MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE

Odessa National Academy of Food Technologies

CURRICULUM WORKING PROGRAM

Physics

Compulsory course

The language of instruction is English

Educational and professional program - Oil and Gas Engineering and Technology

Code and name of specialty - 185 Oil and gas engineering and technology
Code and name of the field of knowledge ¬– 18 Production and technology
Bachelor's degree

Considered and approved by
Methodical Council of the Academy

2020

DEVELOPED AND PROVIDED BY: Department of Physical and Mathematical Sciences of the Odessa National Academy of Food Technologies

DEVELOPER: Sergiy Fedosov, Professor of the Department of Physical and Mathematical Sciences, Professor, Doctor of Physical and Mathematical Sciences

(вказати авторів, їхні посади, наукові ступені та вчені звання)

Considered and approved at the meeting of the Department of Physical and Mathematical Sciences

Protocol from "__" _____ 2020 № ___

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(signature) (surname and initials)

Considered and approved by the methodical council on the specialty – 185 "Oil and Gas Engineering and Technology"
(code and name of the specialty)

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Protocol from "__" _____ 2020_ № ___

Secretary of the Methodical Council of ONAFT _____ Murakhovsky V.G.
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CONTENT

1. Explanatory note

1.1. The purpose and objectives of the discipline

The purpose of teaching the discipline "Physics" is

- to promote the intellectual development of students;
- to create a basis for training in physics, which will allow them to navigate in the flow of scientific and technical information;
- formation of students' skills of abstract thinking, the ability to generalize, analyze, find patterns, think logically, plan ahead;
- preparation of applicants for higher education for the conscious study of disciplines related to physics;
- developing students' ability to study individually.

The main tasks of studying the discipline "Physics" are:

- formation of students' basic physical knowledge for solving problems in professional activities, skills of analytical thinking and formulation of problems in the field;
- acquaintance of students with bases of experiment, acquisition of skills of work with devices, estimation of results of measurements and an estimation of their errors;
- development of logical thinking and raising the general level of knowledge in physics;
- acquisition by students of the ability to independently study the material and use the literature on physics.

As a result of studying a physics course, students must

know:

• physical meaning and units of measurement of basic physical quantities, mechanisms of basic physical phenomena, processes and their theoretical interpretation;

• possible ways of applying basic physical phenomena and research methods in the study of special disciplines and in practice;

• the principle of operation of the most important devices used in the experimental study of various physical phenomena;

be able:

• apply knowledge in the field of physics for independent solution of various physical problems, as well as problems of special and general engineering profiles;

• give a scientific interpretation of various natural phenomena, use in the study of social disciplines various physical concepts, phenomena and laws as an example of the manifestation of general philosophical laws and categories;

• conduct an experiment to study the physical process, present graphically the results and estimate the measurement error.

1.2. Competences that can be obtained by a higher education applicant

As a result of studying the discipline "Physics" the applicant receives the following program competencies and program learning outcomes, which are defined in the Standard of Higher Education in the specialty 185 Oil and Gas Engineering and Technology and educational and professional programs "Oil and Gas Engineering and Technology" bachelors.

General competencies:

ЗК1. Ability to abstract thinking, analysis and synthesis of elements of technical systems for the completion, transportation and storage of oil and gas.

Special (professional, subject) competencies:

ФК3. Ability to apply knowledge of physics and chemistry to analyze the physical and chemical properties of oil, condensate and natural gas.

ФК5. Ability to apply mathematical methods for the analysis of technological processes of production, drilling of wells, transportation and storage of oil and gas

Program learning outcomes:

ПР11. Demonstrate the application of basic concepts, basic laws of physics and chemistry for forecasting and analysis of physicochemical properties of oil, condensate and natural gas in the processes of their extraction, drilling, transportation and storage.

ПР13. Apply mathematical methods to determine the specific values of technological parameters of oil and gas wells, oil and gas preparation systems, industrial and main gas and oil pipelines, gas and oil storage facilities.

1.3. Interdisciplinary connections

The course "Physics" is closely related to technical disciplines. In the process of mastering physical concepts, laws, theories and practical skills acquired, the student acquires physical knowledge, which is then directly based on general technical disciplines, in particular ("Theoretical Mechanics", "Resistance of Materials", "Theory of Machines and Mechanisms", "Electrical Engineering and Power Supply", "Materials Science"," Thermodynamics and Heat Transfer", "Hydraulics", etc.). The discipline "Physics" is basic for the specialty 185 "Oil and Gas Engineering and Technology" and is the basis for further training of specialists. Without such a thorough foundation, a full-fledged professional activity of an engineer is impossible.

