SARSEN AMANZHOLOV EAST KAZAKHSTAN UNIVERSITY

APPROVED
Chairman of the Council of the Higher School of IT and Natural Sciences

_____ Adikanova C.

Protocol
№ from «__» _____ 202 year

DISCIPLINE PROGRAM (SYLLABUS)

INNOVATIVE LABORATORY PHYSICS WORKSHOP

Name of the academic discipline

6B01509 – Physics-Computer Science
6B01502 – Physics
(code and name of the EP)

Form of study / full-time distance (fd/f) on the base of Higher education
(full-time)

Number of credits 5
Cycle OMED/BS
Component SC

Ust-Kamenogorsk, 2023 year

The compiler: _____ Maulet Meruyert, lecturer of the Department of Physics and Technology Master

Discipline program (Syllabus)
Discipline program developed on the basis of standard curricula of the cycle of general education disciplines for organizations of higher and (or) postgraduate education (Order ME RK from 31.10.2018 year. № 603) (*for general education discipline*);

Discipline program (Syllabus) developed on the basis of the curriculum approved at the meeting of the Academic Council of the University
Protocol №___ «___» _____202 year. (*for basic and profile disciplines*)

Recommended at the meeting of the Department of Physics and Technology
Protocol № «___» 202 year.

Head of the Department of Physics and Technology _____ Sakenova R.E.

1. Information about the discipline

Name and Discipline code of the discipline	**IT ILPF -3202 «Innovative Laboratory Physics Workshop»**
code and name of the EP	**6B01509 – Physics-Computer Science** **6B01502 – Physics**
Number of credits	**5**
Course	**4**
Term	**7**
Department	Department of Physics and Technology
Higher School	Higher School of IT and Natural Sciences
Labor intensity of the discipline (in hours)	
Lectures	**20**
Practical (seminar) classes	**30**
laboratory studies	**0**
IWST	**25**
IWS	**75**
Time and place of the discipline according to the schedule	
Consultation time - according to the schedule	
Rating schedule: 7 and 15 weeks	
Full name of the teacher, academic degree, academic title, activity / Maulet Meruyert, lecturer of the Department of Physics and Technology Master	Contact details (telephone, e-mail) +7-705-214-15-88 maulet_meruert@mail.ru

2. Brief description of the discipline:

Innovative Laboratory Physics Workshop" is a discipline that focuses on providing students with hands-on experience in conducting innovative and advanced experiments in the field of physics. This course is designed to go beyond traditional physics laboratory work and encourages students to explore cutting-edge techniques, technologies, and concepts in physics experimentation.

Purpose:

The purpose of the "Innovative Laboratory Physics Workshop" is to provide students with a comprehensive and immersive learning experience that goes beyond traditional physics coursework. It equips them with the skills, knowledge, and mindset necessary to excel in contemporary physics research and prepares them for successful careers in various scientific and technological fields.

Tasks:

- Do the self-diagnosis test.

- Read the instruction.

- Examine carefully the unit objectives. Find out what you are expected to do upon completion of the unit.

- Read through the, from time to time to see how well you are mastering the objectives. Review what you do not understand. Try the written exercises and activities.

- Read some of the suggested reading.

- Do the written assignment. Assignments should be submitted to the Head,

- To earn credit in a course, you must complete all required assignments, two continuous assessment tests and pass an end of semester examination to demonstrate your mastery of the course content.

Competencies

As a result of mastering the discipline, students develop the following competencies:

- the ability to use natural science and mathematical knowledge for orientation in the modern information space;
- ability to self-organize and self-education;
- willingness to implement the educational process in physics in accordance with the requirements of educational standards;
- willingness to use systematized theoretical and practical knowledge to formulate and solve research problems in the field of education;
- the ability to use the opportunities of the educational environment to achieve personal, meta-subject and subject learning outcomes and to ensure the quality of teaching physics;
- willingness to interact with participants in the educational process;

Result of training

By the end of the course, the leaner should be able to:

- select and use appropriate instruments to carry out measurements in the physical environment;
- use the knowledge acquired to discover and explain the order of the physical environment
- use the acquired knowledge in the conservation and management of the environment
- apply the principles of Physics and acquired skills to construct appropriate scientific devices from the available resources
- develop capacity for critical thinking in solving problems in any situation
- contribute to the technological and industrial development of the nation
- appreciate and explain the role of Physics in promoting health in society
- observe general safety precautions in all aspects of life
- acquire and demonstrate a sense of honesty and high integrity in all aspects of Physics and life in general
- acquire positive attitude towards Physics

Acquire adequate knowledge in Physics for further education and/or training.

