnetic field. Magnetic field	2

	of a linear conductor with current. Circular current magnetic field. **Ampere's Law. Lawrence's force on a moving charged particle.** The motion of charged particles in magnetic and electric fields. The principle of operation of charged particle accelerators. Lit.: [1], p. 649-664.	
8	**Magnetic flux.** Gauss' theorem for magnetic field induction. Work on moving the conductor and frame with current in a magnetic field. **The phenomenon of electromagnetic induction.** Faraday's law and its derivation from the law of energy conservation. Rotation of the frame in a magnetic field. Foucault currents. Lit.: [1], p. 665-680.	2
	Total:	**16**

5.1 CONTENT OF THE PRACTICAL CLASSES

Week №	***List of Practical classes, their annotations***	***Hours***
	Topic 1. Fundamentals of classical mechanics	**6**
1	Input test control. The kinematics' problems of translational and rotational movement	2
2	The dynamics' problems of translational and rotational movement. Newton's laws. The law of conservation of momentum. Moment of inertia. Fundamental equation of rotational dynamics.	2
3	Kinetic and potential energy. The law of conservation of mechanical energy. Forces of elasticity, the force of friction, the force of gravity, weight. The law of universal gravitation.	2
	Topic 2. Electrostatics and electric current	**6**
4	Problems of electrostatics. Coulomb's law. Electrostatic field. The electric field of a point charge. Calculation of the electric field of charged bodies.	2
5	Work on moving a charge in an electrostatic field. Potential energy of a charge in a field. Potential. The relationship between potential and field strength. Capacitance.	2
6	Electromotive force. Electric current. Current density. Current source. Voltage in an electric circuit. Ohm's law. Joule-Lenz law.	2
	Topic 3. Magnetism	**4**
7	The law of Biot-Savart-Laplace and its application to the calculation of the magnetic field. The magnetic field of a straight conductor with a current. The magnetic field of a circular current. Ampere's law. Lorentz force. The motion of charged particles in magnetic and electric fields.	2
8	Magnetic flux. The phenomenon of electromagnetic induction. Faraday's law. Rotation of the frame in a magnetic field. Work on moving the conductor and frame with current in a magnetic field.	2
	Total:	**16**

5.2 CONTENT OF THE LABORATORY WORKES

Week №	***List of Laboratory Works, their annotations***	***Hours***
1	Introductory lesson. Types of measurements. Measurement errors and uncertainties.	4
2	Determination of the density of bodies of regular geometric shape.	4
3	Studying the laws of dynamics on the Atwood's machine.	4
4	Determination of the rotational inertia of a flywheel by the dynamic method.	4
5	Determination of electrical capacity by periodic charging and discharging	4
6	Determination of the dependence of the resistance of a metal conductor on temperature	4
7	Determination of the Earth's magnetic field.	4
8	Determination of the speed of sound in air by the resonance method.	6
	Total:	**34**

5.3. CONTENT OF INDEPENDENT WORK

Independent work of students of all forms of study involves systematic processing of the course material from relevant sources, preparation for laboratory works and testing. Students have access to the course page in the Modular

Learning Environment, which contains the Working Programme of the course and the necessary teaching and learning materials. Access: https://msn.khmnu.edu.ua/course/view.php?id=10107

