SYLLABUS[1]

1. Study programme

1.1 Higher education institution	„Aurel Vlaicu" University of Arad
1.2 Faculty	Faculty of Exact Sciences
1.3 Department	Department of Mathematics and Computer Science
1.4 Field of study	Mathermatics
1.5 Study level	II - Master
1.6 Study programme / Qualification	**Mathematical Modelling in Research and Didactics**

2. Course details

2.1 Name of the course	**Special Chapters of Operator Theory**
2.2 Course coordinator	**Assoc. Prof. Gaşpar Păstorel, Ph.D.**
2.3 Seminar/laboratory/project coordinator	**Assoc. Prof. Gaşpar Păstorel, Ph.D.**
2.4 Study year	1
2.5 Semester	1
2.6 Evaluation type	Exam
2.7 Course type	Compulsory

3. Estimated total time (hours per semester)

3.1 Hours per week	3	of which 3.2 lecture	2	3.3 seminar/laboratory/project	1
3.4 Total hours per curriculum	42	of which 3.5 lecture	28	3.6 seminar/laboratory/project	14
Time division					Hrs
Independent study from textbooks, course support, bibliography and notes					35
Additional reading (libraries, specialized electronic platforms and field research)					30
Preparing of seminars/laboratories/projects, homework, papers, portfolios and essays					30
Tutorial coaching					0
Examinations					3
Other activities					-
3.7 Total individual study hours					**108**
3.8. Total hours per curriculum (3.4) + Total individual study hours (3.7)					**150**
3.9 Total hours per semester					**150**
3.10 Number of ECTS credits					**6**

4. Prerequisites (if applicable)

4.1 curriculum related	Real and Complex Analysis, Functional Analysis
4.2 competence related	N. A.

5. Conditions (if applicable)

5.1 for the lecture	Classroom with Black or White Board, Beamer / videoconferencing tool (e.g. Zoom, BBB, WebEx, GoogleMeet)
5.2 for the seminar/laboratory/project	Classroom with Black or White Board, Beamer / videoconferencing tool (e.g. Zoom, BBB, WebEx, GoogleMeet)

[1] Cf. M.O. of Romania, Part I, Nr. 800 bis/13.XII.2011, Ministerial Decree nr. 5703 from Oct. 18, 2011

6. Specific educational objectives (competences to be acquired)

Professional competences	**C1.** Operating with advanced notions and methods of functional and numerical analysis.
Transversal competences	**CT1.** Showing a responsible attitude towards the scientific and didactical domain, valuating the own potential professionally, respecting the rules of rigorous and efficient labor for executing complex professional tasks. **CT3.** Selecting informational resources, efficient use of professional formation sources, developing the correlation capacity of the professional capacity to the requirements of a dynamical society.

7. Course outcomes (resulting from the specific educational objectives to be acquired)

7.1 General outcomes	• Basic knowledge of unbounded densely defined operators and their spectral theory • Ability to properly apply the accumulated knowledge to solve various types of problems • Develop the analytic capacity
7.2 Specific outcomes	• The students gain the capability of explaining the fundamentals of closed operator, densely defined operator, normal operator, self-adjoint and symmetric operator, spectra of an operator. • The students gain the capability of synthesizing notions needed for advanced topics. • Capability to develop a project for the mathematical modelling of some problems.

8. Course outline

8.1 Lecture	**Teaching methods**	**Remarks**
1. Genaral and specific notions on Hilbert spaces, inner product, orthogonality and the projection theorem, orthonormal bases	▪ Participative lecture, proof.	4 hrs
2. General and specific notions on operators on Hilbert spaces: bounded operators, continuous operator, densely defined operator, Riesz representation of linear and continuous functionals, the adjoint of an operator, orthogonal projection operators, the graph of an operator	▪ Participative lecture, proof.	8 hrs
3. Closed operators 4. Differential operators 5. Spectra of an operator 6. Accretive and sectorial operators	▪ Participative lecture, proof.	4 hrs / item

8.2 Seminar / Laboratory / Project	**Teaching methods**	**Remarks**
1. Genaral and specific notions on Hilbert spaces, inner product, orthogonality and the projection theorem, orthonormal bases	▪ Exercises, presentations, projects	2 hrs
2. General and specific notions on operators on Hilbert spaces: bounded operators, continuous operator, densely defined operator, Riesz representation of linear and continuous functionals, the adjoint of an operator, orthogonal projection operators, the graph of an operator	▪ Exercises, presentations, projects	4 hrs

3. Closed operators 4. Differential operators 5. Spectra of an operator 6. Accretive and sectorial operators	▪ Exercises, presentations, projects	1 hrs / item

8.3. References

1. K. Schmudgen, *Unbounded Self-adjoint Operators on Hilbert Space*, GTM: 265, Springer, 2012
2. J. Weidmann, *Linear Operators in Hilbert Spaces*, GTM: 68, Springer, 1980

9. Correlation of course outline with the expectations of the epistemic community, professional associations and representative employers within the field of the program

This course is taught in similar programs at many universities, both in Romania and abroad. For a better matching with the demands of the labor market, meetings with employers' representatives and specialty teachers from the pre-university education system have been organized. Using English brings and added value to the program, enabling the hiring of graduates by multinational companies (both abroad and in Romania).

