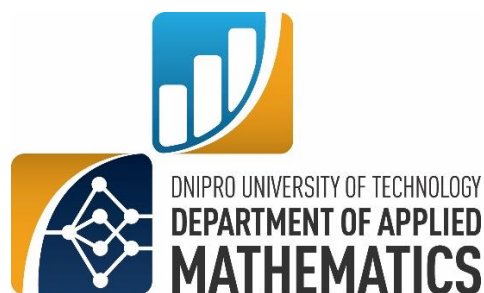


# SYLLABUS OF THE ACADEMIC DISCIPLINE

## «Higher mathematics»

<b>Academic degree</b>	Bachelor
<b>Specialty</b>	141 Electrical energetics, electrical engineering and electromechanics
<b>Academic program</b>	Electrical energetics, electrical engineering and electromechanics
<b>Period of study</b>	1, 2 semesters (1-4 terms)
<b>Total workload</b>	12,5 credits ECTS (375 hours)
<b>Classroom workload:</b>	
lectures:	3 hours (1, 2 term), 2 hours (3, 4 term)
...practical:	3 hours (1 term), 2 hours (2-4 term)
<b>Language of study</b>	English



### Distance courses

- [Linear and Vector Algebra & Analytic Geometry](https://do.nmu.org.ua/course/view.php?id=3382) (<https://do.nmu.org.ua/course/view.php?id=3382>)
- [Differentiation of a Function](https://do.nmu.org.ua/course/view.php?id=2634) (<https://do.nmu.org.ua/course/view.php?id=2634>);
- [Indefinite integral \(En\) - Babets D.V.](https://do.nmu.org.ua/course/view.php?id=2682) (<https://do.nmu.org.ua/course/view.php?id=2682>);
- [Definite integral \(Babets D.V.\)](https://do.nmu.org.ua/course/view.php?id=3073) (<https://do.nmu.org.ua/course/view.php?id=3073>);
- [Differential Equations \(Babets D.V.\)](https://do.nmu.org.ua/course/view.php?id=3450) (<https://do.nmu.org.ua/course/view.php?id=3450>);

**Teaching department** Applied Mathematics (AP)

**Consultations: 12:55 - 14:15**, every Thursday (except holidays), room 5/33

### Information about the teacher:



**Babets Dmytro  
Volodymyrovych**

Associate Professor, Doctor of Technical Sciences, Professor at the Department of Applied Mathematics

Personal page:

<https://sites.google.com/view/personaliyivm/%D0%BF%D1%80%D0%BE%D1%84%D0%B5%D1%81%D0%BE%D1%80-%D0%B1%D0%B0%D0%B1%D0%B5%D1%86%D1%8C-%D0%B4-%D0%B2>

**Email:**

[Babets.d.v@nmu.one](mailto:Babets.d.v@nmu.one)

### 1. About course

*«Neglect of mathematics work injury to all knowledge, since he who is ignorant of it cannot know the other sciences or things of this world»*

Roger Bacon

Mathematics is a fundamental science, the methods of which are used in many natural sciences. Without knowledge of the basics of mathematics, it is impossible to study physics and chemistry. Mathematics as a science is the basis of engineering, where it is necessary to make calculations on the characteristics of materials, parameters of machines and mechanisms, as well to assess the strength of engineering units.

Mathematics operates with abstract interrelations, but entering the field of any science, it is immediately embodied in the description, modeling and prediction of very specific and real natural processes.

For example, in order not to conduct many expensive and dangerous experiments, we can describe the system or process mathematically, and this allows us to predict the state of the object under the influence of various factors, assess the criticality of this state, develop technical and management decisions.

Here are the words of the great Sophia Kovalevskaya: "Among all the sciences that open the way for mankind to learn the laws of nature, the most powerful, the greatest science is mathematics."

## 2. Aim and objectives

**The aim of the course** – formation of competencies for the use of mathematical knowledge in the training of bachelors in the specialty 141 Electrical energetics, electrical engineering and electromechanics.

### Course objectives:

- teaching the principles of using linear algebra to solve systems of linear equations;
- covering vector algebra and analytical geometry to solve problems of natural science;
- providing the principles of using mathematical analysis, differential and integral calculus.
- teaching algorithms for solving technical problems based on the construction and solution of differential equations.

## 3. Learning outcomes:

- know the basics and principles of linear and vector algebra, analytical geometry, differential and integral calculus;
- be able to use a mathematical apparatus for objective analysis of processes in electromechanical equipment;
- know the principles of solving technical problems based on mathematical analysis, construction and solution of differential equations.