Week №	***Type of Independent Work***	***Hours***
1	Studying the Topic 1 Lecture № 1 material. Lit.: [1], p. 53-81, p. 93-99, p. 197-206, p. 212-215. Preparation for Laboratory work № 1.	8
2	Preparation for the defense of laboratory work № 1. Preparation for Laboratory work № 2.	6
3	Studying Topic 1 Lecture № 2 material. Lit.: [1], p. 115-134, p. 216-217.	6
4	Preparation for the defense of Laboratory work № 2. Preparation for Laboratory work № 3.	6
5	Studying Topic 1 Lecture № 3 material. Lit.: [1], p. 229-240, p. 279-286. Preparation for Test Control (TC) № 1 Preparation for defense of Individual Homework Assignment (IHA) № 1	8
6	Preparation for the defense of Laboratory work № 3. Preparation for Laboratory work № 4	6
7	Studying Topic 2 Lecture № 4 material. Lit.: [1], p. 549-571.	6
8	Preparation for the defense of laboratory work № 4. Preparation for Laboratory work № 5.	6
9	Studying Topic 2 Lecture № 5 material. Lit.: [1], p. 572-590.	6
10	Preparation for the defense of Laboratory work № 5. Preparation for Laboratory work № 6	6
11	Studying Topic 2 Lecture № 6 material. Lit.: [1], p. 603-636. Preparation for defense of Individual Homework Assignment (IHA) № 2.	8
12	Preparation for the defense of laboratory work № 6. Preparation for Laboratory work № 7.	6
13	Studying Topic 3 Lecture № 7 material. Lit.: [1], p. 649-664.	8
14	Preparation for the defense of laboratory work № 7. Preparation for Laboratory work № 8.	6
15	Studying Topic 3 Lecture № 8 material. Lit.: [1], p. 665-680.	6
16	Preparation for the defense of laboratory work № 8. Preparation for Test Control (TC) № 2.	8
17	Studying and reviewing theoretical material.	8
	Total:	**114**

Notes: TC –Test Control, IHA – Individual Homework Assignment

6. TEACHING METHODS

The learning process for the course is based on the use of both traditional and modern teaching technologies and methods, in particular: lectures (using visualisation methods, problem-based and interactive learning, motivational techniques, and information and communication technologies); laboratory works (using training exercises, problem situation analysis, explanation, discussions, etc.); practical classes (using instruction, demonstration, solving typical and applied problems, analysing situational tasks, discussion elements, etc.); independent work (study of theoretical material, preparation for laboratory works, ongoing and final assessment), with the use of information and computer technologies and distance learning technologies (Zoom online conferencing service, Modular learning environment, etc.).

7. METHODS OF ASSESSMENT

Current control is carried out during classroom practical and laboratory classes, as well as using the Modular Learning Environment. The following methods of current control are used:

- evaluation of the results of laboratory work defence;
- test control (TC) of mastering theoretical material on the topic;
- evaluation of individual homework Assignment (IHA).

When deriving the final semester grade, the results of both current control and final control, which is carried out on the entire material of the discipline according to tickets previously developed and approved at a meeting of the department, are taken into account. A student who has scored less than 60 percent of the maximum score in any type of educational work is not allowed to take semester control until he has completed the amount of work provided for by the Work Program. A higher education student who has scored a positive weighted average score (60 percent or more of the maximum score) in all types of

current control and has not passed the exam is considered to have academic debt. The elimination of academic debt from semester control is carried out during the examination session or according to the schedule established by the dean's office in accordance with the "Regulations on the control and assessment of learning outcomes of students at KhNU."

8. COURCE POLICY

The policy of the academic course is generally determined by the system of requirements for the student as stipulated by the current University regulations on the organisation and teaching and learning support of the educational process. In particular, this includes completing the safety briefing; attendance at course classes is compulsory. For valid reasons (documentarily confirmed), theoretical training may, with the lecturer's approval, take place online. Successful completion of the course and the formation of professional competences and programme learning outcomes require preparation for each laboratory work (studying the theoretical material for the topic of the work), active participation during the class, thorough preparation of the report, defence of the results, participation in discussions regarding the constructive decisions made during the laboratory works, etc.

Students must meet the established deadlines for completing all types of academic work in accordance with the Working Programme of the course. A missed laboratory class must be completed within the deadline set by the lecturer, but no later than two weeks before the end of the theoretical classes in the semester. The student's mastery of the theoretical material of the course is assessed through testing. When performing laboratory work, the student must comply with the policy of academic integrity (cheating, plagiarism — including with the use of mobile devices — is prohibited). If a violation of academic integrity is detected in any type of academic work, the student receives an unsatisfactory grade and must re-do the task on the relevant topic (type of work) as stipulated by the Working Programme. Any form of academic dishonesty is unacceptable.