10. Evaluation / Grading

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Percentage of the final grade
10.4 Lecture	- correct and complete knowledge of the material; - logical coherence; - assimilation of the specific language and terms;	On-line quiz	30%
10.5 Seminar / laboratory / project	- capacity to operate with the acquired notions;	On-line quiz	20%
	Criteria regarding attitude towards learning, especially the interest for self study	Portfolio	50%
10.6 Minimal performance standard:			
Aquiring basic concepts, mastering the specific terminology and succesfully applying the theory on examples			

Date	Signature of the course coordinator	Signature of the seminar/ laboratory/project coordinator
20.09.2020	Assoc. Prof. Gaşpar Păstorel, Ph.D.	Assoc. Prof. Gaşpar Păstorel, Ph.D.

Date of Department Approval	Signature of the Head of the Department	Signature of the Dean
25.09.2020	Lect. Dr. Lorena Popa	A. Prof. dr. Marius Tomescu

MINISTERUL EDUCAŢIEI ȘI CERCETĂRII
UNIVERSITATEA „AUREL VLAICU“ DIN ARAD
310130 Arad, B-dul Revoluției nr. 77, P.O. BOX 2/158 AR
Tel : 0040-257- 283010; fax. 0040-257- 280070
http://www.uav.ro; e-mail: rectorat@uav.ro
Operator de date cu caracter personal nr.2929

SYLLABUS

1. Study programme

1.1. Higher education institution	**„AUREL VLAICU" UNIVERSITY OF ARAD**
1.2. Faculty	**Faculty of Exact Sciences**
1.3. Department	**Department of Mathematics and Computer Science**
1.4. Field of study	**Mathematics**
1.5. Academic year	**2020-2021**
1.6. Study level	**Master**
1.7. Study programme	**Mathematical Modeling in Research and Didactics**
1.8. Form of education	**Full-time education**

2. Course details

2.1. Name of the course	**Special chapters of algebra**
2.2. Course coordinator	**Moţ Ghiocel, PhD**
2.3. Seminar/laboratory/project coordinator	**Deac Dan, PhD**
2.4. Study year	**1**
2.5. Semester	**1**
2.6. Evaluation type	**SE**
2.7. Course type	**Compulsory**

3. Estimated total time (hours per semester)

3.1. Hours per week	**3**
3.2. Lecture hours per week	**1**
3.3. Seminar/laboratory/project hours per week	**2**
3.4. Total hours per curriculum	**42**
3.5. Lecture hours per per curriculum	**14**
3.6. Seminar/laboratory/project hours per curriculum	**28**
Time division [Hours]	
3.4.1. Independent study from textbooks, course support, bibliography and notes	**30**

3.4.2. Additional reading	**30**
3.4.3. Preparing of seminars/laboratories/projects, homework, papers, portfolios and essay	**30**
3.4.4. Tutorial coaching	**14**
3.4.5. Examinations	**4**
3.4.6. Other activities	**0**
3.7. Total individual study hours	**108**
3.8. Total hours per semester	**150**
3.9. Number of ECTS credits	**6**

4. Prerequisites (if applicable)

4.1. Curriculum related	-
4.2. Competence related	-

5. Conditions (if applicable)

5.1. Conditions for the lecture	**Whiteboard, Projector, Internet Connection**
5.2. Conditions for the seminar	**Whiteboard, Computers, Internet Connection**
5.3. Conditions for the laboratory	-
5.4. Conditions for the project	-

6. Specific educational objectives (competences to be acquired)

6.1. Professional competences	**C1. Operation with notions and advanced methods of functional and numerical analysis.** **C2. Statistical data processing, analysis and interpretation of phenomena and random processes.** **C4. Designing and applying mathematical models for the analysis of phenomena and processes.**
6.2. Transversal competences	**CT1. Manifestation of a responsible attitude towards the scientific and didactic field, capitalizing on own professional potential, observing the rigorous and efficient working rules for the execution of complex professional tasks.** **CT3. Selection of information resources, efficient use of training sources, development of the ability to correlate professional activity to the requirements of a dynamic society.**