1.4. The volume of academic discipline in ECTS credits

Number of ECTS credits - **8,** hours - 240

Auditorial classes, hours:	all	lectures	laboratory
Full-time	88	40	48
Individual work, hours	Full-time -152		

2. The content of the discipline

2.1. The program of meaningful modules

Content of the module 1: Physical foundations of mechanics. Molecular physics and thermodynamics. Electrostatics.

No of topics	Contents of the topic	Hours
1.	Introduction. The subject of physics and its connection with other sciences. Physical foundations of mechanics. Kinematics. Physical models. Reference system. Trajectory, path, movement. Speed. Acceleration and its components. Classification of forms of motion using normal and tangential accelerations. Angular characteristics of motion.	2
2.	The dynamics of the material point and the translational motion of a rigid body. Newton's laws. See strength. Attraction. The law of universal gravitation. Friction forces. The force of elasticity. System of bodies. Center of mass. The law of motion of the center of mass. The law of conservation of momentum.	2
3.	Energy and work. Energy, work, power. Kinetic and potential energy. The law of conservation of energy. Graphic image of energy. Impact of absolutely elastic and inelastic bodies. Conservation laws.	2
4.	Solid state mechanics. Moment of inertia. Kinetic energy of rotational motion. Moment of force. Equation of dynamics of rotational motion of a rigid body. The moment of momentum (momentum) and the law of its conservation.	2
5.	Molecular physics and thermodynamics. Experimental laws of an ideal gas. Clapeyron-Mendeleev equation. The basic equation of the molecular - kinetic theory of an ideal gas. Barometric formula. Boltzmann distribution. Maxwell's law for the distribution of ideal gas molecules by velocities and energies of thermal motion.	2
6.	Phenomena of transfer in gases. The average number of collisions, the average free path length, the effective diameter of the molecule. Diffusion. Thermal conductivity. Viscous friction.	2
7.	Thermodynamics. The law of uniform distribution of energy by degrees of freedom of molecules. Work and heat are functions of the process. The first law of thermodynamics. Application of the first law of thermodynamics to isoprocesses. Adiabatic process. The second law of thermodynamics. Heat machines. Carnot cycle.	2
8.	Properties of the liquid state. Floor layer. Floor tension. Wetting. Laplace formula. Capillary phenomena. Laplace formula. Capillary phenomena.	2
9.	Aero- and hydrostatics. Aero- and hydrodynamics	2
10.	The law of conservation and quantization of charge. Coulomb's law. Electrostatic	2

	field. Electrostatic field strength. The principle of superposition of electrostatic fields. Dipole field.	
11.	Electrostatic field potential. Tension as a potential gradient. Equipotential surfaces. Types of dielectrics. Polarization of dielectrics. Polarization. Field strength in the dielectric. Types of dielectrics, Active dielectrics: piezo-, pyro- and ferroelectrics and devices based on them.	2
12.	Conductors in an electrostatic field Electrical capacity of a single conductor. Capacitors. Charging system energy, single charged conductor and capacitor. Volumetric energy density.	2

Content of module 2: Electricity. Electromagnetism. Oscillations and waves. Wave and quantum optics. Elements of quantum mechanics.

No of topics	Contents of the topic	Hours
1.	Direct electric current. Current strength and density. Electromotive force and voltage. Ohm's law for a section of a circle. Resistance of conductors. Conductor connections.	2
2.	Operation and power of direct current. Joule's law - Lenz. Ohm's law for an inhomogeneous section of a circle. Kirchhoff's rules for branched DC circuits.	2
3.	Magnetic field and its characteristics. Magnetic moment. Magnetic field inducti Physical phenomena in magnetic fields.	2
4.	Phenomena of electromagnetic induction. Self-induction. Extracurrents of closing and opening. Magnets. Magnetic field in matter	2
5.	Free harmonic mechanical and electromagnetic oscillations. Damping oscillations. Forced oscillations. Resonance. Alternating electric current. Current generators..	2
6.	Wave processes. Standing waves. Electromagnetic waves. Scale of electromagnetic waves.	2
7.	Wave and quantum optics	
8.	Elements of quantum mechanics.	2

