COURSE OUTLINE

1. Information about the program

1.1 Higher education institution	**“Alexandru Ioan Cuza” University of Iaşi**
1.2 Faculty	**Faculty of Economics and Business Administration**
1.3 Departament which provides the discipline	**Accounting, Economic Informatics and Statistics**
1.3 Departament which benefits	**Management, Marketing and Business Administration**
1.4 Field of study	**Business Administration**
1.5 Cycle of study	**Bachelor**
1.6 Study program / Qualification	**Business Administration**

2. Information about the course

2.1 Course title			**Mathematics applied in economics**				
2.2 Course coordinator			Lecturer **Teodor – Marius SPÎNU**, PhD				
2.3 Seminar coordinator			Lecturer **Teodor – Marius SPÎNU**, PhD				
2.4 Year of study	**1**	**2.5** Semester	**1**	**2.6** Type of evaluation*	**M**	**2.7** Course status**	**C**

* *MT-MID-TERM, O-ORAL EXAM, E-EXAM, M-MIXED; ** C-compulsory/O-optional/E-elective*

3. Estimated time allocation (hours per semester and teaching activities)

3.1 Number of hours per week	**4**	out of which: **3.2** course	**2**	**3.3** seminar / laboratory	**2**
3.4 Total number of hours per semester	**56**	out of which: **3.5** course	**28**	**3.6** seminar / laboratory	**28**

Time allocation	h
Study based on course book, course materials, bibliography and other	**24**
Supplementary study in the library, on electronic platforms and on the field	**6**
Preparing seminars/laboratories, assignments, papers, portfolios and essays	**20**
Tutorship	**5**
Examination	**4**
Other activities: Final preparing for Partial Evaluation Tests (PET)	**10**

3.7 Total hours of individual study	**69**
3.8 Total hours per semester	**125**
3.9 Number of credits	**5**

4. Prerequisites (if applicable)

4.1 Referring to curriculum	**Mathematics (Algebra) of 9-th to 12-th class from high school**
4.2 Referring to competences	**Matrices and theory of linear systems.**

5. Conditions (if applicable)

5.1 For the course	**Video-projector and blackboard**
5.2 For the seminar / laboratory	**Video-projector and blackboard**

6. Specific competences accumulated

Professional competencies	Collection, processing and analysis of information on the external environment-enterprise/organisation interaction; Managing the activity of a subdivision of the enterprise/organisation structure; Use of databases specific to business administration.
Transversal competencies	Applying the principles, rules and values of professional ethics in their own rigorous, efficient and responsible work strategy; Identify opportunities for continuous training and make effective use of learning resources and techniques for own development.

7. Course objectives (based on specific competencies accumulated)

7.1 General objective	➢ The aim of the course is to teach students the methods of mathematical analysis and modelling of economic phenomena. ➢ Students must learn how to identify the types of economic phenomena which can be accompanied by mathematical solving models and to choose the appropriate method of investigation, mathematical modelling and resolution. ➢ An essential aim of the course is students' identification of work hypotheses, logical and rigorous reasoning, accurate contextual analysis of the resulting conclusions as well as their appropriate implementation method within the context of an economic/financial/banking phenomenon.
7.2 Specific objectives	After successfully completing this course, students will be able to: ▪ mathematically model an important type of economic phenomena; ▪ implement mathematical methods of optimisation of linear programming problems; ▪ use SIMPLEX type solving algorithms; ▪ use mathematical methods in the context of other study subjects and understand the logic of applying specific concepts and/or indices to the general economic field and the specific financial and banking ones; ▪ solve optimisation problems of various types of economic phenomena using differential calculus; ▪ identify, undestand and implement approximation (adjustments, interpolations) methods for particular economic and financial phenomena and problems.