7. Course outcomes (resulting from the specific educational objectives to be acquired)

7.1. General outcomes	**- The student deepens the knowledge already acquired by algebra.** **- The student develops the skills to correctly apply the knowledge acquired to solve different classes of problems.** **- The student must train and develop his analytical ability.**
7.2. Specific outcomes	**- The student is able to correctly apply the basic methods and principles in solving complex problems.** **- The student is able to select the appropriate methods and techniques for solving algebra problems.**

8. Course outline

8.1 Lecture	Teaching methods	Remarks
1. Tensor calculus 1.1. Linear and bilinear forms. 1.2. Quadratic forms and canonical forms 1.3. Dual and bidual vector spaces. Dual basis, canonical isomorphism. 1.4. Multilinear applications and forms. Tensors. 1.5. Operations with tensors. Applications in quantum information theory. 1.6. Addition (sum) of tensors. The scalar product of the tensors. The tensor product of two tensors 1.7. The operation of contracting a tensor. Contracted tensor product. Domestic	Lecture, debate, proof exemplification	7 hours
2. The ring of polynomials 2.1. Polynomial rings. Rings of polynomial functions 2.2. Symmetric polynomials. Symmetric rational fractions 2.3. The relation of divisibility and association in divisibility in commutative monoids with simplification. C.m.m.d.c. and c.m.m.m.c. Prime and irreducible elements 2.4. Factorial semigroups. The relation of divisibility and association in divisibility in domains of integrity. The connection with the main ideals. Factorial domains 2.5. Domains with main ideals. Euclidean domains. Divisibility in rings of polynomials 2.6. Prime ideals and maximal ideals. The characteristic of a ring with unit. The first subfield. Prime fields. 2.7. The degree of an extension of fields. Finite extensions. Algebraic extensions. Algebraic elements, minimal polynomial.	Lecture, discussion, proof, exemplification	7 hours

8.2 Lecture references

1. R. Larson, Elementary linear algebra, Brooks Cole, 2016.
2. G. M. Ionescu, Calcul tensorial pentru stiintele ingineresti, Ed. Agir, 2007.
3. G. Moţ, Seminar and course notes- Special chapters of algebra, 2020.
4. G. Moţ, C. L. Mihiţ, Algebra. Seminar and course support, "Aurel Vlaicu" Univ. Publishing House Arad, 2019, 162 pagini, ISBN:978-973-752-809-4.
5. G. Moţ, L. Popa, Algebră liniară. Geometrie analitică şi diferenţială. Ed. Univ. "Aurel Vlaicu" Arad, 2015, 160 pagini, ISBN: 978-973-752-715-8.
6. P. J. Olver, C. Shakiban, Applied Linear Algebra, Undergraduate Texts in Mathematics, 2018.

8.3 Seminar	Teaching methods	Remarks
1. Tensor calculus 1.1. Linear and bilinear forms. 1.2. Quadratic forms and canonical forms 1.3. Dual and bidual vector spaces. Dual basis, canonical isomorphism. 1.4. Multilinear applications and forms. Tensors. 1.5. Operations with tensors. Applications in quantum information theory. 1.6. Addition (sum) of tensors. The scalar product of the tensors. The tensor product of two tensors 1.7. The operation of contracting a tensor. Contracted tensor product. Domestic	Exercise, debate, modeling, project	14 hours
2. The ring of polynomials 2.1. Polynomial rings. Rings of polynomial functions 2.2. Symmetric polynomials. Symmetric rational fractions 2.3. The relation of divisibility and association in divisibility in commutative monoids with simplification. C.m.m.d.c. and c.m.m.m.c. Prime and irreducible elements 2.4. Factorial semigroups. The relation of divisibility and association in divisibility in domains of integrity. The connection with the main ideals. Factorial domains 2.5. Domains with main ideals. Euclidean domains. Divisibility in rings of polynomials 2.6. Prime ideals and maximal ideals. The characteristic of a ring with unit. The first subfield. Prime fields. 2.7. The degree of an extension of fields. Finite extensions. Algebraic extensions. Algebraic elements, minimal polynomial.	Exercise, debate, modeling, project	14 hours

8.4 Seminar references

1. R. Larson, Elementary linear algebra, Brooks Cole, 2016.
2. G. M. Ionescu, Calcul tensorial pentru stiintele ingineresti, Ed. Agir, 2007.
3. G. Moţ, Seminar and course notes- Special chapters of algebra, 2020.
4. G. Moţ, C. L. Mihiţ, Algebra. Seminar and course support, "Aurel Vlaicu" Univ. Publishing House Arad, 2019, 162 pagini, ISBN:978-973-752-809-4.
5. G. Moţ, L. Popa, Algebră liniară. Geometrie analitică şi diferenţială. Ed. Univ. "Aurel Vlaicu" Arad, 2015, 160 pagini, ISBN: 978-973-752-715-8.
6. P. J. Olver, C. Shakiban, Applied Linear Algebra, Undergraduate Texts in Mathematics, 2018.

