

**MINISTRY OF INTERNAL AFFAIRS OF UKRAINE**  
**DNIPROPETROVSK STATE UNIVERSITY OF INTERNAL**  
**AFFAIRS**

**DEPARTMENT OF ECONOMIC AND INFORMATION**  
**SECURITY**

**APPROVED**

Rector of Dnipropetrovsk State  
University of Internal Affairs  
Colonel of the Police

**ANDRII FOMENKO**

**PLANS OF SEMINARS (PRACTICAL CLASSES)**  
**IN THE ACADEMIC DISCIPLIN**

**FURTHER MATHEMATICS**

Academic level

Academic level Bachelor

Specialty 073 " Management "

Educational program «Financial and economic security and risk management»

Status of the academic discipline Mandatory

Language of instruction: English

**Dnipro – 2021**

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<b>I SEMESTER</b>
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**Topic 1. Matrices. Determinants. Systems of linear algebraic equations**

**Practical class № 1.1 – 2 hrs.**

**Plan**

1. The concept of the matrix. Types of matrices. Transposed matrix.
2. Operations with matrices. Multiplication of matrices
3. The concept of the inverse matrix. Calculation of the inverse matrix

**Skills to be developed in the course of the class:**

Finding of the transposed matrix, operations with matrices. Ability to calculate the inverse matrix.

**Practical class № 1.2 – 2 hrs.**

**Plan**

1. Determinants of the 2nd and 3rd order.
2. Triangle method.
3. Using the properties of determinants to calculate them..

**Skills to be developed in the course of the class:**

A calculation of determinants of the 2nd and 3rd order

**Practical class № 1.3 – 4 hrs.**

**Plan**

1. Systems of linear equations of the 2nd and 3rd order.
2. Cramer`s method.
3. Solution of systems of linear equations using Gaussian`s method.

**Skills to be developed in the course of the class:**

Ability to find solutions to systems of linear equations using Gauss`s and Cramer`s methods.

**Recommended literature for Topic 1**

1. Peter Jones, Michael Evans, Kay Lipson, Kyle Staggard, Cambridge Senior Maths AC/VCE Further Mathematics 3&4, Cambridge University Press, 2016. P.880
2. Tony Beadsworth, Complete Additional Mathematics for Cambridge IGCSE & O Level, Oxford University Press. United Kingdom. 2017.P.512
3. Dyskovsky A.A., Kosychenko A.A., Rybalchenko L.V. Higher mathematics: Manual. Dnipro: Dnipropetrovsk State University of Internal Affairs, 2019. P.108.

## **Topic 2. Functions of singular variable. Borders. Continuity of the function**

**Practical class № 2.1 – 2 hrs.**

### **Plan**

1. The concept of functional dependence.
2. Properties of functions.
3. Basic elementary functions and their graphs.

#### **Skills to be developed in the course of the class:**

Knowing of the basic elementary functions and ability to build their graphs.  
Ability to check the properties of functions.

**Practical class № 2.2 – 4 hrs.**

### **Plan**

1. Sequence and function boundary.
2. Special borders.
3. Calculate the boundary of the function.

#### **Skills to be developed in the course of the class:**

Knowing of the basic methods of finding the boundaries of functions

**Practical class № 2.3 – 4 hrs.**

### **Plan**

1. Continuity of functions.
2. Basic theorems about continuous functions.
3. Properties of continuous functions.

#### **Skills to be developed in the course of the class:**

Ability to recognize continuous function and to use its properties.

### **Recommended literature for Topic 2:**

1. David Rayner, Jim Fensom. Complete International Mathematics for Cambridge IGCSE Oxford University Press - Children, 2013. P.516
2. Jean Linsky, Brian Western, James Nicholson, Complete Pure Mathematics 1 for Cambridge International AS & A Level. Oxford University Press - Children, 2018. P.260
3. Jean Linsky, Brian Western, James Nicholson. Complete Pure Mathematics 2 & 3 for Cambridge International AS & A Level. Oxford University Press - Children, 2019 P.348
4. GCE Further Mathematics Further Pure Unit 2 Textbook – AQA, URL: <https://pdf4pro.com/view/gce-further-mathematics-6360-2cf39e.html>
5. Dyskovsky A.A., Kosychenko A.A., Rybalchenko L.V. Higher mathematics: Manual. Dnipro: Dnipropetrovsk State University of Internal Affairs, 2019. P.108

### **Topic 3. Differential calculus of a function of singular variable**

**Practical class № 3.1 – 2 hrs.**

#### **Plan**

1. The concept of derivative.
2. Derivatives of basic elementary functions.
3. Derivative calculation.

#### **Skills to be developed in the course of the class:**

Ability to find derivatives of simple and complex functions.