Prerequisites

№	Name of the discipline, sections (topics)
1	School physics course
2	Mathematics
3	General and Theoretical Physics course
4	Computer science
5	Psychology
6	Pedagogy
7	English language

List of post-requisites

№	Name of the discipline, sections (topics)
1	Workshop on solving physical problems
2	Pre-graduate practice

5. Calendar and thematic plan

№	Name of the discipline topics	weeks	Number of classroom hours by type of classes		Number of extracurricular hours by type of occupation		Total (hours)
			Lecture (hours)	Pract/sem/ lab/stud (hours)	IWST (hours)	IWS (hours)	
1	Introduction to an innovative laboratory workshop in physics	**1**	**1**	**2/0/0**	**2**	**5**	**10**
2	Fundamentals of experimental physics	**2**	**1**	**2/0/0**	**2**	**5**	**10**
3	Electronics and Measurements	**3**	**1**	**2/0/0**	**2**	**5**	**10**
4	Mechanics and movement	**4**	**1**	**2/0/0**	**1**	**5**	**9**
5	Optics and waves	**5**	**1**	**2/0/0**	**1**	**5**	**9**
6	Thermodynamics and thermal measurements	**6**	**2**	**2/0/0**	**2**	**5**	**11**
7	Electromagnetism and electrodynamics	**7**	**1**	**2/0/0**	**1**	**5**	**9**
8	Quantum Mechanics and atomic physics	**8**	**2**	**2/0/0**	**2**	**5**	**11**
9	Nuclear physics and measurement of radioactivity	**9**	**1**	**2/0/0**	**1**	**5**	**9**
10	Solid State Physics and Nanotechnology	**10**	**2**	**2/0/0**	**2**	**5**	**11**
11	Physics of liquids and gases	**11**	**2**	**2/0/0**	**2**	**5**	**11**
12	Astrophysics and space measurements	**12**	**1**	**2/0/0**	**2**	**5**	**10**
13	Experiments in particles and high energy physics	**13**	**2**	**2/0/0**	**2**	**5**	**11**

14	Physics in Medicine and Biology	**14**	**1**	**2/0/0**	**1**	**5**	**9**
15	Innovations and prospects in laboratory physics	**15**	**1**	**2/0/0**	**2**	**5**	**10**
	Total		**20**	**30/0/0**	**25**	**75**	**150**

6. Content of lectures

Lecture 1: Introduction to an innovative laboratory workshop in Physics

• Goals and objectives of the workshop
• Tools and equipment
• Rules of work in the laboratory.
Literature: [1,2,5].

Lecture 2: Fundamentals of Experimental Physics

• The concept of experiment in physics
• Basic methods and instruments for measurements
• Data processing and statistics.
Literature: [1,2,5].

Lecture 3: Electronics and Measurements

• Basics of working with electronic components
• Oscilloscopes, multimeters and other measuring instruments
• Design and assembly of circuits.
Literature: [1,2,5].

Lecture 4: Mechanics and Motion

• Newton's Laws
• Forces and their measurement
• Movement in different environments
Literature: [5].

Lecture 5: Optics and waves

• Optical phenomena
• Waves and their characteristics
• Optical instruments and measurement methods.
Literature: [1,2,5].

Lecture 6: Thermodynamics and thermal measurements

• Laws of thermodynamics
• Measurement of temperature and thermal characteristics
• Thermal processes.
Literature: [1,2,5].

Lecture 7: Electromagnetism and Electrodynamics

• Laws of Electromagnetism
• Measurement of electric and magnetic fields

• Electromagnetic waves and their measurement.
Literature: [7,4,5].

Lecture 8: Quantum Mechanics and Atomic Physics
• Fundamentals of Quantum Mechanics
• Spectroscopy and measurement of atomic energy levels
• Quantum phenomena.
Literature: [1,2,5,6].

Lecture 9: Nuclear physics and measurement of radioactivity
• Structure of atomic nuclei
• Radioactivity and its measurement
• Research of elementary particles.
Literature: [1,2,5,6].

Lecture 10: Solid State Physics and Nanotechnology
• Fundamentals of Solid State Physics
• Nanomaterials and their properties
• Research of nanostructures.
Literature: [1,2,5,6].