8.5 / Laboratory	Teaching methods	Remarks

8.6 Laboratory references

8.7 / Project	Teaching methods	Remarks

8.8 Project References

9. Corroboration / validation of course putline (if applicable)

This course is taught in similar programs at many universities, both in Romania and abroad. For a better matching with the demands of the labor market, meetings with employers' representatives and specialty teachers from the pre-university education system have been organized. Using English brings and added value to the program, enabling the hiring of graduates by multinational companies (both abroad and in Romania).

10. Evaluation / Grading

Activity type	Evaluation criteria	Evaluation methods	Percentage of the final grade
10.1. Lecture	▪ **knowledge;** ▪ **logical coherency;** ▪ **acquiring the specialty language;**	**Oral Assessment (final exam period):** ▪ **presentation of a final project** ▪ **free exposure** **oral questionnaires.**	**40%**
	▪ **criteria that envisage attitudinal aspects: seriousness, conscientiousness and interest for the subject.**	**Active participation to the course.**	**10%**
10.2. Seminar	▪ **capacity of using the acquired knowledge;** ▪ **capacity of applying in practice;**	**Oral assessment (final exam period): preparation and submission of final project.**	**40%**
	▪ **conscientiousness and interest for the study.**	**Active participating to the seminar activities**	**10%**
10.3. Laboratory			%

10.4. Project			%

10.5 Minimal performance standard

Acquiring the fundamental concepts, using the specialty language and solving an application at basic level.

Date	Signature of course coordinator	Signature of seminar coordinator
21.09.2020	Prof. Moț Ghiocel, Ph.D.	Lect. Deac Dan, Ph.D.

Date of Department Approval	Signature of the Head of the Department	Signature of the Dean
25.09.2020	Lect. Lorena Popa,Ph.D.	A. Prof. dr. Marius Tomescu

SYLLABUS[1]

1. Study programme

1.1 Higher education institution	„Aurel Vlaicu" University of Arad
1.2 Faculty	Faculty of Exact Sciences
1.3 Department	Department of Mathematics and Computer Science
1.4 Field of study	Mathematics
1.5 Study level	Master
1.6 Study programme / Qualification	Mathematical modelling in research and didactics

2. Course details

2.1 Name of the course	**Lie Algebras and their application in physics**
2.2 Course coordinator	**Prof. dr. habil.Adrian Palcu**
2.3 Seminar coordinator	**Prof. dr. habil. Adrian Palcu**
2.4 Study year	I
2.5 Semester	I
2.6 Evaluation type	Exam
2.7 Course type	proficiency / compulsory

3. Estimated total time (hours per semester)

3.1 Hours per week	2	of which 3.2 lecture	1	3.3 seminar/laboratory/project	1
3.4 Total hours per curriculum	28	of which 3.5 lecture	14	3.6 seminar/laboratory/project	14

Time division	hrs
Independent study from textbooks, course support, bibliography and notes	43
Additional reading (libraries, specialized electronic platforms and field research)	20
Preparing of seminars/laboratories/projects, homework, papers, portfolios and essays	20
Tutorial coaching	10
Examinations	4
Other activities	-
3.7 Total individual study hours	**97**
3.8. Total hours per curriculum (3.4) + Total individual study hours (3.7)	**125**
3.9 Total hours per semester (25 hrs /1 credit) **25 x 5= 150**	**125**
3.10 Number of ECTS credits	**5**

4. Prerequisites (if applicable)

4.1 curriculum related	1. Linear algebra 2. Mathematical analysis
4.2 competence related	

5. Conditions (if applicable)

5.1 for the lecture	Classroom equipped with laptop, projector and blackboard
5.2 for the seminar/laboratory/project	blackboard

6. Specific educational objectives (competences to be acquired)

Professional competences	C4. Conceive and apply mathematical models in analyzing real processes and systems.
Transversal competences	CT2. Coordination and efficient leadership of activities in a multidisciplinary group.

7. Course outcomes (resulting from the specific educational objectives to be acquired)

7.1 General outcomes	- Student get familiar with basic notions of Lie groups and Lie algebras, understand main theorems - Student develop abilities to apply correctly the notions in resolving certain problems. - Studentul develops his/her capacity to analyse.
7.2 Specific outcomes	- Student is able to prove knowledge regarding: Lie groups, Lie algebra, unitary representation, simple and double connected, subalgebras. - Student is able to apply the methods and basic principles in solving complex problems. - Student is ableto identify main kinds of semisimple algebras. - Student is able to conceive projects to model some concrete problems in particle physics.