Within the framework of studying the course, students are provided with recognition and crediting of learning outcomes acquired through non-formal education, available on accessible platforms (https://prometheus.org.ua/, https://www.coursera.org/), which contribute to the formation of competences and the deepening of learning outcomes defined in the Working Programme of the course, or ensure the study of a relevant topic and/or type of work from the course syllabus (for more details, see the *Regulation on the Procedure for Recognition and Crediting of Learning Outcomes of Students at Khmelnytskyi National University*).

9. ASSESSMENT OF STUDENTS' LEARNING OUTCOMES DURING THE SEMESTER

Assessment of a student's academic achievements is carried out in accordance with the *Regulation on the Control and Assessment of Students' Learning Outcomes at Khmelnytskyi National University*. During the ongoing assessment of the work performed by the student for each structural unit and the results obtained, the lecturer awards a certain number of points as set out in the Working Programme for that type of work.

Each structural unit of academic work may be credited only if the student has scored at least 60 percent (the minimum level for a positive grade) of the maximum possible points assigned to that structural unit.

When assessing students' learning outcomes for any type of academic work (structural unit), it is recommended to use the generalised criteria provided below:

Table – Assessment Criteria for Student Learning Outcomes

Grade and Level of Achievement of Intended Learning Outcomes and Competences	***General Description of Assessment Criteria***
Excellent (High)	The student has deeply and fully mastered the course content, confidently navigates it, and skilfully uses the conceptual framework; demonstrates the ability to connect theory with practice, solve practical problems, and clearly express and justify their reasoning. An excellent grade implies a logical presentation of the answer in the language of instruction (oral or written), high-quality formatting of the work, and proficiency in using specialised tools, instruments, or application software. The student demonstrates confidence when answering reformulated questions, is capable of making detailed and summarised conclusions, and shows practical skills in solving professional tasks. The answer may contain two or three minor inaccuracies.
Good (Average)	The student has shown full understanding of the course content, possesses the conceptual framework, and navigates the material well; applies theoretical knowledge consciously to solve practical tasks. The answer is generally well-articulated, although some minor inaccuracies or vague formulations of rules or principles may occur. The student's answer is based on independent thinking. Two or three minor mistakes are acceptable.
Satisfactory (Sufficient)	The student demonstrates knowledge of the basic course material sufficient for continued learning and practical activity in the profession; is able to complete the practical tasks foreseen by the programme. The answer is usually based on reproductive thinking. The student has limited knowledge of the structure of the discipline, makes inaccuracies and significant errors in the answer, and hesitates when answering reformulated questions. Nevertheless, they possess basic skills to complete simple practical tasks that meet the minimum assessment criteria and, under the lecturer's guidance, can correct their mistakes.

Unsatisfactory (Insufficient)	The student demonstrates fragmented, unstructured knowledge, cannot distinguish between main and secondary ideas, makes conceptual errors, misinterprets definitions, presents material in a chaotic and unconfident manner, and cannot apply knowledge to solve practical problems. An unsatisfactory grade is typically given to a student who is unable to continue learning the subject without additional study.

Course Structuring by Types of Academic Work and Assessment of Student Learning Outcomes

In-Class Work								***Assessment Activities***		***Individual Homework Assignment***		**Semester Final Assessment**	
Laboratory Work №:								Test Control:		IHA		Exam	Total
1	2	3	4	5	6	7	8	TC 1	TC 2	IHA 1	IHA 2		
Number of points per type of academic work (min–max)													
3-5	3-5	3-5	3-5	3-5	3-5	3-5	3-5	3-5	3-5	3-5	3-5	24-40	**60-100***
24-40								**6-10**		**6-10**		**24-40**	

Notes: If the number of points earned for any type of academic work in the course is below the established minimum, the student receives a failing grade and must retake the work within the deadline set by the lecturer (or dean). The institutional grade is determined in accordance with the table "Correspondence between the Institutional Grading Scale and the ECTS Grading Scale".