Lecture 11: Physics of liquids and Gases
• Features of liquids and gases
• Measurement of pressure, density and viscosity
• Gas laws.
Literature: [1,2,5,3].

Lecture 12: Astrophysics and space measurements
• Modern astrophysics
• Measurement methods in space research
• Astronomical instruments.
Literature: [1,2,5,3].

Lecture 13: Experiments in particles and high energy physics
• Accelerators and detectors
• Fundamental particle interactions
• Search for new particles and phenomena.
Literature: [1,2,5].

Lecture 14: Physics in Medicine and Biology
• Application of physics in medical research
• Medical devices and measurement methods
• Biophysics and Biomedical physics.
Literature: [5]

Lecture 15: Innovations and prospects in laboratory physics
• Current trends in experimental physics
• Innovative methods and technologies
• Prospects for the development of laboratory research.
Literature: [5]

7. The content of practical (seminar) classes

Lecture 1: Introduction to an innovative laboratory workshop in Physics
• Goals and objectives of the workshop
• Tools and equipment
• Rules of work in the laboratory.
Literature: [1,2,5].

Lecture 2: Fundamentals of Experimental Physics
• The concept of experiment in physics
• Basic methods and instruments for measurements
• Data processing and statistics.
Literature: [1,2,5].

Lecture 3: Electronics and Measurements
• Basics of working with electronic components
• Oscilloscopes, multimeters and other measuring instruments
• Design and assembly of circuits.
Literature: [1,2,5].

Lecture 4: Mechanics and Motion
• Newton's Laws
• Forces and their measurement
• Movement in different environments
Literature: [5].

Lecture 5: Optics and waves
• Optical phenomena
• Waves and their characteristics
• Optical instruments and measurement methods.
Literature: [1,2,5].

Lecture 6: Thermodynamics and thermal measurements
• Laws of thermodynamics
• Measurement of temperature and thermal characteristics
• Thermal processes.
Literature: [1,2,5].

Lecture 7: Electromagnetism and Electrodynamics

• Laws of Electromagnetism
• Measurement of electric and magnetic fields
• Electromagnetic waves and their measurement.
Literature: [7,4,5].

Lecture 8: Quantum Mechanics and Atomic Physics
• Fundamentals of Quantum Mechanics
• Spectroscopy and measurement of atomic energy levels
• Quantum phenomena.
Literature: [1,2,5,6].

Lecture 9: Nuclear physics and measurement of radioactivity
• Structure of atomic nuclei
• Radioactivity and its measurement
• Research of elementary particles.
Literature: [1,2,5,6].

Lecture 10: Solid State Physics and Nanotechnology
• Fundamentals of Solid State Physics
• Nanomaterials and their properties
• Research of nanostructures.
Literature: [1,2,5,6].

Lecture 11: Physics of liquids and Gases
• Features of liquids and gases
• Measurement of pressure, density and viscosity
• Gas laws.
Literature: [1,2,5,3].

Lecture 12: Astrophysics and space measurements
• Modern astrophysics
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• Accelerators and detectors
• Fundamental particle interactions
• Search for new particles and phenomena.
Literature: [1,2,5].

Lecture 14: Physics in Medicine and Biology
• Application of physics in medical research
• Medical devices and measurement methods
• Biophysics and Biomedical physics.

Literature: [5]

Lecture 15: Innovations and prospects in laboratory physics

• Current trends in experimental physics
• Innovative methods and technologies
• Prospects for the development of laboratory research.

Literature: [5]

8. Content of laboratory classes

Laboratory work is not provided for in the curriculum

9. IWST and IWS tasks

№	Name of topics	Content of tasks for IWST and IWS	Form of control	Deadline for delivery
Topic 1	Introduction to an innovative laboratory workshop in physics	Students' work with literature	Protection of the abstract	1
Topic 2	Fundamentals of experimental physics	Students' work with textbooks, notes	oral explanation of the material	3
Topic 3	Electronics and Measurements	Students' work with physical devices	demonstration of a physical experiment with an explanation	4
Topic 4	Mechanics and movement	Student work with problem books, notes	Protection of the selection of tasks and methods of their solution	5-6
Topic 5	Optics and waves	Students' work with textbooks, notes	Explanation of the material with the use of the outline	7-8
Topic 6	Thermodynamics and thermal measurements	Students' work with textbooks, notes	Explanation of new material with the creation of a problem situation	9
Topic 7	Electromagnetism and electrodynamics	Students work on computers	Explanation of the new material with the use of slides	10-11
Topic 8	Quantum Mechanics and atomic physics	Students' work with textbooks, notes	Protect task selection	12-13
Topic 9	Nuclear physics and measurement of radioactivity	Students' work with textbooks, notes	Conducting an extracurricular activity in physics	14
Topic 10	Solid State Physics and	Students' work with textbooks, notes	Written outline	15

	Nanotechnology			

Consultation on all issues - on schedule.