8. Course outline

8.1 Course	**Teaching methods**	**Remarks**
1. **Fundamentals of group theory**	Participatory lecture, debate, exposing, questioning, demonstration.	2 hours
2. **Group representations**	Participatory lecture, discussion, interactive exposure, exemplifying	2 hours
3. **Continuous groups**	Participatory lecture, discussion, interactive exposure, exemplifying	2 hours
4. **Lie groups. Lie algebras**	Participatory lecture, discussion, interactive exposure, exemplifying	2 hours
5. **Rotation groups SO(2), SO(3)**	Participatory lecture, discussion, interactive exposure, exemplifying	2 hours
6. **Special unitary groups SU(2), SU(3)**	Participatory lecture, discussion, interactive exposure, exemplifying	2 hours
7. **Lorentz-Poincare group**	Participatory lecture, discussion, interactive exposure, exemplifying	2 hours

8.2 Seminar	**Teaching methods**	**Remarks**
1. **Discrete groups**	Exercise, discussion and debate, organized group work	2 hours

2. Unitary representations	Exercise, discussion and debate, organized group work	2 hours
3. Topological manifolds	Exercise, discussion and debate, organized group work	2 hours
4. Adjoint representation of a Lie algebra	Exercise, discussion and debate, organized group work	2 hours
5. SO(3) group. Generators of rotations	Exercise, discussion and debate, organized group work	2 hours
6. SU(2) group. Pauli matrices	Exercise, discussion and debate, organized group work	2 hours
7. Lorentz-Poincare group. Rotations and boosts	Exercise, discussion and debate, organized group work	2 hours

References

[1] R. Gilmore, *Lie Groups, Lie Algebras and Some of Their Applications*, Dover (2006).
[2] J. E. Humphreys, *Introduction to Lie Algebras and Representation Theory,* Springer (1973).
[3] J. - P. Serre, *Lie Algebras and Lie Groups 1964 Lectures given at Harvard University*, Springer (2003).
[4] R. N. Cahn, *Semi-Simple Lie Algebras and Their Representations*, Dover (2006).
[5] A. Palcu, *Grupuri. Algebre Lie. Aplicatii in fizica particulelor*, Ed. UAV (2016).
[6] Wu-Ki Tung, *Group Theory in Physics*, World Scientific (1985).
[7] B. C. Hall, *Lie Groups, Lie Algebras and Representations: An Elementary Introduction*, Springer (2003).

9. Correlation of course outline with the expectations of the epistemic community, professional associations and representative employers within the field of the program

This course is taught in similar programs at many universities, both in Romania and abroad. Using English brings and added value to the program, enabling the hiring of graduates by multinational companies (both abroad and in Romania).

10. Evaluation / Grading

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Percentage of the final grade
10.4 Course	▪ correctness and completeness of knowledge ▪ logical consistency ▪ degree of assimilation of language specialist	Oral Assessment (final exam period): ▪ Presentation ▪ Exposure free student ▪ Conversation Assessment ▪ Questionnaires oral.	30%
	▪ consciousness, interest for study	Written Assessment: Preparation and submission of a written project on a topic chosen by the student	20%

10.5 Seminar	▪ ability to work with their knowledge; ▪ ability in practice.	Oral Assessment (final exam period): ▪ defending the written project.	30%
	▪ consciousness, interest for study.	Active participation to seminars and applications.	20%
10.6 Minimal performance standard:			
▪ Learning the basic concepts, using specialized language, resolving some problems.			

Date,	Signature of the course coordinator	Signature of the seminar/ laboratory/project coordinator
24.09.2020	Prof. dr. habil. ADRIAN PALCU	Prof. dr. habil. ADRIAN PALCU

Date of Department Approval	Signature of the Head of the Department	Signature of the Dean
25.09.2020	Lect. Dr. Lorena Popa	A. Prof. dr. Marius Tomescu

SYLLABUS

1. Information regarding the program

1.1 Higher education institution	„Aurel Vlaicu" University of Arad
1.2 Faculty	Faculty of Exact Sciences
1.3 Department	Mathematics-Informatics Department
1.4 Field of study	Mathematics
1.5 Cycle of study	Master
1.6 Program of study /Degree	**Mathematical modeling in research and didactics**

2. Information regarding the subject

2.1 Name of subject	Modeling and optimization of decisions
2.2 Course holder	Prof.dr.Sorin Nadaban
2.3 Seminar holder	Lect. Dr. Dan Deac
2.4 Year of study	I
2.5 Semester	1 (I)
2.6 Type of assessment	Exam
2.7 Type of discipline	Elective (E)

(C) Compulsory; (E) Elective; (F) Facultative

3. Estimated total time (hours/semester of activities)

3.1 Number of hours/week	1	out of which: 3.2 course	1	3.3 seminar	1
3.4 Total of hours in Curriculum	28	out of which: 3.5 course	14	3.6 seminar	14

