

**Ministry of Education and Science of Ukraine
Dnipro University of Technology**

**FACULTY OF GEOLOGICAL PROSPECTING
DEPARTMENT OF "*Higher Mathematics*"**

“APPROVED”

Head of Department

Sdvyzhkova Olena O

“ ___ ” _____ 2018

**WORK PROGRAM OF THE ACADEMIC DISCIPLINE
"*Higher Mathematics*"**

| | |
|-------------------------------|-----------------------------------------------|
| Field of study..... | 18 Production and Technology |
| Specialty..... | 185 Oil and Gas Engineering and Technology |
| Academic degree..... | Bachelor |
| Academic program..... | Oil and Gas Engineering and Technology |
| Type of discipline..... | Basic |
| Total workload..... | 5 ECTS credits (150 hours) |
| Type of final assessment..... | exam |
| Period of study..... | 1st semester |
| Language of study..... | English |

Lecturers: prof. Sdvyzhkova O.O., prof. Babets D.V.

Prolonged: for 20 __ / 20__ academic year _____ (_____) " __ " __ 20__.

(Signature, name, date)

for 20 __ / 20__ academic year _____ (_____) " __ " __ 20__.

(Signature, name, date)

Dnipro
NTU “DP”
2018

Work program of the academic discipline “Higher Mathematics” for bachelor’s specialty 185 “Oil and Gas Engineering and Technology”/ O.O. Sdvyzhkova, D.V. Babets / NTU “Dnipro Polytechnic” Department Of Higher Mathematics. - DA: NTU «DP» 2018 - 13 p.

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The work program regulates:

- key goals and objectives;
- the disciplinary learning outcomes generated through the transformation of the intended learning outcomes of the degree program;
- the content of the discipline formed according to the criterion “disciplinary learning outcomes”;
- the discipline program (thematic plan by different types of classes);
- distribution of the discipline workload by different types of classes;
- an algorithm for assessing the level of achievement of disciplinary learning outcomes (scales, tools, procedures and evaluation criteria);
- criteria and procedures for evaluating the academic achievements of applicants by discipline;
- the contents of the educational and methodological support of the discipline;

The work program is designed to implement a competency approach in planning an education process, delivery of the academic discipline, preparing students for control activities, controlling the implementation of educational activities, internal and external quality assurance in higher education, accreditation of degree programs within the specialty.

Approved by the decision of the Methodical Commission of specialty 185 “Oil and Gas Engineering and Technology” (protocol № 6 from 07.06.2018).

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1 DISCIPLINE OBJECTIVES

In the educational and professional programs of the Dnipro University of Technology specialty 185 “Oil and gas engineering and technology”, the distribution of program learning outcomes (NRN) for the organizational forms of the educational process is done. In particular, the following learning outcomes are attributed to the discipline B1 " **Higher Mathematics** ":

| | |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SR5 | Apply mathematical methods for determining the specific values of technological parameters of oil and gas wells, oil and gas preparation systems, industrial and main gas pipelines, gas storage facilities, other elements of the gas supply system |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

The objective of discipline - formation an understanding of the basic concepts and methods of linear algebra, analytical geometry and differentiation of functions of one and many variables for the study of mathematical models of real processes and the formation of competencies in the bases of extraction, transportation and storage of hydrocarbon energy.

The implementation of the objective requires transforming program learning outcomes into the disciplinary ones as well as an adequate selection of the contents of the discipline according to this criterion.

2 INTENDED DISCIPLINARY LEARNING OUTCOMES

| Code NRN | Disciplinary learning outcomes (DRN) | |
|-------------|--------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | DRN code | content |
| SR5 | SR5-B1-1 | Apply mathematical methods for determining the specific values of technological parameters of oil and gas wells, oil and gas preparation systems, industrial and main gas pipelines, gas storage facilities, other elements of the gas supply system |

3 BASIC DISCIPLINES

| Subjects | The acquired learning outcomes |
|---------------------------------------------|-----------------------------------------------------|
| Mathematics of the general secondary school | Perform the transformation of algebraic expressions |
| | Use geometry and trigonometry formulas |
| | Understand the basics of analysis |

4 WORKLOAD DISTRIBUTION BY THE FORM OF EDUCATIONAL PROCESS ORGANIZATION AND TYPES OF CLASSES

| Type of classes | Workload hours | Distribution by forms of education, <i>hours</i> | | | | | |
|-----------------|----------------|--------------------------------------------------|----------------------|-------------|----------------------|-------------|----------------------|
| | | Full-time | | Part-time | | Distance | |
| | | Classes (C) | Individual work (IW) | Classes (C) | Individual work (IW) | Classes (C) | Individual work (IW) |
| lecture | 75 | 35 | 40 | - | - | - | - |
| practical | 75 | 35 | 40 | - | - | - | - |

| | | | | | | | |
|------------|-----|----|----|---|---|---|---|
| laboratory | - | - | - | - | - | - | - |
| workshops | - | - | - | - | - | - | - |
| TOGETHER | 150 | 70 | 80 | - | - | - | - |

