Ministry of Education and Science of Ukraine
Dnipro University of Technology

DEPARTMENT OF "Higher Mathematics"

"APPROVED"
Head of Department

Sdvyzhkova Olena O.

_____15.09.2020

WORK PROGRAM OF THE ACADEMIC DISCIPLINE
"Higher Mathematics"

Field of study ………….….   14 Electrical engineering
Specialty ……………...   141 Power engineering, electrical engineering and electromechanics
Academic degree …………….   Bachelor
Academic program ………….   Power engineering, electrical engineering and electromechanics
Type of discipline …   Basic
Total workload..………….   12,5 credits (375 hours)
Type of final assessment ….   exam
Period of study ………..   1st & 2nd semester
Language of study ……………   English

Lecturer: 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"
2020

Work program of the academic discipline "Higher Mathematics" for bachelor's specialty 141 «Power engineering, electrical engineering and electromechanics» / D.V. Babets / NTU "Dnipro Polytechnic" Department of Higher Mathematics. - D: NTU «DP» 2020 - 14 p.

Author – Babets D.V., prof. of the dept. Higher Mathematics

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 141 «Power engineering, electrical engineering and electromechanics» at the request of the Department of Higher Mathematics.

CONTENT

1 DISCIPLINE OBJECTIVES

In the educational and professional programs of the Dnipro University of Technology 141 «Power engineering, electrical engineering and electromechanics» 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**":

ПР07	Carry out analysis of processes in electromechanical equipment, relevant complexes and systems.
ПР08	Select and apply suitable methods for analysis and synthesis of electromechanical systems with specified parameters.

The objective of discipline – formation of competencies for the use of mathematical knowledge in the training of bachelors in the specialty 141 «Power engineering, electrical engineering and electromechanics».

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

Disciplinary learning outcomes (DRN)		
Code NRN	**DRN code**	**content**
ПР07	ДРН.1	Know the basics and principles of linear and vector algebra, analytical geometry, differential and integral calculus.
ПР07	ДРН.2	Be able to use a mathematical apparatus for objective analysis of processes in electromechanical equipment;
ПР08	ДРН.3	Know the principles of solving technical problems based on mathematical analysis, construction and solution of differential equations.

3 BASIC DISCIPLINES

Subjects	The acquired learning outcomes
Mathematics of the general secondary school	Performing the transformation of algebraic expressions
	Using the geometry and trigonometry formulas
	Understanding 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, *hours*					
		Full-time		**Part-time**		**Distance**	
		Classes (C)	Individual work (IW)	Classes (C)	Individual work (IW)	Classes (C)	Individual work (IW)
lecture	193	63	130	-	-	-	-
practical	164	52	112	-	-	-	-
laboratory	-	-	-	-	-	-	-
tests	18						
total	375	115	242	-	-	-	-

5 DISCIPLINE PROGRAM BY TYPES OF CLASSES

DRN code	Types and topics of training sessions	The amount of the components (total / aud.), *hours*
	LECTURES	**193 (63)**
ДРН.1	**1 Linear and vector algebra**	24 (8)
	Linear algebra. Matrices. Determinants.	
	Systems of linear algebraic equations.	
	Vector algebra. General concepts of vector algebra. Product of vectors and their application.	
ДРН.1	**2 Analytical geometry**	24 (8)
	Plane in space.	
	Straight line in space.	
	Mutual placement of the plane and the line in space.	
	Straight line on the plane	
	Second order curves.	
	The concept of the polar coordinate system.	
ДРН.2	**3 Complex numbers**	16 (5)
	Complex numbers and operations on them	
	Elementary functions of a complex variable	
ДРН.2	**4 Basic concepts of Calculus**	33 (8)
	Functions of one variable. Limits. Continuity of a function.	
	Derivative of a function.	
	Differentiation of a complex function, inverse function. Logarithmic differentiation.	
	The application of derivatives. Extrema values.	
	Full investigation of a function. Curve sketching.	
	Differential. Differential invariance.	
ДРН.2	**5 Integral calculus of a function of one variable**	36 (10)
	Indefinite integral.	
	Basic methods of integration. Integration by substitution. Integration by parts.	
	Definite integral.	
	Geometrical & physical applications of definite integrals.	
	Improper integrals.	
ДРН.3	**6 Integral and differential calculus of a function of many variables**	24 (6)
	Functions of many variables. Partial derivatives. Extreme.	
	Multiple and line integrals and their applications	
ДРН.3	**7 Ordinary differential equations**	36 (9)
	Ordinary differential equations	
	Cauchy problem. Equations with separable variables. Homogeneous equations. Linear equations and Bernoulli equations.	
	Higher order differential equations. The order reduction.	