Distribution of hours:	hours
Studying the workbook, course book, bibliography and notes	30
Supplementary documentation in the library, on electronic specialty sites and in the field	25
Preparing seminars/laboratories, themes, projects, portfolios and essays	25
Tutorship	13
Assessment activities	4
Other activities.....	
3.7 Total hours of individual study	97
3.8 Total hours:(3.4) + (3.7)	**125**
3.9 Total hours/semester	**125**
3.10 Number of credits ECTS	**5**

4. Pre-requisites (if applicable)

4.1 curriculum	-
4.2 skills	-

5. Conditions (if applicable)

5.1. concerning course activities	
5.2. concerning seminar/laboratory activities	

6. Specific skills acquired	
Professional skills	Design and application of mathematical models for the analysis of phenomena and processes

Transversal Skills	1. Manifestation of a responsible attitude towards the scientific and didactic field, capitalizing on one's own professional potential, observing the rules of rigorous and efficient work for the execution of complex professional tasks 2. Coordination and efficient management of activities organized in a team or in an interdisciplinary group 3. Selection of information resources, efficient use of vocational training sources, development of the capacity to correlate professional activity to the requirements of a dynamic society

7. Objectives of discipline (resulting from the grid of specific skills acquired)

7.1 General objective of discipline	Familiarizing students with decision theory and optimization techniques
7.2 Specific objectives	A. Cognitive objectives - Knowledge of optimization techniques in decision making B. Procedural objectives -Training skills for continuous self-education C. Attitudinal objectives -Acquiring the knowledge and skills necessary for a future teacher to combine mathematical rigor with didactic accessibility

8. Contents

8.1 Course (C)	**Teaching methods**	**Observations**
1. Decisions and decision makers (2 hours)	▪ Interactive Exposure ▪ Individual Study ▪ Questioning ▪ Modeling	Short power-point presentations to stimulate reflective exercise
2. Modeling Decision Monocriteriale Problems: - under uncertainty - under risk (4 hours)		
3. Modeling and Optimization of Multiattribute Decisions. Characteristics of Multiattribute Decision Problems. Expression of the Multiattribute Decision Problem. (4 hours)		
4. Modeling Multiattribute Decision Using Fuzzy Sets. (4 hours)		

8.2 Seminar (S)	**Teaching methods**	**Obs**
1. Organizational seminar: presentation of the seminar plan, of the discipline objectives, of the targeted competencies (2 hours)	• Practical application • Case Study. • Exercise • Explication • Debate	• Computer • Educational software • E-learning platform
2. Modeling Decision Monocriteriale Problems: - under uncertainty - under risk (4 hours)		
2. Multicriteria methods (PROMETHEE, ORESTE, Electre, TOPSIS) (4 hours)		
3. Linear and nonlinear programming problems (4 hours)		

Bibliography for course and seminar

1. Nagy M, Lecture notes, 2016 (electronic learning material)

2.Filip F. Gh., Sisteme suport pentru decizii, Ed. Tehnică, Bucureşti, 2007

3. Gaindric, C. Systemic approaches in decision making, Chisinau, 2017.
4. Nădăban, S .; Dzitac, S .; Dzitac, I. Fuzzy TOPSIS: A General View, Procedia Computer Science, Volume 91, Pages823-831, 2016.

9. Corroboration of the contents of the discipline with the expectations of the epistemic community, professional associations and employers representing the field of study of the program

• the correctness and accuracy of the use of concepts and theories acquired at the level of the discipline - will satisfy the expectations of the representatives of the epistemic / academic community in the field of didactic mathematics
• the procedural and attitudinal competencies that will be acquired at the level of the discipline - will satisfy the expectations of the representatives of the professional associations and the employers in the field of education

10. Assessment

Type of activity	10.1 Assessment criteria	10.2 Assessment methods	10.3 Percentage of the final grade
10.4 Course (C)	Correctness and completeness of knowledge; Ability to synthesize and apply theoretical knowledge; Use of specialized language; Logical coherence	Test	30%
10.5 Seminar (S)	Seminar activity	Report on a given topic	70%
10.9Minimum performance standard			
Learning the basic concepts, using specialized language, making a simple application.			