Assessment of Laboratory Work Defence Results

A laboratory work completed and formatted in accordance with the requirements established in the Methodological Guidelines is comprehensively assessed by the lecturer during its defence based on the following criteria: – independence and accuracy of execution; – completeness of the answer and understanding of the principles of building machine learning models; – ability to justify the choice of algorithm or method; – correctness of model implementation in the Python programming environment using appropriate libraries; – ability to interpret the results of modelling and evaluate their suitability for solving the given task.

When assessing a laboratory session, the lecturer uses the generalised criteria outlined in the table “Assessment Criteria for Student Learning Outcomes” (minimum passing score – 3 points, maximum – 5 points).

If the student demonstrates a knowledge level below 60 percent of the maximum score established in the Working Programme for each structural unit, the laboratory work is not credited. In such a case, the student must study the topic more thoroughly, review the methodology, correct major mistakes, and re-defend the work at the time set by the lecturer.

Assessment of Test-Based Control Results

Each test included in the Working Programme consists of 25 test items, each carrying equal weight. According to the table for structuring types of academic work, the student may receive between 3 and 5 points depending on the number of correct answers.

Distribution of points depending on the number of correct answers to test items: The test duration is 30 minutes. Students complete the test online in the Modular Learning Environment. If a failing grade is received, the test must be retaken before the next scheduled assessment

Distribution of points depending on correct answers to test questions

Number of Correct Answers	1-14	15-18	19-21	22-25
Percentage of Correct Answers	0-59	60-73	74-87	88-100
Number of Points	0	3	4	5

Assessment of Individual Homework Results

Completed and designed in accordance with the requirements specified in the Methodological Recommendations, an Individual Homework Assignment (IHA) is comprehensively evaluated by the teacher, taking into account the following criteria: independence of execution; correctness of solving the tasks; reasonableness of the choice of solution methods; completeness of explanations and justification of answers; quality of design and compliance with the requirements for the structure and content of the work.

The result of the student's performance in each IHA is evaluated in accordance with the table of ***“Assessment Criteria for Student Learning Outcomes “***, taking into account the level of achievement of the planned program learning outcomes and acquired competencies.

Based on the results of the defense, the appropriate amount of points is assigned (minimum positive score - 3 points, maximum - 5 points). If the higher education applicant has revealed a level of knowledge and performance of the IHA that is lower than 60 percent of the maximum number of points established by the Work Program for this structural unit, the task is not counted. In this case, the student must rework the content of the assignment, eliminate errors, and submit the revised IHA for review within the time frame agreed upon with the teacher.

Assessment of the Final Semester Control (Exam)

The educational programme provides for a final semester control in the form of an examination, the purpose of which is to systematically and objectively assess both the theoretical and practical preparation of the student in the course. The examination is conducted according to examination papers prepared in advance and approved at the meeting of the department.

In accordance with this, the examination paper contains a combination of both theoretical questions (including in test form) and practical tasks.

Table: Assessment of Final Semester Examination Results for full-time students (40 points allocated for final control)

Type of Task	*For each individual type of task*		
	Minimum (Satisfactory) Score	*Potential Positive Score (Good)**	*Maximum (Excellent) Score*
Theoretical Question № 1	6	8	10
Theoretical Question № 2	6	8	10
Practical Tasks № 1	6	8	10
Practical Tasks № 2	6	8	10
Total:	**24**		**40**

Note: A passing score for the exam, different from the minimum (24 points) and the maximum (40 points), falls within the range of 25–39 points and is calculated as the sum of points for all structural elements (tasks) of the exam.

For each individual type of task in the final semester assessment, the assessment criteria for student learning outcomes provided above (see **Table – Assessment Criteria for Student Learning Outcomes**) are applied. The final semester grade according to the institutional grading scale and the ECTS grading scale is determined automatically after the lecturer enters the assessment results in points for all types of academic work into the electronic gradebook. The correspondence between the institutional grading scale and the ECTS grading scale is shown below in the **Correspondence Table**.

