MATHEMATICAL ANALYSIS

Course code	*FUN101*
Course title	*Mathematical analysis*
Type of course	*Main*
Year of study	*First*
Semester	*Autumn*
ECTS	*6: 26 hrs. of lectures, 22 hrs. of seminars; 2 hours of examinations, 112 hrs. of individual study*
Coordinating lecturer	*Kristina Aldošina*
Study form	*Full-time*
Course prerequisites	*None*
Language of instruction	*English*

Annotation

The course covers topics on limit, differential, and integral calculus as the basis for modelling of various phenomena in economics, finances, management and engineering.

Aims of the course

This course aims to develop skills for mathematical modeling of basic economical, financial, managerial and engineering problems.

Learning methods

The course is structured as a combination of lectures, practical sessions in small groups, homework assignments and student‘s individual work.

Course learning outcomes (CLO)	Learning methods	Assessment methods
CLO1. Ability to operate the main concepts, laws, and techniques of limits, differential and integral calculus	Lectures, tutorials, exercises, examples, self-studies	Control works, final exam, retake (optional)
CLO2. Ability to apply these concepts, laws and techniques in economical, financial, managerial analysis and engineering	Lectures, tutorials, exercises, examples, development and analysis of mathematical models, homework assignments, self-studies	Control works, final exam, retake (optional)

Quality issues

The lecturer assures a variety of teaching methods and testing. The feedback from students will always be highly valued and appreciated. Learning and teaching methods during practical seminars enable the lecturer and the students to realize weakness and improve their knowledge and skills in relevant areas.

Cheating issues

The teaching and testing methods are chosen taking into account the purpose of the minimization of cheating opportunities. The ISM regulations on academic ethics are fully applied in the course.

Content of the course

No.	Topic	Classroom hours		Readings
		Lectures	Practice[1]	
1.	*Introduction to the course.* **1. Linear functions and models.** Cartesian coordinate system. Equations of a straight line (point-slope, point-point, general). Simultaneous equations. Applications: linear depreciation, equilibrium point of supply and demand, break-even point, budget line, choice of the means of production.	2	2	68-72, 74-79, 111-116, 134, lecture notes
2.	**Mathematics of finance.** Number sequences and limit of a sequence. Geometric series. Sigma notation. Applications: compound interest, double declining-balance method of depreciation, present value, annuity etc.	2	2	[1] 4.1, 4.2, 4.4 [2] 3.1
3.	**Limit of a function.** Rational functions. Asymptote as geometrical representation of a limit. Limit laws. One-sided limits. Continuity of a function. Applications: forecasting.	2	2	[1] 9.1, 9.2 [2] 6.5
4.	**Limit calculation techniques.** Unboundedly increasing and vanishing functions. Number e. Natural logarithm. Applications: continuous compounding.	2	2	[2] 4.9; 4.10; 7.9; 10.2
5.	**First order derivative of a function.** Definition. The main rules of differentiation. The chain rule. Applications: slope of a function, tangent line, marginal analysis, velocity. Increasing and decreasing functions. Monotony, relative and absolute extrema of a function. Applications: profit maximization and cost minimization problems, L'Hospital's rule.	2	2	[1] 9.3-9.8 [1] 10.1, 10.4, 10.5 [2] 7.7; 7.12
6.	**Higher order derivatives of a function.** Concavity, inflection points. Second derivative test. Taylor's approximation. Applications: law of diminishing returns, optimization.	2	2	[1] 9.5, 10.2, lecture notes
7.	**Midterm assessment 1**	2	0	
8.	**Functions of several variables.** Graphs and level curves. Partial differentiation. Higher order partial derivatives. Differentials. Implicit differentiation. Applications: Cobb–Douglas production function, utility function, indifference curves, substitute and complementary commodities, marginal analysis, marginal rate of substitution.	2	2	[1] 12.1, 12.2 [2] 11.8; 12.3; 12.5; 12.9
9.	**Extrema of functions of several variables.** The Lagrange problem. The least squares method. Applications: profit maximization (cost minimization) in case of several products, constrained optimization, forecasting by curve fitting.	2	2	[1] 12.3 [2] 13.4; 14.1 – 14.4
10.	**Indefinite integral.** Antiderivative. Integration rules. Integration by substitution. Integration by parts. Applications: marginal analysis.	2	2	[1] 11.1; 11.2 [2] 9.5
11.	**Definite integral.** Properties. Newton – Leibniz formula. Area between two curves. Integration by substitution. Integration by parts. Applications: producer and consumer surplus, Lorentz curve and Gini index, mean value over time interval, growth and decay.	2	2	[1] 11.3–11.7
12.	**Improper integrals.** Applications: economic growth theory, area under unbounded function, evaluation of investment (total discounted value).	2	2	[2] 9.7
13.	**Midterm assessment 2**	2	0	
	Total hours:	**26**	**22**	
Exam session	Consultation	2		
Exam session	Final exam	2		

[1] Practices 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.

Individual work and assessment

Type	Topics	Self-study hours	Weight, %	Additional points
Midterm assessment 1	1 – 6	21	20	0,5
Midterm assessment 2	7 – 11	21	20	0,5
Final exam	1 – 11	70	60	-
Total:		**112**	**100**	**1**

The overall assessment of the course (total maximum of 100% is possible) will be composed from evaluations of 3 tasks (two control works and final exam), which are described as follows:

1. Both midterm assessments will count for the 40% of the final evaluation. Each assessment is two academic hours long written closed book examination. Only non-text (non-graphical, non-solving) calculators and provided sheet with formulas will be allowed. Individual postponing and retake of an assessment impossible.
2. In case a student participates in a feedback session (after an assessment), he/she has possibility to get additional points to the final grade. A student has to answer in full extent one question from the assessment to get those additional points. Possibility to get additional points applies only to students, who participated in the control work.
3. Two academic hours long written closed book exam will count for the 60% of the final evaluation. Only non-text (non-graphical, non-solving) calculators and provided sheet with formulas will be allowed. Exam will include applied problems on the topics of the whole course.

In case of the negative final evaluation, retake is possible. Retake is two academic hours long written closed book examination, and it will cover material of the whole course and will comprise 100% of the final mark (marks earned for midterm assessments will be annulled). Only non-text (non-graphical, non-solving) calculators and provided sheet with formulas will be allowed.

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.

Textbooks

Main

1. S.T.Tan. Applied Mathematics for the Managerial, Life, and Social Sciences. 3rd ed. Thomson, 2004, p.969.

Optional

2. K.Sydsaeter, P.Hammond. Essential Mathematics for Economic Analysis. 2nd ed. Prentice Hall, 2006, p.714.
3. V. Būda. Matematiniai ekonominės analizės pagrindai. Vilnius, TEV, 2008. P. 359.
4. Solodovnikov A.C. et.al. Matematika v ekonomike. Moskva, Finansy i statistika, parts 1–2. 2000.