8. Content

8.1	**Course**	**Teaching methods**	**Observations** (time and bibliography)
1.	Linear spaces. Definitions, general concepts.	Interactive course, heuristic conversation	**2 hours** [1] chapters 4.1, 4.2, (2) chapter 2.1
2.	Linear dependence and independence, fundamental properties. Particular cases.	Interactive course, heuristic conversation	**2 hours** [1] chapters 4.1, 4.2, 4.3, 4.4 (2) chapters 2.1 - 2.3
3.	Basis, dimension, coordinates. Particular cases.	Interactive course, heuristic conversation	[1] chapters 4.1, 4.2, 4.4, 4.5 (2) chapters 2.1, 2.2
4.	Change of basis. Substitution lemma.	Interactive course, heuristic conversation	**2 hours** [1] chapters 4.4, 4.5, 4.6, 4.10 (2) chapters 2.2, 2.3, 2.6

5.	Linear forms. Linear programming problems (LPP). Economical problem and its mathematical models.	Interactive course, heuristic conversation	**2 hours** [1] chapters 4.10, 5.1, 5.3, 5.4 [2] chapters: 3.1, 3.2 (1) chapters: 5.1, 5.2 (2) chapter: 3.1
6.	Fundamental theorems and general properties at LPP.	Interactive course heuristic conversation	**2 hours** [2] chapters: 3.1, 3.2 (1) chapters: 5.1, 5.2 (2) chapter: 3.1
7.	Overview and the algebra of the Simplex alghoritm.	Interactive course heuristic conversation	**2 hours** [2] chapters: 4.1, 4.2, 4.3 (1) chapters: 6.1, 6.2 (2) chapter: 3.2
8.	The two-phases method. The transportation problems (TP)	Interactive course, heuristic conversation	**2 hours** [2] chapters: 4.4, 4.5 (1) chapters: 5.2, 7.1, 7.2 (2) chapters: 3.2.3, 3.3
9.	The algebric alghoritm to solve equilibrate transportation problems (ETP).	Interactive course, heuristic conversation,	**2 hours** [2] chapters: 4.4, 4.5 (1) chapters: 5.2, 7.1, 7.2 (2) chapter: 3.3.2
10.	Non-equilibrate transportation problems (NTP) and the perturbation method.	Interactive course, heuristic conversation,	**2 hours** [2] chapters: 4.4, 4.5 (1) chapters: 5.2, 7.1, 7.2 (2) chapter: 3.3.2
11.	Introduction to Markov processes (chains) theory.	Interactive course, heuristic conversation,	**2 hours** [2] chapters: 8.1 [3] chapters: 9.1 (1) chapters: 5.2, 7.1, 7.2 (2) chapter: 3.3.2
12.	Properties of Markov chains. Regular Markov chains.	Interactive course, heuristic conversation,	**2 hours** [2] chapters: 8.1 [3] chapters: 9.2 (1) chapters: 5.2, 7.1, 7.2 (2) chapter: 3.3.2
13.	Stationary state and stationary transition matrix for regular Markov chains.	Interactive course, heuristic conversation,	**2 hours** [2] chapters: 8.1 [3] chapters: 9.2 (1) chapters: 5.2, 7.1, 7.2 (2) chapter: 3.3.2
14.	Absorbing Markov chains	Interactive course, heuristic conversation,	**2 hours** [2] chapters: 8.1 [3] chapters: 9.3 (1) chapters: 5.2, 7.1, 7.2 (2) chapter: 3.3.2

Bibliography:

Compulsory reading:

[1] Anton, H., *“Elementary linear algebra”*, 5-th edition, WIE, New York, 1987;

[2] Goldstein, L.J., Schneider, D.I., Siegel, M.J., *Finite mathematics & its applications”*, tenth edition, Pearson Prentice Hall, USA, 2010;

[3] Barnett, R. A., Ziegler, M. R., Byleen, K. E., *“Finite Mathematics for Business, Economics, Life Sciences and Social Sciences”* – 11-th edition, Prentice-Hall, Inc., Pearson Education, Inc., U.S.A., 2008;

***Optional reading*:**

(1) Budnick, F.S., *“Finite mathematics with applications”* , Mcgraw-Hill, Inc.,USA, 1985;
(2) Diaconiţa, V., Rusu, Gh., Spînu, T.M., *“Matematici aplicate în economie”*, Ed. Sedcom Libris, Iaşi, 2004;
(3) Diaconiţa, V., Rusu, Gh., Spînu, T.M., *“Matematici aplicate în economie – teste grilă”*, Ed. Sedcom Libris, Iaşi, 2005;
(4) Sydsæter, K., Hammond, P., *“Essential Mathematics for Economic Analysis”* - third edition, Prentice-Hall, Inc., Pearson Education Limited, U.K., 2008;