## 4. Course program

LECTURES
<b>1 Linear and vector algebra</b>
Linear algebra. Matrices. Determinants.
Systems of linear algebraic equations.
Vector algebra. General concepts of vector algebra. Product of vectors and their application.
<b>2 Analytical geometry</b>
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.
<b>3 Complex numbers</b>
Complex numbers and operations on them
Elementary functions of a complex variable
<b>4 Basic concepts of Calculus</b>
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.
<b>5 Integral calculus of a function of one variable</b>
Indefinite integral.
Basic methods of integration. Integration by substitution. Integration by parts.
Definite integral.
Geometrical & physical applications of definite integrals.
Improper integrals.
<b>6 Integral and differential calculus of a function of many variables</b>
Functions of many variables. Partial derivatives. Extreme.
Multiple and line integrals and their applications
<b>7 Ordinary differential equations</b>
Ordinary differential equations
Cauchy problem. Equations with separable variables. Homogeneous equations. Linear equations and Bernoulli equations.
Higher order differential equations. The order reduction.
Linear DE of higher order.
Systems of linear differential equations with constant coefficients.
<b>PRACTICAL TRAINING</b>
<b>1 Linear and vector algebra</b>
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.
<b>2 Analytical geometry</b>
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.
<b>3 Complex numbers</b>
Complex numbers and operations on them
Elementary functions of a complex variable
<b>4 Basic concepts of Calculus</b>
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.
<b>5 Integral calculus of a function of one variable</b>
Indefinite integral.
Basic methods of integration. Integration by substitution. Integration by parts.
Definite integral.
Geometrical & physical applications of definite integrals.
Improper integrals.
<b>6 Integral and differential calculus of a function of many variables</b>
Functions of many variables. Partial derivatives. Extreme.
Multiple and line integrals and their applications
<b>7 Ordinary differential equations</b>
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

## 5. Technical equipment and/or software

Technical teaching aids.

A laptop and a projector are used to teach lectures in the classroom. The mixed form of training uses the MOODLE 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.

## 6. Evaluation system and requirements

6.1. Students' academic achievements based on the results of the course will be assessed on the scale below:

Rating scale	Institutional scale
90 – 100	excellent
74-89	good
60-73	satisfactory
0-59	fail

The general criteria for achieving the learning outcomes correspond to the descriptions of the 6th qualification level of the NQF.

6.2. Students can receive a **final grade** in the discipline based on the formative assessment of the knowledge, provided that the total number of points from the formative testing and independent work is at least 60 points.

The formative performance consists of the performance in two colloquia (each with a maximum score of 15 points) and grades for work in seminars/practical classes (14 classes are evaluated, participation in a class can bring a student a maximum of 5 points). The points received for colloquia and seminars/practical classes are added up and constitute the final grade for the discipline. A student can score a maximum of 100 points for formative academic performance.

<b>Summative assessment (if the student scored less than 60 points and/or seeks to improve the grade)</b>	The exam is conducted in the form of a written exam, with exam papers containing 1 open-ended question and three practical tasks. A correct answer to an open-ended question is worth 40 points, and a correctly completed practical task is worth 20 points. Open-ended questions are evaluated by comparing them with the reference answers. Maximum number of points for the exam: 100
<b>Practical / Seminar classes</b>	Problem solving. It is worth 70 points (7 classes × 10 points/class).
<b>Colloquia</b>	Presentations of your own research using IT. The maximum score is 30 points (2 colloquia × 15 points/ colloquium).

### 6.3 Grading criteria for **solving problems**.

**5 points:** the correct answer is obtained (according to the standard), the formula is used with an explanation of the content of its individual components, the units of measurement are indicated.

**4 points:** the correct answer is given with minor inaccuracies in accordance with the standard, there is no formula and/or explanation of the content of individual components, or the units of measurement are not specified.

**3 points:** the answer is incorrect, but the formula is used with an explanation of the meaning of its individual components, and the units of measurement are indicated.

**2 points:** the answer is incorrect, but the formula is not used with an explanation of the content of its individual components and/or the units of measurement are not specified.

**1 point:** an incorrect answer is given without any explanation.

### 6.4. Grading criteria for **discussions**:

**5 points:** active participation in the discussion (speeches, comments, active listening), mastery of the educational material, providing reasoned answers with reference to sources.

**4 points:** active participation in the discussion (speeches, comments, active listening), mastery of the educational material with minor errors in the essence of the issues discussed.

**3 points:** active participation in the discussion (speeches, comments, active listening) without sufficient knowledge of the educational material related to the topic of discussion.

**2 points:** involvement in the discussion by the teacher, inattention, lack of sufficient knowledge of the subject of discussion.

**1 point:** involvement in the discussion by the teacher, unwillingness to participate in the discussion, lack of sufficient knowledge of the subject matter.