DRN code	Types and topics of training sessions	The amount of the components (total / aud.), *hours*
	Linear DE of higher order.	
	Systems of linear differential equations with constant coefficients.	
	PRACTICAL TRAINING	**164 (52)**
ДРН.1	**1 Linear and vector algebra**	20 (6)
	Linear algebra. Matrices. Determinants.	
	Systems of linear algebraic equations.	
	Vector algebra. General concepts of vector algebra. Product of vectors and their application.	
	Linear algebra. Matrices. Determinants.	
ДРН.1	**2 Analytical geometry**	22 (6)
	Plane & Straight line in 3D.	
	Mutual placement of the plane and the line in 3D.	
	Straight line in the plane (2D case)	
	Second order curves.	
	The concept of the polar coordinate system.	
ДРН.2	**3 Complex numbers**	11 (4)
	Complex numbers and operations on them	
	Elementary functions of a complex variable	
ДРН.2	**4 Basic concepts of Calculus**	25 (8)
	Functions of one variable. Limits. Continuity of a function.	
	Differentiation of a complex function, inverse function. Logarithmic differentiation.	
	The application of derivatives. Extrema values.	
	Full investigation of a function. Curve sketching.	
ДРН.2	**5 Integral calculus of a function of one variable**	26 (8)
	Indefinite integral.	
	Basic methods of integration. Integration by substitution. Integration by parts.	
	Definite integral.	
	Geometrical & physical applications of definite integrals.	
	Improper integrals.	
ДРН.3	**6 Integral and differential calculus of a function of many variables**	28 (8)
	Functions of many variables. Partial derivatives. Extreme.	
	Multiple and line integrals and their applications	
ДРН.3	**7 Ordinary differential equations**	32 (12)
	Ordinary differential equations	
	Cauchy problem. Equations with separable variables. Homogeneous equations. Linear equations and Bernoulli equations.	
	Higher order differential equations. The order reduction.	
	Linear equations of higher order	
	Systems of linear differential equations with constant coefficients	
	TOTAL	**375 (140)**

6 TASKS FOR SELF TRAINING

The main tasks for self-training are:
1) preliminary processing of information concerning the module (topic);
2) preparation for the current tests - solving tasks of self-control on each topic;
3) performance of an individual task;
4) preparation for the defense of an individual task;
5) preparation for the final test.

7 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.

7.1 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.

7.2 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 6th 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; CCW performance during the examination at the request of the student
practical	control tasks for each topic	tasks during practical classes		
	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.

7.3 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 practical trainings 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).

descriptors NLC	Requirements for knowledge, communication, autonomy and responsibility	Indicator evaluation
Knowledge		
♦ 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		
♦ solving complex problems and unforeseen problems in specialized areas of professional and/or training, which involves the collection and interpretation of information (data), choice of methods and	- The answer describes the ability to: - identify the problem; - formulate hypotheses; - solve problems; - choose adequate methods and tools; - collect and interpret logical and understandable information; - use innovative approaches to solving the problem	95-100
	The answer describes the ability to apply knowledge in practice with no blunders	90-94

descriptors NLC	Requirements for knowledge, communication, autonomy and responsibility	Indicator evaluation
tools, the use of innovative approaches	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		
♦ 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	- 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 strategy (a total of four requirements is not implemented)	80-84
	Good knowledge of the problems of the industry. Good clarity response (report) and relevant communication strategy (total not implemented the five requirements)	74-79

descriptors NLC	Requirements for knowledge, communication, autonomy and responsibility	Indicator evaluation
	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		
♦ 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	- Excellent individual ownership management competencies focused on: 1) management of complex projects, providing: - 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: - 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: - 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: - 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
	Satisfactory ownership of individual competence management (not implemented seven requirements)	70-73
	Satisfactory ownership of individual competence management (not implemented eight claims)	65-69

descriptors NLC	Requirements for knowledge, communication, autonomy and responsibility	Indicator evaluation
	The level of autonomy and responsibility fragmented	60-64
	The level of autonomy and responsibility poor	<60

8 TOOLS, EQUIPMENT, AND SOFTWARE

Technical teaching aids.

A Lenovo G500 laptop and a Nec V260G projector are used to teach lectures in the classroom. The mixed form of training uses the MOODLE distance platform, the MS Teams corporate platform, and the Zoom video conferencing program.

MS Excel packages and online resources:

https://www.desmos.com/calculator?lang=en;

https://www.geogebra.org/3d are used during the practical classes

9 RECOMMENDED BIBLIOGRAPHY

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Educational edition

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"Higher Mathematics" for bachelors
141 «Power engineering, electrical engineering and electromechanics»

Author: Dmytro Babets