APPLIED MATHEMATICS FOR SOCIAL SCIENCES

Course code	*FUN114*
Compulsory in the programmes	*Industrial Technology Management, International Business and Communication*
Level of studies	*Undergraduate*
Number of credits	*6 ECTS (48 in-class hours + 4 hours of consultations + 5,4 hours of examination, 104,6 individual work hours)*
Course coordinator (title and name)	*Kristina Aldošina*
Prerequisites	*-*
Language of instruction	*English*

THE AIM OF THE COURSE

This course is based on the flipped classroom method and aims to develop skills for mathematical modeling of basic economic, financial, managerial and engineering problems.

MAPPING OF COURSE LEVEL LEARNING OUTCOMES (OBJECTIVES) WITH DEGREE LEVEL LEARNING OBJECTIVES (See Annex I), ASSESSMENT AND TEACHING METHODS

Course level learning outcomes (objectives)	Learning objectives for BSc in Business Management	Assessment methods	Teaching methods
CLO1. Ability to operate the main concepts, laws, and techniques of linear algebra, linear programming, differential and integral calculus	BLO1.1, BLO1.2	Midterm exam, final exam, tests	Lectures, tutorials, exercises, examples, practical sessions in small groups, individual work
CLO2. Ability to apply these concepts, laws and techniques in economic, financial, managerial analysis and engineering	BLO4.3	Midterm exam, final exam	Lectures, tutorials, exercises, examples, development and analysis of mathematical models; practical sessions in small groups, individual work
CLO3. Analytical thinking, active learning and learning strategies, complex problem-solving, critical thinking and analysis, initiative (see Annex II)	BLO1.1, BLO1.2, BLO4.3	Midterm exam, final exam	Lectures, tutorials, exercises, examples, development and analysis of mathematical models; practical sessions in small groups, individual work

ACADEMIC HONESTY AND INTEGRITY

The ISM University of Management and Economics Code of Ethics, including cheating and plagiarism are fully applicable and will be strictly enforced in the course. Academic dishonesty, and cheating can and will lead to a report to the ISM Committee of Ethics. With regard to remote learning, ISM remind students that they are expected to adhere and maintain the same academic honesty and integrity that they would in a classroom setting.

COURSE OUTLINE

Topic	In-class hours	Readings (paragraphs from the required readings)
1. Linear depreciation, equilibrium point of supply and demand, break-even point, budget constraint, choice of the means of production. Cartesian coordinate system. Equations of a straight line (point-slope, point-point, general). Simultaneous equations. *Test 1.* *Case study: the cheapest way to acquire details for the production line.*	4	[1] 2.1, 2.2, 2.4, 2.5 [2] 1.1, 1.2, 1.3, 1.4
2. Planning of production and sales, cost analysis, forecast of market shares. Matrices, operations: transposition, equality, sum, product. Representation of data using matrices. Markov chains. *Test 2.* *Case study: forecasting market shares of three competing automobile manufacturing companies.*	4	[1] 5.4, 5.5 [2] 2.4, 2.5, 9.1
3. Rational production plan, stable market shares, flow management (traffic control), investment portfolio problem. Augmented matrix, Gauss elimination method. *Test 3.* *Case study: building the optimal production plan for a souvenirs producing company.*	4	[1] 5.1, 5.2, 5.3 [2] 2.1, 2.2, 2.3, 9.2
4. Profit maximization in case of finite resources, cost minimization in case of additional requirements, optimal production plan, advertising problem, investment portfolio problem. Linear programming for two variables: formulation and graphical solution. Sensitivity analysis, shadow prices. *Test 4.* *Case study: minimizing cost of operating two mines subject to the given extraction goals.*	4	[1] 6.1, 6.2, 6.3 [2] 3.1, 3.2, 3.3, 3.4
5. Profit maximization in case of finite resources, cost minimization in case of additional requirements, optimal production plan, advertising problem, investment portfolio problem, logistics problem, pollution minimization problem. Linear programming for any quantity of variables: formulation and simplex method. Dual problem. Sensitivity analysis, shadow prices. *Test 5.* *Case study: maximizing profit of plastic fixtures producing company subject to the given finite resources.*	4	[1] 6.4, 6.5 [2] 4.1, 4.2, 4.3
CONSULTATION	2	
MIDTERM EXAM	2,7	
6. Marginal analysis, profit maximization and cost minimization problems. First order derivative of a function. Definition. The main rules of differentiation. The chain rule.	4	[1] 9.3, 9.4, 9.5, 9.6, 9.7, 9.8, 10.1

Slope of a function, tangent line, velocity. Increasing and decreasing functions. Monotony, relative and absolute extrema of a function. **Test 6.** *Case study: minimizing average cost of CD printing company subject to the given technological constraints.*		
7. Law of diminishing returns, optimization. Higher order derivatives of a function. Concavity, inflection points. Second derivative test. **Test 7.** *Case study: examining effect of increasing marketing spending on growth of sales.*	4	[1] 9.5, 10.2
8. Cobb–Douglas production function, utility function and indifference curves, substitute and complementary commodities, marginal analysis, marginal rate of substitution. Functions of several variables. Graphs and level curves. Partial differentiation. Higher order partial derivatives. Implicit differentiation. **Test 8.** *Case study: examining effect of growing capital and labor force on increase of productivity of a country.*	4	[1] 12.1, 12.2
9. Profit maximization (cost minimization) in case of two products, constrained optimization. Extrema of functions of several variables, the Lagrange problem. **Test 9.** *Case study: minimizing cost of two types of school desks producing company.*	4	[1] 12.3
10. Profit, cost, revenue analysis. Dynamic analysis of economic phenomena. Indefinite integral. Antiderivative. Integration rules. Integration by substitution. **Test 10.** *Case study: forecasting population growth / decay.*	4	[1] 11.1, 11.2
11. Producers' and consumers' surplus, Lorentz curve and Gini index (measure of income inequality), mean value over the time interval, "Is it worth?" analysis. Definite integral. Properties. Newton – Leibniz formula. Area between two curves. Integration by substitution. **Test 11.** *Case study: evaluation of efficiency of two different marketing strategies.*	4	[1] 11.3, 11.4, 11.5, 11.6, 11.7
	Total: 48,7 hours	
CONSULTATION	2	
FINAL EXAM	2,7	