**Practical class № 3.2 – 4 hrs.**

#### **Plan**

1. Derivative of an implicit function.
2. Differential.
3. Derivatives and differentials of higher powers

#### **Skills to be developed in the course of the class:**

Capability to find the derivative of an implicit function. Ability to find the differential of a function.

### **Practical class № 3.3 – 2 hrs.**

#### **Plan**

1. Basic theorems of differential calculus.
2. L'opital's rule.

#### **Skills to be developed in the course of the class:**

Ability to find the differential of a function.

### **Practical class № 3.4 – 4 hrs.**

#### **Plan**

1. Rising and falling of functions.
2. Finding of the extremes of the function.
3. Investigation of a function to the extremes using higher-power derivatives.
4. The largest and smallest values of the function on the segment.
5. Investigation of the function of convexity and concavity. Inflection points.
6. Asymptotes of curves.
7. General scheme of plotting functions.

#### **Skills to be developed in the course of the class:**

Capability to investigate functions using derivatives. Ability to find points of local extremum with the usage of a derivative.

#### **Recommended literature for Topic 3:**

1. Jean Linsky, Brian Western, James Nicholson, Complete Pure Mathematics 1 for Cambridge International AS & A Level. Oxford University Press - Children, 2018. P.260
2. Jean Linsky, Brian Western, James Nicholson. Complete Pure Mathematics 2 & 3 for Cambridge International AS & A Level. Oxford University Press - Children, 2019 P.348
3. Dyskovsky A.A., Kosyuchenko A.A., Rybalchenko L.V. Higher mathematics: Manual. Dnipro: Dnipropetrovsk State University of Internal Affairs, 2019. P.108.

## II SEMESTER

### Topic 4. Indefinite and definite integral of functions of singular variable.

**Practical class № 4.1 – 2 hrs.**

#### Plan

1. Initial. Indefinite integral and its properties.
2. Integration methods.
3. Table of basic integration formulas.
4. Integration of some function classes

#### **Skills to be developed in the course of the class:**

Basic methods of integration: direct integration, variable replacement, integration by parts.

**Practical class № 4.2 – 4 hrs.**

#### Plan

1. The integral is defined as a limit of integral sums.
2. The main properties of a definite integral.
3. Newton- Leibniz formula.
4. Calculation of a definite integral: integration by parts and substitution.

#### **Skills to be developed in the course of the class:**

Methods of integration by parts and variable replacement in a defined integral.

#### **Recommended literature for Topic 4:**

1. Jean Linsky, Brian Western, James Nicholson, Complete Pure Mathematics 1 for Cambridge International AS & A Level. Oxford University Press - Children, 2018. P.260
2. Jean Linsky, Brian Western, James Nicholson. Complete Pure Mathematics 2 & 3 for Cambridge International AS & A Level. Oxford University Press - Children, 2019 P.348
3. Dyskovsky A.A., Kosychenko A.A., Rybalchenko L.V. Higher mathematics: Manual. Dnipro: Dnipropetrovsk State University of Internal Affairs, 2019. P.108.

## **Topic 5. Functions of multiple variables**

**Practical class № 5.1 – 2 hrs.**

### **Plan**

1. Functions of multiple variables.
2. Partial derivatives.
3. Full differential.

#### **Skills to be developed in the course of the class:**

Ability to find partial derivatives of two variables of the first and the second order. Capability to find integrals for functions of two variables.

**Practical class № 5.2 – 2 hrs.**

### **Plan**

1. Implicit functions.
2. Extremes of functions of several variables.
3. Conditional extreme.

#### **Skills to be developed in the course of the class:**

Ability to research of the extremum of simple two variables` functions.

### **Recommended literature for Topic 5:**

1. Jean Linsky, Brian Western, James Nicholson, Complete Pure Mathematics 1 for Cambridge International AS & A Level. Oxford University Press - Children, 2018. P.260
2. Vladimir Lepetic, Principles of Mathematics: A Primer. John Wiley and Sons Ltd. Hoboken, United States. 2016 P.672
3. Dyskovsky A.A., Kosychenko A.A., Rybalchenko L.V. Higher mathematics: Manual. Dnipro: Dnipropetrovsk State University of Internal Affairs, 2019. P.108.