Data of issue
16.09.2020

Signature of course holder
Prof. Sorin Nadaban,Phd

Signature of laboratory holder
Prof. Dan Deac, Phd

Date of Department Approval
25.09.2020

Signature of the Head of the Department
Lect. Lorena Popa,Phd

Signature of the Dean
A. Prof. dr. Marius Tomescu

SYLLABUS[1]

1. Study programme

1.1 Higher education institution	„Aurel Vlaicu" University of Arad
1.2 Faculty	Faculty of Theoretical Sciences
1.3 Department	Department of Theoretical Sciences
1.4 Field of study	Mathematics
1.5 Study level	Masters
1.6 Study programme / Qualification	Full time / Mathematical Modelling in Research and Teaching

2. Course details

2.1 Name of the course	**Ethics and Academic Integrity**
2.2 Course coordinator	**Professor CORNELIU C. SIMUȚ**
2.3 Seminar/laboratory/project coordinator	
2.4 Study year	I
2.5 Semester	I
2.6 Evaluation type	E
2.7 Course type	Compulsory course

3. Estimated total time (hours per semester)

3.1 Number of hours per week	1	of which 3.2 course	1	3.3 seminar/laboratory	0
3.4 Total hours per curriculum	14	of which 3.5 course	14	3.6 seminar/laboratory	0
Time division					ore
Study from textbooks, course platform, bibliography, and notes					15
Additional reading in the library, specialized e-platforms, and onsite research					15
Preparation for seminars/laboratories, assignments, papers, essays, portfolios					10
Tutorial coaching					10
Examinations					2
Other activities					9
3.7 Total individual study hours					**59**
3.8 Total hours per curriculum (3.4) + Total hours individual study (3.7)					**73**
3.9 Total hourse per semester (25 hours / 1 credit): 25 x 1 = 25					**75**
3.10 Number of credits					**3**

4. Prerequisites (if applicable)

4.1 curriculum related	N/A
4.2 competence related	N/A

5. Conditions (if applicable)

5.1 for the lecture	PowerPoint and Internet A decent verbal attitude and a proper dress code are mandatory for students. Students are also required to participate in the seminar's activities by asking questions and providing comments.
5.2 for the seminar/laboratory/project	PowerPoint and Internet, short videos, etc. A decent verbal attitude and a proper dress code are mandatory for students. Students are also required to participate in the seminar's activities by asking questions and providing comments.

6. Specific educational objectives (competences to be acquired)

Professional competences	C.P1. The enactment of the mission to preach the faith in a spirit of tolerance while using scientific tools for the ethical investigation of biblical information. C.P2. The correct dissemination of biblical doctrines and the means for the perfection of human beings in

[1] Cf. M.O. of Romania, Part I, Nr. 800 bis/13.XII.2011, Ministerial Decree nr. 5703 from Oct. 18, 2011

	the world with regard to ethical and scientific minuteness and precision. C.P3. The recognition and interpretation of the complex issues adjoint to religious and ecumenical development from the perspective of scientific research in an ethical way. C.P4. The capacity to clearly and ethically evaluate religious phenomena in the light of religious research. C.P5. The ethical promotion of ecumenical dialogue based on thorough academic research.
Transversal competences	C.T1. The application of deontological values and principles pertaining to the theology of sacred/biblical texts, based on professional autonomy and independence originating in scientific research. C.T2. The planning and organization of human resources to provide a more effective work for the church and the dissemination of ecclesiastical mission in the world as a result of earnest academic research. C.T3. The self-evaluation of the needs for life-long formation to adapt professional competences to the dynamics of religious phenomena and the promotion of ecclesiastical mission; the appropriation of specific methods and techniques of self-taught learning, including individual research.

7. Course outcomes (resulting from the specific educational objectives to be acquired)

General outcomes	☒ Understanding and having the ability to present the course subject from a scientific and ethical perspective ☒ Developing the capacity to analyze the course's main notions and the necessary conditions for their actual manifestation ☒ Developing proper knowledge and abilities to build a research enterprise with adequate strategies, working methods, and research techniques
Specific outcomes	1. Knowledge and understanding - To know and use adequately the notions presented by the course - To know the main rules of selection and utilization of various methods and techniques necessary for the acquisition of information in scientific research as related to the course and the issues raised by the research enterprise 2. Explanation and interpretation - To explain and interpret adequately the theoretical and conceptual notions of the course - To explain and interpret the main enterprises aimed at achieving the research goals of theology - To acknowledge the connection between the cultural differences and the peculiarities of the theological enterprise in various contexts 3. Instrumental Application - Draft a scientific enterprise which is applicable and demonstrates usefulness epistemologically and methodologically. - Use methods, techniques, and instruments specific to scientific investigations - The projection, conducting, and evaluations of practical activities meant to investigate theology as science 4. Attitude Related - Display positive and responsible attitudes towards scientific enterprises - Manifesting a positive and responsible attitude to theology as science. - The optimal and creative valorization of one's self-potential in scientific activities.