5 DISCIPLINE PROGRAM BY TYPES OF CLASSES

| Ciphers DRN | Types and topics of training sessions | The volume of components, <i>hours</i> |
|----------------|---------------------------------------------------------------------------------|-------------------------------------------------|
| | LECTURES | 75 |
| SR5-B1-1 | 1 Linear algebra | 13 |
| | Matrices & Determinants | |
| | Inverse Matrix | |
| | Sets of Linear Equations, Gaussian Elimination | |
| SR5-B1-1 | 2 Vector Algebra & Analytic Geometry | 13 |
| | Scalars and Vectors | |
| | Scalar Product, Vector Product | |
| | Application: Equation of a Line and a Plane | |
| SR5-B1-1 | 3 Differential Calculus | 13 |
| | Sequences and Limits | |
| | Differentiation of a Function | |
| | Higher Derivatives | |
| | Extreme Values and Points of Inflexion | |
| | Determination of Limits by Differentiation | |
| SR5-B1-1 | 4 Integral Calculus | 13 |
| | The Primitive Function and Indefinite Integral | |
| | Methods of Integration | |
| | The Definite Integral | |
| | The Area Problem | |
| | Lengths of Curves | |
| | Volume of a Solid of Revolution | |
| SR5-B1-1 | 5 Differential Equations | 13 |
| | Concept and Classification of Differential Equations | |
| | General Solution of DE | |
| | Homogeneous and Linear DE | |
| | Second-Order DE with Constant Coefficients | |
| | Simultaneous DE | |
| SR5-B1-1 | 6 Power Series | 10 |
| | Series | |
| | Expansion of a Function in a Power Series | |
| | Interval of Convergence of Power Series | |
| | Applications of Series: Polynomials as Approximations, Integration of Functions | |
| | PRACTICAL TRAINING | 75 |
| SR5-B1-1 | 1 Addition and Subtraction of Matrices. Product of Two Matrices | 5 |
| | 2 Calculation of the Determinants | 5 |
| | 3 Gaussian Elimination | 5 |
| | 4 Vecrot components | 5 |
| | 5 Products of the vectors | 5 |
| | 6 Line & Plane | 5 |

| Ciphers DRN | Types and topics of training sessions | The volume of components, hours |
|------------------------|----------------------------------------------|----------------------------------------------------|
| | 7 Calculation of the limits | 7 |
| | 8 Finding the derivative of a function | 7 |
| | 9 Derivative application: sketching a graph | 8 |
| | 10 Methods of Integration | 8 |
| | 11 Geometrical application of the integrals | 7 |
| | 12 Types of DE. Methods of solving. | 7 |
| | 13 Taylor & Maclaurin series | 6 |
| TOGETHER | | 150 |

6 KNOWLEDGE PROGRESS TESTING

Certification of student achievement is accomplished through transparent procedures based on objective criteria in accordance with the University Regulations “On Evaluation of Higher Education Applicants' Learning Outcomes”.

The level of competencies achieved in relation to the expectations, identified during the control activities, reflects the real result of the student's study of the discipline.

6.1 GRADING SCALES

Assessment of academic achievement of students of the Dnipro University of Technology is carried out based on a rating (100-point) and institutional grading scales. The latter is necessary (in the official absence of a national scale) to convert (transfer) grades for mobile students.

The scales of assessment of learning outcomes of the NTUDP students

| Rating | Institutional |
|---------------|----------------------|
| 90 ... 100 | Excellent |
| 74 ... 89 | Good |
| 60 ... 73 | Satisfactory |
| 0 ... 59 | Failed |

Discipline credits are scored if the student has a final grade of at least 60 points. A lower grade is considered to be an academic debt that is subject to liquidation in accordance with the Regulations on the Organization of the Educational Process of NTUDP.

6.2 DIAGNOSTIC TOOLS AND EVALUATION PROCEDURES

The content of diagnostic tools is aimed at controlling the level of knowledge, skills, communication, autonomy, and responsibility of the student according to the requirements of the National Qualifications Framework (NQF) up to the 7th qualification level during the demonstration of the learning outcomes regulated by the work program.

During the control activities, the student should perform tasks focused solely on the demonstration of disciplinary learning outcomes (Section 2).