8.2	**Seminar / Laboratory**	**Teaching methods**	**Observations** (time and bibliography)
1.	Elementary transformations (ET). Gauss – Jordan elimination method, reduced row-echelon form at a matrix.	heuristic conversation, problem solving method, case study method	**2 hours** [1] chapters: I.1 - I.6, 4.6 [2] chapters: 2.1, 2..2, 2.5 [3] chapters: 4.1 – 4.3 (1) chapters: 3.3, 3.5
2.	Application of ET in matrix operations (determined the rank of an matrix and computed the inverse matrix of an non-singular/non-degenerate square matrix.	heuristic conversation, problem solving method, case study method	**2 hours** [1] chapter: 1.1 – 1.7 [2] chapters: 2.1, 2..4, 2.5 [3] chapters: 4.3 – 4.4 (1) chapter: 3.3 (3) chapter: I.2
3.	Gauss-Jordan method for solving the system of linear equations. Explicite forms at a system of linear equations, basic solutions.	heuristic conversation, problem solving method, case study method	**2 hours** [1] chapter: 1.1 – 1.7 [2] chapters: 2.1, 2..4, 2.5 [3] chapters: 4.4 – 4.5 (1) chapter: 3.3 (3) chapter: I.2
4.	Linear dependence and independence, fundamental properties. Basis, dimension, coordinates.	heuristic conversation, problem solving method, case study method	**2 hours** [1] chapters: 4.1,4.2,4.4,4.5 (2) chapters: 2.1 - 2.3 (3) chapter: II.1
5.	Change of basis. Substitution lemma.	heuristic conversation, problem solving method, case study method	2 hours [1] chapters 4.4, 4.5, 4.6 (2) chapters 2.2, 2.3
6.	Linear programming, a geometrical approach (n=2)	heuristic conversation, problem solving method, case study method	**2 hours** [2] chapters: 3.1, 3.2 [3] chapters: 5.1-5.3 (1) chapter: 5.3 (3) chapter: I.3
7.	Mathematical models of economic problems.The Simplex table and the Simplex alghoritm.	heuristic conversation, problem solving method, case study method	[2] chapters: 4.1, 4.2, 4.3 [3] chapters: 6.1, 6.2 (1) chapters: 6.1, 6.2 (2) chapter: 3.2 (3) chapters: III.1, III.2
8.	Solving LPP with the Simplex alghoritm. The two-phases method.	heuristic conversation, problem solving method, case study method	[2] chapters: 4.1, 4.2, 4.3 [3] chapters: 6.3, 6.4 (1) chapters: 6.1, 6.2 (2) chapter: 3.2 (3) chapters: III.1, III.2
9.	The two-phases method. The algebric alghoritm to solve TP.	heuristic conversation, problem solving method, case study method	**2 hours** [2] chapters: 4.4, 4.5 (1) chapters: 5.2, 7.1, 7.2 (2) chapter: 3.3.2 (3) chapter: III.8

10.	Non-equilibrate TP. The perturbation method.	heuristic conversation, problem solving method, case study method	**2 hours** [3] chapters: 6.1,6.2 (2) chapters: 4.1, 4.2, 4.6
11.	Economical problems modeling with Markov chains. Transition diagram and transition probability matrix.	heuristic conversation, problem solving method, case study method	**2 hours** [2] chapters: 8.1 [3] chapters: 9.1 (1) chapters: 5.2, 7.1, 7.2 (2) chapter: 3.3.2
12.	Regular Markov chains. Stationary state.	heuristic conversation, problem solving method, case study method	**2 hours** [2] chapters: 8.1 [3] chapters: 9.2 (1) chapters: 5.2, 7.1, 7.2 (2) chapter: 3.3.2
13.	Stationary state. Absorbing Markov chains.	heuristic conversation, problem solving method, case study method	**2 hours** [2] chapters: 8.1 [3] chapters: 9.2 (1) chapters: 5.2, 7.1, 7.2 (2) chapter: 3.3.2
14.	Absorbing Markov chains: standard form, fundamental matrix, limiting matrix.	heuristic conversation, problem solving method, case study method	**2 hours** [2] chapters: 8.1 [3] chapters: 9.3 (1) chapters: 5.2, 7.1, 7.2 (2) chapter: 3.3.2