The final examination grade is recorded if the total number of points accumulated by the student in the course as a result of ongoing assessment falls within the range of 60 to 100 points. In this case, a grade of *Excellent/Good/Satisfactory* is assigned according to the institutional scale, and a letter grade is assigned according to the ECTS scale, corresponding to the total number of points earned by the student as specified in the **Correspondence Table**.

Table: Correspondence between the Institutional Grading Scale and the ECTS Grading Scale

<table>
<tr><th rowspan="2">ECTS Grade</th><th rowspan="2">Rating Scale (Points)</th><th colspan="2">Institutional Grade(Level of Achievement of the Intended Learning Outcomes in the Course)</th></tr>
<tr><th>Pass/ Fail</th><th>Exam / Graded Credit</th></tr>
<tr><td>A</td><td>90-100</td><td rowspan="5">Pass</td><td>Excellent – a high level of achievement of the intended learning outcomes in the course, indicating the learner’s full readiness for further study and/or professional activity in the field.</td></tr>
<tr><td>B</td><td>83-89</td><td rowspan="2">Good – an average level of achievement of the intended learning outcomes in the course and readiness for further study and/or professional activity in the specialty.</td></tr>
<tr><td>C</td><td>73-82</td></tr>
<tr><td>D</td><td>66-72</td><td rowspan="2">Satisfactory – the student has demonstrated a minimally sufficient level of achievement of the learning outcomes required for further study and/or professional activity in the specialty.</td></tr>
<tr><td>E</td><td>60-65</td></tr>
<tr><td>FX</td><td>40-59</td><td rowspan="2">Fail</td><td>Fail – several intended learning outcomes in the course have not been achieved. The level of acquired learning outcomes is insufficient for further study and/or professional activity in the specialty.</td></tr>
<tr><td>F</td><td>0-39</td><td>Fail – no learning outcomes have been achieved.</td></tr>
</table>

10. SELF-ASSESSMENT QUESTIONS ON LEARNING OUTCOMES

1. The subject of mechanics. Classical mechanics. Kinematics and dynamics. Physical models: material point, system of material points, absolutely solid body.
2. Kinematic description of movement. Linear motion of a point. Speed and acceleration.
3. Speed and acceleration in curvilinear motion.
4. The movement of a point in a circle. Angular velocity and angular acceleration.
5. The main task of dynamics. Equation of motion.
6. Newton's laws. Inertial reference systems. Inertia, force, mass, momentum.
7. The law of momentum conservation in a mechanical system.
8. The law of conservation of momentum. Jet propulsion.
9. Energy and power. Variable force operation.
10. Kinetic energy Potential energy Conservative forces and their work.
11. The law of energy conservation.
12. The moment of inertia of a material point and a rigid body. The moment of inertia of the rod and other bodies. Steiner's theorem. Torque of the force.
13. The basic law of dynamics of rotational motion for a material point and a rigid body.
14. The rotational momentum of a material point and a rigid body. The law of conservation of rotational momentum.
15. Kinetic energy of rotational motion.
16. Coulomb's law. Electric field. Electric field flux. Gauss’ theorem.

17. The work of the electrostatic field. Electric field circulation. Potential. Relationship between potential and electrostatic field.
18. Electrical capacitance of conductors. Capacitors.
19. Energy of a charged conductor and capacitor. The energy density of the electrostatic field.
20. Conditions for the existence of current. Current strength, potential difference, electromotive force and voltage (voltage drop).
21. Generalized Ohm's law in integral form. Differential form of Ohm's law.
22. Joule-Lenz law. Differential form of the Joule-Lenz law.
23. Kirchhoff rules.
24. Magnetic field and its properties. Biot-Savart-Laplas' law for the current element. Ampere's law.
25. Magnetic field of linear and circular conductors with current.
26. Magnetic flux. The work of moving frame with current in a magnetic field.
27. Lorentz force.
28. Gauss's theorem for a magnetic field in vacuum. Field of the solenoid.
29. The phenomenon of electromagnetic induction (experiments of Faraday). Law of Faraday and Lenz.
30. Movement of charged particles in an electric and magnetic field.