Diagnostic tools provided to students at the control activities in the form of tasks for the intermediate and final knowledge progress testing are formed by specifying the initial data and a way of demonstrating disciplinary learning outcomes.

Diagnostic tools (control tasks) for the intermediate and final knowledge progress testing are approved by the appropriate department.

Type of diagnostic tools and procedures for evaluating the intermediate and final knowledge progress testing are given below.

Diagnostic and assessment procedures

| INTERMEDIATE CONTROL | | | FINAL ASSESSMENT | |
|----------------------|------------------------------|--------------------------------|------------------------------------|----------------------------------------------------------------------|
| training sessions | diagnostic tools | procedures | diagnostic tools | procedures |
| lectures | control tasks for each topic | task during lectures | comprehensive reference work (CCW) | determining the average results of intermediate controls; |
| practical | control tasks for each topic | tasks during practical classes | | CCW performance during the examination at the request of the student |
| | or individual task | tasks during independent work | | |

During the intermediate control, the lectures are evaluated by determining the quality of the performance of the control specific tasks. Practical classes are assessed by the quality of the control or individual task.

If the content of a particular type of teaching activity is subordinated to several descriptors, then the integral value of the assessment may be determined by the weighting coefficients set by the lecturer.

Provided that the level of results of the intermediate controls of all types of training at least 60 points, the final control can be carried out without the student's immediate participation by determining the weighted average value of the obtained grades.

Regardless of the results of the intermediate control, every student during the final knowledge progress testing has the right to perform the CDF, which contains tasks covering key disciplinary learning outcomes.

The number of specific tasks of the CDF should be consistent with the allotted time for completion. The number of CDF options should ensure that the task is individualized.

The value of the mark for the implementation of the CDF is determined by the average evaluation of the components (specific tasks) and is final.

The integral value of the CDF performance assessment can be determined by taking into account the weighting factors established by the department for each NLC descriptor.

6.3 EVALUATION CRITERIA

The actual student learning outcomes are identified and measured against what is expected during the control activities using criteria that describe the student's actions to demonstrate the achievement of the learning outcomes.

To evaluate the performance of the control tasks during the intermediate control of lectures and practicals the assimilation factor is used as a criterion, which automatically adapts the indicator to the rating scale:

$$O_i = 100 a / m,$$

where a - number of correct answers or significant operations performed according to the solution standard; m - the total number of questions or substantial operations of the standard.

Individual tasks and complex control works are expertly evaluated using criteria that characterize the ratio of competency requirements and evaluation indicators to a rating scale.

The content of the criteria is based on the competencies identified by the NLC for the Bachelor's level of higher education (given below).

General criteria for achieving learning outcomes 7th qualification for LDCs (BA)

Integral competence is the ability to solve complex problems and specialized practical problems in a particular area of professional activities or in a learning process that involves the use of certain theories and methods of the relevant scientific areas and characterized by complexity and conditions uncertainty.

| descriptors NLC | Requirements for knowledge, communication, autonomy and responsibility | Indicator evaluation |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| Knowledge | | |
| <ul style="list-style-type: none"> ◆ Conceptual knowledge acquired during the training and professional activities, including some knowledge of modern achievements; ◆ critical understanding of the main theories, principles, methods, and concepts in education and careers | - A great - proper, reasonable, sensible. Measures the presence of: - conceptual knowledge; - a high degree of state ownership issues; - critical understanding of the main theories, principles, methods and concepts in education and careers | 95-100 |
| | A non-gross contains mistakes or errors | 90-94 |
| | The answer is correct but has some inaccuracies | 85-89 |
| | A correct some inaccuracies but has also proved insufficient | 80-84 |
| | The answer is correct but has some inaccuracies, not reasonable and meaningful | 74-79 |
| | A fragmentary | 70-73 |
| | A student shows a fuzzy idea of the object of study | 65-69 |
| | Knowledge minimally satisfactory | 60-64 |
| Knowledge unsatisfactory | <60 | |
| Ability | | |
| <ul style="list-style-type: none"> ◆ solving complex problems and unforeseen problems in specialized areas of | - The answer describes the ability to: <ul style="list-style-type: none"> - identify the problem; - formulate hypotheses; - solve problems; | 95-100 |