## **Topic 6. Series**

**Practical class № 6.1 – 4 hrs.**

### **Plan**

1. Numeric series



2. The concept of the sum of a numerical series.
3. Alternate series
4. Functional series.

**Skills to be developed in the course of the class:**

Acquisition of the concepts of constants and alternating series

**Practical class №6.2 – 2 hrs.**

**Plan**

1. Power series.
2. Taylor's series.

**Skills to be developed in the course of the class:**

Ability to perform the decomposition of functions in power series.

**Recommended literature for Topic 6:**

1. Jean Linsky, Brian Western, James Nicholson, Complete Pure Mathematics 1 for Cambridge International AS & A Level. Oxford University Press - Children, 2018. P.260
2. Jean Linsky, Brian Western, James Nicholson. Complete Pure Mathematics 2 & 3 for Cambridge International AS & A Level. Oxford University Press - Children, 2019 P.348
3. GCE Further Mathematics Further Pure Unit 2 Textbook – AQA, URL: <https://pdf4pro.com/view/gce-further-mathematics-6360-2cf39e.html>
4. Dyskovsky A.A., Kosychenko A.A., Rybalchenko L.V. Higher mathematics: Manual. Dnipro: Dnipropetrovsk State University of Internal Affairs, 2019. P.108.

**Topic 7. Differential equations**

**Practical class № 7.1 – 4 hrs.**

**Plan**

1. General concepts related to differential equations.
2. Cauchy's problem.
3. Basic classes of first-order differential equations

**Skills to be developed in the course of the class:**

Solving the Cauchy`s problem. Solving linear differential equations of the 1st order.

**Practical class № 7.2 – 4 hrs.**

### **Plan**

1. Equations that reduce the order.
2. Linear differential equations, homogeneous and inhomogeneous

#### **Skills to be developed in the course of the class:**

Solving 2nd order linear differential equations. Solving homogeneous differential equations. Solving inhomogeneous differential equations

### **Recommended literature for Topic 7:**

1. Jean Linsky, Brian Western, James Nicholson. Complete Pure Mathematics 2 & 3 for Cambridge International AS & A Level. Oxford University Press - Children, 2019 P.348
2. Dyskovsky A.A., Kosychenko A.A., Rybalchenko L.V. Higher mathematics: Manual. Dnipro: Dnipropetrovsk State University of Internal Affairs, 2019. P.108

## **Topic 8. Fundamentals of theory of probability**

**Practical class № 8.1 – 2 hrs.**

### **Plan**

1. Random events and operations with them.
2. Set of elementary events.
3. Relative frequency of the event..

#### **Skills to be developed in the course of the class:**

Usage of the basic formulas of combinatory to calculate the probability of events.

**Practical class № 8.2 – 2 hrs.**

### **Plan**

1. Classical probability.
2. The formula of total probability.

3. Bayesian's formula.
4. Bernoulli's formula.

**Skills to be developed in the course of the class:**

Ability to use the full probability formula. Ability to use the Bayesian's, Bernoulli's formula.

**Practical class № 8.3 – 4 hrs.**

**Plan**

1. The normal rule of distribution of a random variable.
2. Examples of other distributions.
3. Numerical characteristics of functions of random variables.
4. Properties of mathematical expectation and variance.
5. Numerical characteristics of functions of random variables.

**Skills to be developed in the course of the class:**

Ability to declare graphically and analytically the distribution of a discrete random variable

**Practical class № 8.4 – 4 hrs.**

**Plan**

1. The concept of variation and correlation coefficient.
2. Conditional numerical characteristics.
3. Regression.

**Skills to be developed in the course of the class:**

Ability to calculate conditional numerical characteristics. Capability to calculate the regression line.

**Recommended literature for Topic 8**

1. David Rayner, Jim Fensom. Complete International Mathematics for Cambridge IGCSE Oxford University Press - Children, 2013. P.516
2. Jean Linsky, Brian Western, James Nicholson. Complete Pure Mathematics 2 & 3 for Cambridge International AS & A Level. Oxford University Press - Children, 2019 P.348

3. Dyskovsky A.A., Kosychenko A.A., Rybalchenko L.V. Higher mathematics: Manual. Dnipro: Dnipropetrovsk State University of Internal Affairs, 2019. P.108