## 7. Course policy

**7.1. Academic Integrity Policy.** Academic integrity of students is an important condition for mastering the results of training in the discipline and obtaining a satisfactory grade on the current and final tests. Academic integrity is based on condemnation of the practices of copying (writing with external sources other than those allowed for use), plagiarism (reproduction of published texts by other authors without indication of authorship), fabrication (fabrication of data or facts used in the educational process). The policy on academic integrity is regulated by the Regulation "Regulations on the system of prevention and detection of plagiarism at the Dnipro University of Technology ([https://www.nmu.org.ua/ua/content/activity/us\\_documents.pdf](https://www.nmu.org.ua/ua/content/activity/us_documents.pdf))

In case of violation of academic integrity by a student (copying, plagiarism, fabrication), the work is evaluated unsatisfactorily and must be repeated. The teacher reserves the right to change the topic of the task.

### **7.2. Communication policy.**

Students must have activated university mail.

It is the student's responsibility to check the mailbox at Office365 once a week (every Sunday).

During the weeks of independent work, it is the student's responsibility to work with the distance course "Higher Mathematics" ([www.do.nmu.org.ua](http://www.do.nmu.org.ua))

All written questions to teachers regarding the course should be sent to the university e-mail.

### **7.3. Reassembly policy.**

Works that are submitted in violation of deadlines without good reason are evaluated at a lower grade. Relocation takes place with the permission of the dean's office if there are good reasons (for example, sick leave).

### **7.4. Attending classes.**

Full-time students are required to attend classes. Good reasons for not attending classes are illness, participation in university events, business trips, which must be confirmed by documents in case of prolonged (two weeks) absence. The student must inform the teacher either in person or through the headmaster about the absence from class and the reasons for absence. If a student is ill, we recommend staying home and studying with a distance platform. Students whose health is unsatisfactory and may affect the health of other students will be encouraged to leave the class (such absence will be considered an absence due to illness). Practical classes are not repeated; these assessments cannot be obtained during the consultation. For objective reasons (for example, international mobility), learning can take place remotely - online, in agreement with the teacher.

**7.5 Evaluation Appeal Policy.** If the student does not agree with the assessment of his knowledge, he may appeal the assessment made by the teacher in the prescribed manner.

**7.6. Bonuses.** Students who regularly attended lectures (have no more than two passes without good reason) and have a written syllabus of lectures receive an additional 2 points to the results of the assessment to the final grade.

**7.7. Participation in the survey.** At the end of the course and before the session, students will be asked to fill out anonymously questionnaires (Microsoft Forms Office 365), which will be sent to your university mailboxes. Completing the questionnaires is an important component of your learning activity, which will allow you to assess the effectiveness of the teaching methods used and take into account your suggestions for improving the content of the discipline "Higher Mathematics".

## **8. Recommended readings**

### **8.1 Basic**

1. Є.С. Сінайський, Л.В. Новікова, Л.І. Заславська. Вища математика (*частина 1*): навч. посібник. – *Дніпропетровськ: НГУ, 2004. – 389 с.*
2. Derivatives and their application = Похідні та їх застосування: Textbook (**англійською мовою**) / О. Sdvyzhkova, S. Tymchenko, D. Babets, Yu. Olevska, D. Klymenko, P. Shcherbakov; / The Ministry of Education and Science of Ukraine, Dnipro University of Technology. – Dnipro: «Dniprotech», 2020. – 70 с.
3. Indefite Integral (**англійською мовою**) [Текст]: навч. посіб. для студ. вищ. навч. закл /Бабець Д.В, Сдвижкова О.О.; Тимченко С.Є.; Щербakov П.М/ М-во освіти і науки України, Нац. техн. ун-т «Дніпровська політехніка». – Дніпро: НТУ «ДП», 2018. – 65 с.