10. Evaluation policy and criteria *(choose in the language of instruction)*

One of the elements of the organization of the educational process in the conditions of credit technology of training is the use of a point-rating system for assessing the educational achievements of students. The grading policy is based on the principles of objectivity, transparency, flexibility and high differentiation.

The study of the discipline ends with an exam in various forms (written or oral exam, testing), which covers all the material passed. A prerequisite for admission to the exam is the completion of all the tasks provided in the program.

Each task is rated 0-100 points.

№	**Type of work**	Score (max point) for one task	Number of tasks	The amount
Rating 1				
1	individual tasks	100	1	100
2	performing and protecting laboratory work	100	5	500
…	test papers and colloquiums	100	2	200
			Total	800/8 = 100
Rating 2				
1	individual tasks	100	1	100
2	performing and protecting laboratory work	100	5	500
…	test papers and colloquiums	100	2	200
			Total	800/8 = 100

The assessment of the admission rating, which is calculated as the arithmetic mean of the sum of all the assessments of the current and boundary controls received during the academic period:

$$AR = (CC_1 + CC_2 + CC_3 + \ldots + CC_n + BC_1 + BC_2) / (n+2),$$

where, AR – admission rating; CC – current control; BC – border control; n – number of current controls; 2 – number of boundary controls.

Students who have fulfilled all the requirements of the discipline program (execution and delivery of all practical (seminar, laboratory) works and tasks on IWST, IWS), who have scored an admission rating (at least 50 points) are allowed to the final control (FC) in the discipline. Students who do not have a positive assessment of the admission rating in the discipline (at least 50%) are not allowed to take the exam.

The final grade for the discipline is calculated automatically according to the formula:

$$T = (R_1+R_2)/2*0,6+ \text{ex. assessment } *0,4,$$

where, R_1 – evaluation of the first boundary control; R_2 – evaluation of the second boundary control.

The final grade in the discipline is calculated only if the student has positive grades, both according to the admission rating and according to the final control. If you do not show up for the final control for a valid or disrespectful reason, "0" (zero) is set in the "Exam score" column. The results of the intermediate certification in the discipline are brought to the students on the same day.

A letter-based system for evaluating students' academic achievements, corresponding to the digital equivalent of a four-point system

Rating by letter system	Digital equivalent of points	% content	Assessment according to the traditional system
A	4,0	95-100	Great
A-	3,67	90-94	
B+	3,33	85-89	Well
B	3,0	80-84	
B-	2,67	75-79	
C+	2,33	70-74	
C	2,0	65-69	Satisfactory
C-	1,67	60-64	
D+	1,33	55-59	
D	1,0	50-54	
FX	0,5	25-49	Unsatisfactory
F	0	0-49	

11. Teacher requirements *(choose in the language of instruction)*

The policy of evaluating students' academic achievements is based on the principles of academic honesty, unity of requirements, objectivity and fairness, openness and transparency.

At the first training session, the teacher introduces students to the content of the syllabus of the discipline, the planned results of training in the academic discipline and the procedures for their assessment.

In case of academic dishonesty on the part of university students:

- *during classroom and extracurricular activities*: after the first violation committed, the established commission conducts a conversation with the student; the act records the warning issued and the measure taken (reduction of the assessment for the work being evaluated; cancellation of the student's written work, recommendation to re-conduct the control event, etc.). In case of repeated admission of the facts of academic dishonesty during the academic year, a commission is created again, an act is drawn up and submitted to the Disciplinary and Anti-Corruption Council (hereinafter referred to as ACC) for further decisions;

- *during the intermediate or final certification:* a student who has shown academic dishonesty is removed from the classroom without the right to retake the exam during the same academic period. At the same time, an entry "Removed from the exam for academic dishonesty" is entered in the examination sheet with an

indication of its type. Repeated passing of the exam is carried out in the Summer semester or in the next academic semester on a paid basis. At the same time, the student re-enrolls in this academic discipline, attends all types of training sessions, performs all types of academic work according to the working curriculum and passes the exam. In case of repeated removal from the exam (during the entire period of study at the university), the student is expelled without the right to further reinstatement to the university.