1.5. List of laboratory works

No lab work	Name of laboratory work	Hours
	Error theory. Processing of measurement results. Estimation of errors	4
2	Determination of the density of bodies of regular geometric shape.	2
4	Determination of ball velocity by ballistic pendulum method	2
5	Determination of the average impact force of two bullets	2
6	Determination of free fall acceleration using a mathematical pendulum	2
8	Determination of kinematic characteristics of rotational motion and moment of inertia of the Maxwell pendulum.	2
13	Determination of the Young's modulus by the method of deflection deformation	2
16	Determination of the coefficient of internal friction of air, the average free path length of molecules, the average free travel time and the effective diameter of molecules.	2
20	Determination of specific heat of solids. Verification of the law of Dulong and Petit	2
	Virtual laboratory work. Verification of the law of continuity and Bernoulli's equation.	
26	Study of the electrostatic field	2
	Virtual laboratory work. Capacitors	2
27	Determination of resistance of conductors by the method of the Wheatstone bridge	2

29	Determining the filament temperature of an electric lamp filament	2
31	Research of dependence of useful power and efficiency of a current source on electric loading	2
28	Study of temperature dependence of resistivity of metal conductors..	2
37	Determination of the horizontal component of the magnetic induction vector of the Earth's magnetic field	2
40	Study of the phenomenon of self-induction. Determination of the inductance of the coil	2
41	Study of magnetic characteristics of ferromagnetic material	2
	Virtual laboratory work. Fluctuations	2
44	Determination of the oscillation frequency of an electromagnetic vibrator by the standing wave method	2
81	Study of the dependence of the resistance of semiconductors on temperature and determination of activation energy	2

1.6. List of tasks for independent work

№ topics	Types of educational activities	Hours	Types of tasks
1.	Elaboration of lecture material	17	
2.	Preparation for laboratory and practical classes	30	
3.	Elaboration of separate sections of the program which are not taken out at lectures	30	Lectures-presentations and tests on the MOODLE platform
4.	Completion of tasks on the MOODLE platform	60	Tests for independent work of students and tests for control of knowledge on all topics of the physics course
5.	Homework::	20	
5.1.	Mechanics		
5.2	Molecular physics and thermodynamics		
5.3	Electricity		
5.4	Electromagnetism		
5.5	Oscillations and waves		
5.6	Optics		
5.7	Elements of quantum and atomic physics		

2. Criteria for evaluating learning outcomes
Scoring for the implementation of the content module

Type of work subject to control	Evaluation points		Form of study					
			day			correspondence		
	min	*max*	No of works	Total points		No of works	Total points	
				min	*max*		*min*	*max*
1	2	3	4	5	6	7	8	9
Content module 1. Physical foundations of mechanics. Molecular physics and thermodynamics. Electrostatics.								
Execution of laboratory works	3	4	3	9	12	2	6	8
Elaboration of topics not presented at the	2	4	3	6	12	2	4	8
Preparation for laboratory classes	1	2	3	3	6	2	2	4
Execution of individual tasks	2,4/3,6	4/6	5	12	20	5	18	30
Subtotal				30	50		30	50
Modular control (test)	30	50		30	50		30	50
Grade for semantic module 1				**60**	**100**		**60**	**100**
Content module 2. Electricity. Electromagnetism. Oscillations and waves. Wave and quantum optics. Elements of quantum mechanics. .								
Execution of laboratory works	3	4	3	9	12	2	6	8
Elaboration of topics not presented at the	2	4	3	6	12	2	4	8
Preparation for laboratory classes	1	2	3	3	6	2	2	4
Execution of individual tasks	2,4/3,6	4/6	5	12	20	5	18	30
Subtotal				30	50		30	50
Modular control (test)	30	50		30	50		30	50
Grade for semantic module 1				**60**	**100**		**60**	**100**

4. Information recourses

1. Lecture notes on the physics course “Mechanics. Molecular Physics and Thermodynamics, Liquids" for students studying under the bachelor's program / Comp. A.E. Sergeeva, S.N. Fedosov. - Odessa: ONAFT, 2020.– 53 p.

2. Methodical instructions “Theory of errors and its application for processing experimental data” / Contr. S.N. Fedosov, A.E. Sergeeva - Odessa: ONAFT, 2019, 21 p.

3. Robert G. Brown Introductory Physics I, Elementary Mechanics (2013) Durham: Duke University Physics Department, 661 p.

4. Hans C. Ohanian, John T. Markert, Physics for Engineers and Scientists (2007) New York • London: W. W. Norton & Company, Inc., 808 p.