| descriptors NLC | Requirements for knowledge, communication, autonomy and responsibility | Indicator evaluation |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| professional and/or training, which involves the collection and interpretation of information (data), choice of methods and tools, the use of innovative approaches | <ul style="list-style-type: none"> - choose adequate methods and tools; - collect and interpret logical and understandable information; - use innovative approaches to solving the problem | |
| | The answer describes the ability to apply knowledge in practice with no blunders | 90-94 |
| | The answer describes the ability to apply knowledge in practice but has some errors in the implementation of a requirement | 85-89 |
| | The answer describes the ability to apply knowledge in practice but has some errors in the implementation of the two requirements | 80-84 |
| | The answer describes the ability to apply knowledge in practice but has some errors in the implementation of the three requirements | 74-79 |
| | The answer describes the ability to apply knowledge in practice but has some errors in the implementation of the four requirements | 70-73 |
| | The answer describes the ability to apply knowledge in practice while performing tasks on the model | 65-69 |
| | A characterizes the ability to apply knowledge in performing tasks on the model, but with uncertainties | 60-64 |
| | The level of skills is poor | <60 |
| Communication | | |
| <ul style="list-style-type: none"> ◆ report to specialists and non-specialists of information, ideas, problems, solutions and their experience in the field of professional activity; ◆ the ability to form an effective communication strategy | <ul style="list-style-type: none"> - Fluent problematic area. Clarity response (report). Language - correct; - - net; - - clear; - - accurate; - - logic; - - expressive; - - concise. Communication strategy: coherent and consistent development of thought; availability of own logical reasoning; relevant arguments and its compliance with the provisions defended; the correct structure of the response (report); correct answers to questions; appropriate equipment to answer questions; the ability to draw conclusions and formulate proposals | 95-100 |
| | Adequate ownership industry issues with minor faults. Sufficient clarity response (report) with minor faults. Appropriate communication strategy with minor faults | 90-94 |
| | Good knowledge of the problems of the industry. Good clarity response (report) and relevant communication strategy (total three requirements are not implemented) | 85-89 |
| | Good knowledge of the problems of the industry. Good clarity response (report) and relevant communication | 80-84 |

| descriptors NLC | Requirements for knowledge, communication, autonomy and responsibility | Indicator evaluation |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| | strategy (a total of four requirements is not implemented) | |
| | Good knowledge of the problems of the industry. Good clarity response (report) and relevant communication strategy (total not implemented the five requirements) | 74-79 |
| | Satisfactory ownership issues of the industry. Satisfactory clarity response (report) and relevant communication strategy (a total of seven requirements not implemented) | 70-73 |
| | Partial ownership issues of the industry. Satisfactory clarity response (report) and communication strategy of faults (total not implemented nine requirements) | 65-69 |
| | The fragmented ownership issues of the industry. Satisfactory clarity response (report) and communication strategy of faults (total not implemented 10 requirements) | 60-64 |
| | The level of poor communication | <60 |
| Autonomy and responsibility | | |
| <ul style="list-style-type: none"> ◆ management actions or complex projects, responsible for decision-making in unpredictable conditions; ◆ responsible for the professional development of individuals and/or groups ◆ the ability to continue study with a high degree of autonomy | <ul style="list-style-type: none"> - Excellent individual ownership management competencies focused on: <ol style="list-style-type: none"> 1) management of complex projects, providing: <ul style="list-style-type: none"> - exploratory learning activities marked the ability to independently evaluate various life situations, events, facts, detect and defend a personal position; - the ability to work in a team; - control of their own actions; 2) responsibility for decision-making in unpredictable conditions, including: <ul style="list-style-type: none"> - justify their decisions the provisions of the regulatory framework of sectoral and national levels; - independence while performing tasks; - lead in discussing problems; - responsibility for the relationship; 3) responsible for the professional development of individuals and/or groups that includes: <ul style="list-style-type: none"> - use of vocational-oriented skills; - the use of evidence from independent and correct reasoning; - possession of all kinds of learning activities; 4) the ability to further study with a high degree of autonomy, which provides: <ul style="list-style-type: none"> - degree possession of fundamental knowledge; - independent evaluation judgments; - high level of formation of general educational skills; - search and analysis of information resources | 95-100 |
| | Confident personality possession competency management (not implemented two requirements) | 90-94 |
| | Good knowledge management competencies personality (not implemented three requirements) | 85-89 |
| | Good knowledge management competencies personality (not implemented the four requirements) | 80-84 |
| | Good knowledge management competencies personality (not implemented six requirements) | 74-79 |

| descriptors NLC | Requirements for knowledge, communication, autonomy and responsibility | Indicator evaluation |
|-----------------|-------------------------------------------------------------------------------------------------|----------------------|
| | Satisfactory ownership of individual competence management (not implemented seven requirements) | 70-73 |
| | Satisfactory ownership of individual competence management (not implemented eight claims) | 65-69 |
| | The level of autonomy and responsibility fragmented | 60-64 |
| | The level of autonomy and responsibility poor | <60 |

7 TOOLS, EQUIPMENT, AND SOFTWARE

Technical training tools via multimedia software.

Distance learning platform Moodle.

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185 "Oil and Gas Engineering and Technology"

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