11. EDUCATIONAL AND METHODOLOGICAL SUPPORT

The educational process for the course *"Physics"* is supported with all necessary instructional and methodological materials, which are available in the Modular Learning Environment MOODLE:
Course *"Physics"*: https://msn.khmnu.edu.ua/course/view.php?id=10107
Methodological Guidelines for Laboratory Works and Practical Lessons:
https://msn.khmnu.edu.ua/course/view.php?id=10107

12. RECOMMENDED LITERATURE

Primary

9. Urone P.P. College Physics/ Paul Peter Urone, Roger Hinrichs. – Houston: OpenStax College, 2020. – 836 p. https://d3bxy9euw4e147.cloudfront.net/oscms-prodcms/media/documents/Physics-WEB_Sab7RrQ.pdf

10. Halliday D. Fundamentals of Physics/ Jearl Walker, David Halliday, Robert Resnic.-12th ed., Volume 1 - Cleveland: John Wiley & Sons, 2022. – 717 p. https://dl.icdst.org/pdfs/files4/39e1817b05cf155433309dbb2f3289fe.pdf

11. Nolan P.J. Fundamentals of College Physics/ Peter J. Nolan. – 5th ed. –Boston: Pearson Custom Publishing. – Vol.1-2014. – 560 p. https://kfe.khmnu.edu.ua/wp-content/uploads/sites/69/2024/11/nolan_modern_physics.pdf

12. Serway R. College Physics/ Raymond A. Serway, Jerry S. Faughn, Chriss Vuille. – 9th ed. - Boston: Cengage Learning.-2014 - 1622 p. https://physics.fe.uni-lj.si/publications/pdf/Serway_Physics_for_Scientists_Engineers_Modern%20Physics_9th%20Ed_Serway_Jewett.pdf

Supplementary

13. Ohanian Hans Physics for engineers and scientists/ Hans C. Ohanian, John T. Markert -– 3th ed. – New York, London: W. W. Norton & Company – Vol.1 2007. – 807 p. https://www.academia.edu/43841221/Physics_for_Engineers_and_Scientists_Vol_I_Ohanian_and_Markert

14. Ohanian Hans Physics for engineers and scientists/ Hans C. Ohanian, John T. Markert -– 3th ed. – New York, London: W. W. Norton & Company – Vol.1 2007. – 712 p. https://www.academia.edu/43841163/Physics_for_Engineers_and_Scientists_Vol_II_Ohanian_and_Markert

15. Білецька Г.А. Інтеграція знань з біології, хімії і фізики у процесі навчання анатомії та фізіології людини /Г.А. Білецька, Ткачук А.В.// Природнича освіта та наука/Рівненський державний гуманітарний університет. – 2025. – №2. – с.7 – 12. https://doi.org/10.32782/NSER/2025-2

16. Tkachuk H.S. Rheological properties of polyvinyl acetals colloidal systems / H. Tkachuk, A. Tkachuk, O. Hertsyk, M. Tashak, O. Marchuk // Problems of Chemistry and Sustainable Development/ Lesya Ukrainka Volyn National University, Lutsk. – 2025. - №3 – p. 10-16. https://doi.org/10.32782/pcsd-2025-3-2

13. INFORMATION RESOURCES

17. Modular Learning Environment. [Electronic resource]. – Access:

https://msn.khmnu.edu.ua/course/view.php?id=10107

18. Course of Lectures by Walter Lewin, MIT Physics (*Massachusetts Institute of Technology). Classical Mechanics, Electricity, Magnetism:* https://www.youtube.com/watch?v=wWnfJ0-xXRE&list=PLyQSN7X0ro203puVhQsmCj9qhlFQ-As8e

19. Electronic Library of the University. [Electronic resource]. – Access: http://library.khmnu.edu.ua/

20. Institutional Repository of Khmelnytskyi National University. [Electronic resource]. – Access: https://elar.khmnu.edu.ua/home