FINAL GRADE COMPOSITION

Type of assignment	%
Individual Components 100%	
Tests 1 – 11	22 (11*2%)
Midterm exam (topics 1 – 5)	39
Final exam (topics 6 – 11)	39
Total:	**100**

DESCRIPTION AND GRADING CRITERIA OF EACH ASSIGNMENT
(Provide short descriptions and grading criteria of each assignment)

The overall assessment of the course (total maximum of 100% is possible) will be composed from evaluations of multiple tasks (midterm and final exams, tests), which are described as follows:

1. Tests are held at the beginning of each theory lecture and consist of 10 multiple-choice pure mathematical questions that cover material from video tutorials, which students must watch prior each theory lecture. Each test values 2% of the final grade.

2. Two astronomic hours long written closed book midterm exam will count for the 39% of the final evaluation and will require to solve several applied problems. Only non-text (non-graphical, non-solving) calculators, dictionaries, and provided sheet with formulas will be allowed. Exam will include applied problems on the topics 1 – 6.

3. Two astronomic hours long written closed book exam will count for the 39% of the final evaluation and will require to solve several applied problems. Only non-text (non-graphical, non-solving) calculators, dictionaries, and provided sheet with formulas will be allowed. Exam will include applied problems on the topics 7 – 11.

Grading guidelines:

- a task is divided into several steps, each values 0,25 or 0,5 (it depends);
- final grade is sum of evaluations for the right steps;
- modeling and explanations (interpretations) value more than arithmetic;
- if model is wrong but later calculations are right, you get some points (depends on the task);
- you lose some points for mistakes (0,25 for arithmetical, 0,5 or more for methodical, it depends on the task);
- wrong answer doesn't mean zero evaluation;
- all components of the solution are important: model, appropriate solution method, calculations, presentation of information (clear, logical), substantiation, conclusions, explanations, interpretations.

RETAKE POLICY
(Provide short description and percentage of the final grade)

In case of the negative final evaluation, retake is possible. It will cover material of the whole course and will comprise **100%** of the final mark. Marks earned for tests, midterm and final exams will be annulled. Retake is two astronomic hours long written closed book examination and will require to solve several applied problems. Only non-text (non-graphical, non-solving) calculators, dictionaries, and provided sheet with formulas will be allowed.

ADDITIONAL REMARKS

1. Practices (seminars) will be organized in form of consultations (workshops). Students will have possibility to solve both skill-forming and applied problems (individually or in groups), ask questions, discuss.

2. Duration of midterm exam, final exam, and retake may be prolonged depending on the group's performance.

3. Precision of composite evaluations is left intact (up to 2 decimal places) until the end of semester and only the final evaluation will be subject to rounding.

UNIVERSITY OF MANAGEMENT AND ECONOMICS

REQUIRED READINGS

1. S.T. Tan. Applied Mathematics for the Managerial, Life, and Social Sciences. 3rd ed. Thomson, 2004, p.969.
2. S.T. Tan. Finite Mathematics for the Managerial, Life, and Social Sciences. 9th ed. Cengage learning, 2009, p.612.

ADDITIONAL READINGS

1. K. Sydsæter, P. Hammond. Essential Mathematics for Economic Analysis. 2nd ed. Prentice Hall, 2006, p. 714.
2. V. Būda. Matematiniai ekonominės analizės pagrindai. Vilnius, TEV, 2008, p. 359.
3. V. Būda, J. Granskas. Diskretieji matematiniai modeliai. Ekonomika ir vadyba. Vilnius, TEV, 2015, p. 256.

ANNEX I

DEGREE LEVEL LEARNING OBJECTIVES

Learning objectives for the <u>Bachelor of Business Management</u>
Programmes:
International Business and Communication,
Business Management and Marketing, Finance,
Industrial Technology Management

Learning Goals	Learning Objectives
Students will be critical thinkers	BLO1.1. Students will be able to understand core concepts and methods in the business disciplines
	BLO1.2. Students will be able to conduct a contextual analysis to identify a problem associated with their discipline, to generate managerial options and propose viable solutions
Students will be socially responsible in their related discipline	BLO2.1. Students will be knowledgeable about ethics and social responsibility
Students will be technology agile	BLO3.1. Students will demonstrate proficiency in common business software packages
	BLO3.2. Students will be able to make decisions using appropriate IT tools
Students will be effective communicators	BLO4.1. Students will be able to communicate reasonably in different settings according to target audience tasks and situations
	BLO4.2. Students will be able to convey their ideas effectively through an oral presentation
	BLO4.3. Students will be able to convey their ideas effectively in a written paper

ANNEX II

WORLD ECONOMIC FORUM

Top 10 skills of 2025

Analytical thinking and innovation

Active learning and learning strategies

Complex problem-solving

Critical thinking and analysis

Creativity, originality and initiative

Leadership and social influence

Technology use, monitoring and control

Technology design and programming

Resilience, stress tolerance and flexibility

Reasoning, problem-solving and ideation

Type of skill
- Problem-solving
- Self-management
- Working with people
- Technology use and development

Source: Future of Jobs Report 2020, World Economic Forum.