Attendance by students of all classroom classes without delay is mandatory. In case of missing classes, they are worked out in accordance with the procedure established by the dean's office.

The presence of outsiders at lectures who are not a contingent of the student of this course is prohibited.

The work should be handed in by the specified deadline. The deadline for all assignments is 5 days before the exam session.

Repetition of the topic and rehearsal of passed material on each training session is mandatory. The degree of mastery of the study materials is checked by tests or written work. A student may be tested without warning.

When performing independent work of a student under the guidance of a teacher (IWST), consider the following main functions:

- The first - involves the implementation of the active perception of the students of the teacher's information received during the introductory classes in the academic discipline;

- the second function assumes that students independently, based on the recommendations of the teacher, study educational and methodological manuals, literary sources, do homework, tests and coursework, etc. At this stage, the student is required to know the methods of work, fix their difficulties, self-organization and self-discipline;

- the third function is to analyze and systematize their difficult situations, identify the causes of difficulties in understanding and mastering the learning material, performing other learning activities. Students translate insoluble difficulties into a system of questions for the teacher (rank them, arrange them, design them), and build their own versions of answers to these questions;

- The fourth function is to ask the teacher for appropriate explanations, advice, and counseling.

11. Exam questions

1. Introduction to an innovative laboratory workshop in Physics
2. Goals and objectives of the workshop
3. Tools and equipment
4. Rules of work in the laboratory
5. Fundamentals of Experimental Physics
6. The concept of experiment in physics
7. Basic methods and instruments for measurements
8. Data processing and statistics
9. Electronics and Measurements

10. Basics of working with electronic components
11. Oscilloscopes, multimeters and other measuring instruments
12. Design and assembly of circuits
13. Mechanics and Motion
14. Newton's Laws
15. Forces and their measurement
16. Movement in different environments
17. Optics and waves
18. Optical phenomena
19. Waves and their characteristics
20. Optical instruments and measurement methods
21. Thermodynamics and thermal measurements
22. Laws of thermodynamics
23. Measurement of temperature and thermal characteristics
24. Thermal processes
25. Electromagnetism and Electrodynamics
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27. Measurement of electric and magnetic fields
28. Electromagnetic waves and their measurement
29. Quantum Mechanics and Atomic Physics
30. Fundamentals of Quantum Mechanics
31. Spectroscopy and measurement of atomic energy levels
32. Quantum phenomena
33. Nuclear physics and measurement of radioactivity
34. Structure of atomic nuclei
35. Radioactivity and its measurement
36. Research of elementary particles
37. Solid State Physics and Nanotechnology
38. Fundamentals of Solid State Physics
39. Nanomaterials and their properties
40. Research of nanostructures
41. Physics of liquids and Gases
42. Features of liquids and gases
43. Measurement of pressure, density and viscosity
44. Gas laws
45. Astrophysics and space measurements
46. Modern astrophysics
47. Measurement methods in space research
48. Astronomical instruments
49. Experiments in particles and high energy physics
50. Accelerators and detectors
51. Fundamental particle interactions
52. Search for new particles and phenomena
53. Physics in Medicine and Biology
54. Application of physics in medical research

55. Medical devices and measurement methods
56. Biophysics and Biomedical physics
57. Innovations and prospects in laboratory physics
58. Current trends in experimental physics
59. Innovative methods and technologies
60. Prospects for the development of laboratory research

12. References

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7. Sakshi Education – Physical Science. — 2014. — 352p.

Интернет источники

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2. http://www.csun.edu/science/ref/language/teaching-ell.html

Additions and changes to the discipline program (Syllabus) for the discipline_
Innovative laboratory physics workshop
in English 20 ____ /____ academic year

The following changes are made to the discipline program:

1. _____
2. _____
3. _____
4. _____
5. _____

The discipline program (**Syllabus**) has been revised, the changes made were approved at a meeting of the Department of Physics and Technology

Protocol № _____ «_____»_____20 year.

Teacher _____ Maulet Meruyert.

Head of the Department of Physics and Technology _____ Sakenova R.E.

The changes made have been agreed:

Chairman CHS IT NS_____ Adikanova S.
signature

Protocol № _____ «_____»_____20 year