Bibliography:

Compulsory reading:

[1] Anton, H., *“Elementary linear algebra”*, 5-th edition, WIE, New York, 1987;
[2] Goldstein, L.J., Schneider, D.I., Siegel, M.J., *Finite mathematics & its applications”*, tenth edition, Pearson Prentice Hall, USA, 2010;
[3] Barnett, R. A., Ziegler, M. R., Byleen, K. E., *“Finite Mathematics for Business, Economics, Life Sciences and Social Sciences”* – 11-th edition, Prentice-Hall, Inc., Pearson Education, Inc., U.S.A., 2008;

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(3) Diaconiţa, V., Rusu, Gh., Spînu, T.M., *“Matematici aplicate în economie – teste grilă”*, Ed. Sedcom Libris, Iaşi, 2005;
(5) Diaconiţa, V., *“Matematici aplicate în economie – probleme şi exerciţii”*, Ed. Paralela 45, Piteşti, 2002;
(6) Chiriţă, S., *“Probleme de matematici superioare”*, Ed. Did. şi Pedag., Bucureşti, 1989;

9. Bridging course content with the expectations of the community, professional associations and representative employers in the field of the program

On an annual basis, the course content is discussed with the representatives of the business environment, who hire or could hire graduates from this program, while students are required to provide feedback (on-line, anonymous) after each semester about the course structure, teaching methods, as well as strengths / weaknesses (after the final evaluation).

10. Evaluation

Type of activity	**10.1 Evaluation criteria**	**10.2 Evaluation methods**	**10.3 Allocation to the final grade (%)**
10.4 Course	Theoretical and applied knowledge	exam, during session period	50%
10.5 Seminar/ Laboratory	Applied / practical knowledge	two test papers (partials exams), during the semester	50%

10.6 Minimal performance standard:

- Obtaining 5 points (out of 10) for the complete evaluation (**final mark = FM**) during the semester and exam period, compute as arithmetic average ratio of the exam mark **(Ex)** and the partial evaluation mark **(EVP).**
- the partial evaluation mark **(EVP)** must be minimum 4,00 points (out of 10). (**Warning: EVP ≤ 3.99 means you failed the exam! You can repeat the activities at this course only the next year!!!)**
- the exam mark **(Ex)** must be minimum 5,00 points (out of 10). (**Warning: Ex ≤ 4.99 means you failed the exam! You can repeat once the exam in re-examination period)**

Note:

a) The final mark **(FM)** is computed (with two decimals) as arithmetic average ratio of the exam mark **(Ex)** and the partial evaluation mark **(EVP)** and **must be least 5.00.** The calculation formula it is:

$$FM=(Ex + EVP)/2$$

b) The partial evaluation mark **(EVP)** it's compute as weighted average ratio at the marks of the two test papers (partial exams) taken during the semester. The calculation formula it is:

$$EVP=0,35 * EVP_1+0,65 * EVP_2$$

c) The marks for each test paper are computed using the next formula:

$$EVP_{1,2}= 0,25 * TM + 0,75 * PM$$

where:

- **EVP_1** and **EVP_2** are the marks for the two partial tests papers which are held in the 6/7-th and 10/11-th week of the semester;
- **TM** represent the mark obtein for the correct answers of the **theoretical questions** with multiple choice answers**;**
- **PM** represent the mark for solving **practical applications**, which are presented also as multiple choice answers applications (to solve the practical applications issues you will be solved in writing the problem and you must to compare yours obteined results with the answers given in the problem). Will be also a practical problem which after you solve on paper, you must to take a picture of that and transforme into a PDF file. The PDF file will be attach to the subject (on Moodle platform of FEAA).

Date	**Course coordinator**	**Seminar coordinator**
20 september, 2023	Lecturer **Teodor-Marius SPÎNU**, PhD	Lecturer **Teodor-Marius SPÎNU**, PhD

Date of approval in the departament
27 september 2023

Head of departament which provides the discipline
Professor **ASANDULUI Mircea**, PhD

Head of departament which provides the discipline
Associated Professor **Neştian Ştefan - Andrei**, PhD