4. Звичайні диференціальні рівняння (**англійською мовою**) [Текст]: навч. посіб. для студ. гірн. спец. вищ. навч. закл. / Е.А.Сдвижкова, Л.І.Коротка, Д.В.Бабець, Ю.Б.Олевська ; М-во освіти і науки України, Нац. гірн. ун-т. – [Нове вид.]. – Д. : НГУ, 2015. – 60 с. – ISBN 978-966-350-587-9.
5. Вища математика із застосуванням інформаційних технологій. Підручник/ Іващенко В.І., Швачич Г.Г., Коноваленков В.С., Заборова Т.М., Христян В.І. – Запоріжжя: Дике Поле, 2013. – 426 с.
6. K Weltner, W. J. Weber, J. Grosjean P. Schuster: Mathematics for Physicists and Engineers. Springer, 2009
7. Стислий курс вищої математики. Т.1: Аналітична геометрія та елементи лінійної алгебри/ Г.М.Тимченко, О.В.Одинцова, О.С.Мазур, Н.О.Кирилова.: навч. посібн. – К.: Кондор-Видавництво, 2016.- 176 с.
8. Вища математика в прикладах і задачах: у 2 т. Т.1: Аналітична геометрія та лінійна алгебра. Диференціальне та інтегральне числення функцій однієї змінної: навч. посібник / Л.В.Курпа, Ж.Б.Кашуба, Г.Б.Лінник [та ін.]; за ред. Л.В.Курпи. – Харків: НТУ «ХП», 2009. – 532с.
9. Вища математика в прикладах і задачах: у 2 т. Т.2: Диференціальне числення функцій багатьох змінних. Диференціальні рівняння та ряди: навч. посібник / Л.В.Курпа, Н.О.Кирилова, Г.Б.Лінник [та ін.]; за ред. Л.В.Курпи. – Харків: НТУ «ХП», 2009. – 432с.
10. Вища математика. Розв'язання задач та варіанти типових розрахунків. Т.1.: Навч. Посібник / За ред. Л.В.Курпа. — Харків: НТУ “ХП”, 2002 – 316 с.

## 8.2 Additional

1. K.F. Riley, M.P. Hobson and S. J. Bence: Mathematical Methods for Physics and Engineering. Cambridge University Press, 2006.
2. Вища математика: Інтегральне числення у прикладах і задачах. Частина 2.: навч. посібник /Л.Я.Фомичова, В.М.Почепов, В.В.Фомичов. – Дніпро: ТОВ «ЛізуновПрес», 2016. – 200 с.
3. Математика 1. Конспект лекцій. Частина 1. / Л.Я.Фомичова– Дніпро: ТОВ «Лізунов Прес», 2017. – 72 с.
4. Практикум з інтегрування функцій однієї змінної: навч. посібник. / Н.П. Уланова, В.В. Приходько. – Дніпропетровськ: НГУ, 2014. – 80 с.
5. Практикум з початків математичного аналізу: навч. посібник / Новикова Л.В., Уланова Н.П., Приходько В.В. – Дніпропетровськ: НГУ, 2006. – 109 с.
6. «Диференціальні рівняння в прикладах та задачах: навч. посібник / Новикова Л.В., Сдвижкова О.О., Бугрим О.В., Бугрим Є.Д. – Дніпропетровськ: НГУ, 2007. – 95 с.
7. Практикум з вищої математики. Невизначений Інтеграл: нав. посібник. / Замкова Л.Д. – Дніпропетровськ: НГУ, 2007. – 129 с.
8. Методичні вказівки до розв'язання прикладних задач з вищої математики. / Т.С.Кагадій. – Дніпропетровськ: НГУ, 2005. – 29 с.
9. Методичні вказівки до виконання розрахункових завдань і контрольних модульних робіт з лінійної і векторної алгебри. / Л.Й.Бойко, А.Г.Шпорта. – Дніпропетровськ: НГУ, 2006. – 32 с.
10. Функція. Границя. Похідна та її застосування [Текст]: методичні вказівки / Сдвижкова О.О., Бабець Д.В., Тимченко С.Є., Подольська С.Н. / Д: Державний ВНЗ «НГУ» – 2013 . – 126 с.
11. Застосування методів диференціального та інтегрального числення до розв'язання задач технічного змісту. Методичні вказівки для самостійної роботи студентів / Л.Й. Бойко, В.І. Павліщев. – Дніпропетровськ: НГУ, 2012. – 46с.

## 9. Information resources

1. Література на сайті кафедри прикладної математики:  
<https://vm.nmu.org.ua/lib.html>;
2. [Linear and Vector Algebra & Analytic Geometry](https://do.nmu.org.ua/course/view.php?id=3382)  
(<https://do.nmu.org.ua/course/view.php?id=3382>)
3. [Differentiation of a Function](https://do.nmu.org.ua/course/view.php?id=2634) (<https://do.nmu.org.ua/course/view.php?id=2634>);
4. [Indefinite integral \(En\) - Babets D.V.](https://do.nmu.org.ua/course/view.php?id=2682)  
(<https://do.nmu.org.ua/course/view.php?id=2682>);
5. [Definite integral \(Babets D.V.\)](https://do.nmu.org.ua/course/view.php?id=3073) (<https://do.nmu.org.ua/course/view.php?id=3073>);
6. [Differential Equations \(Babets D.V.\)](https://do.nmu.org.ua/course/view.php?id=3450)  
(<https://do.nmu.org.ua/course/view.php?id=3450>);
7. **Учбово-методичні посібники кафедри прикладної математики «ХІІ»:**  
<http://web.kpi.kharkov.ua/apm/navchal-na-diyal-nist/navchal-no-metodichni-posibniki/>