8. Course outline

Lecture	No of hours	Teaching methods	Remarks
1. Integrity-Based Research	**1**	Lectures, Interactive dialogue, Logical analysis, hermeneutics, and text projection	
2. The Nuerenberg Principles	**1**	Lectures, Interactive dialogue, Logical analysis, hermeneutics, and text projection	
3. Taking Ethical Decisions	**1**	Lectures, Interactive dialogue, Logical analysis, hermeneutics, and text projection	
4. Building Integrity	**1**	Lectures, Interactive dialogue, Logical analysis,	

		hermeneutics, and text projection	
5. Courage in Research	**1**	Lectures, Interactive dialogue, Logical analysis, hermeneutics, and text projection	
6. Respectfulness in Research	**1**	Lectures, Interactive dialogue, Logical analysis, hermeneutics, and text projection	
7. Resoluteness in Research	**1**	Lectures, Interactive dialogue, Logical analysis, hermeneutics, and text projection	
8. Honesty in Research	**1**	Lectures, Interactive dialogue, Logical analysis, hermeneutics, and text projection	
9. Humility in Research	**1**	Lectures, Interactive dialogue, Logical analysis, hermeneutics, and text projection	
10. Reflexivity in Research	**1**	Lectures, Interactive dialogue, Logical analysis, hermeneutics, and text projection	
11. Performance Culture in Research	**1**	Lectures, Interactive dialogue, Logical analysis, hermeneutics, and text projection	
12. Virtue Learning in Research	**1**	Lectures, Interactive dialogue, Logical analysis, hermeneutics, and text projection	
13. Being Professional in Research	**1**	Lectures, Interactive dialogue, Logical analysis, hermeneutics, and text projection	
14. Research Ethics as Deontology	**1**	Lectures, Interactive dialogue, Logical analysis, hermeneutics, and text projection	

8.2 Seminar / Laboratory / Project	**No of hours**	**Teaching methods**	**Remarks**

Bibliografie

1. Mihaela Şt. Radulescu, **Metodologia cercetării ştiinţifice**, Ed. Didactică şi Pedagogică, Bucureşti, 2007.
2. Cristina Popescu, **Tehnica muncii intelectuale – metodologia cercetării şi elaborarii lucrărilor ştiinţifice,** Ed. Ars Docendi, Bucureşti, 2011.
3. Matei Simandan, **Metodologia cercetării ştiinţifice**, Ed. Mirton, Timisoara, 2010.
4. Coord. Gheorghe Tauru, **Metodologia şi managementul cercetării ştiinţifice – teorie şi aplicaţii,** Ed. Universitaria, Craiova, 2008.
5. Umberto Eco, **Cum se face o teza de licenţă – disciplinele umaniste**, Ed.revazuta, Ed.Polirom, Iasi, 2006.
6. Laurent Jenny, **Rostirea singulara**, Universitatea Bucureşti, 1999.
7. Earl Babbie, **The Practice of Social Research**, ed.VIII, Wadsworth, Belmont, California, 1995.
8. Jacqes Baryan, Henry F. Graff, **The Modern Research**, ed. A V/a, Harcourt Brace Jovanovich, New York.

9. Doru Cosici, **Metodologia cercetării ştiinţifice – lucrări practice**, Ed.Mirton, Timişoara, 2003.
10. Dumitru Muster, **Metodologia cercetării în educaţie şi învăţământ – ghid în elaborarea şi prezentarea de comunicări şi lucrări metodico-ştiintifice de grad,** Ed.Litera, Bucureşti, 1985.
11. Marin Ardelean, **Metodologia elaborării tezelor de doctorat**, Ed. Academic Press, Cluj, 2007.
12. Mihaela St. Radulescu, **Metodologia cercetării ştiinţifice – elaborarea lucrării de licenţă, masterat, doctorat,** ed. A II-a, Ed.Didactica si Pedagogica, Bucureşti, 2011.
13. Ion Bordeianu, **Metodologia cercetării ştiinţifice: note de curs**, Ovidius University Press, Constanta, 2010.
14. Leonora Caciuc, **Metodologia cercetării ştiinţifice**, Ed.Eikon, Cluj, 2012.
15. Ion Dragutoiu, **Introducere în metodologia cercetării ştiinţifice: note de curs**, Ed.Dimitrie Cantemir, Targu-Mureş, 2009.
16. Sanda Krausz, **Metodologia cercetării ştiinţifice**, Ed.Universitas, Petrosani, 2007.
17. Raducan Oprea, **Initiere în metodologia cercetării ştiinţifice**, Galati University Press, 2008.
18. Kenneth F. Kister, **Best Encyclopedias: A Guide to the Best Specialiyed Envyclopedias**, Ed. a II/a, Oryx Press, Phoenix, 1994.
19. Rebecca B. Rubin, Alan M. Rubin, Linda Piele, **Communication Research: Strategies and Sources,** ed. a 3/a, Belmont, California, 1993.

9. Correlation of course outline with the expectations of the epistemic community, professional associations and representative employers within the field of the program

This course provides epistemic and methodological tools for the preparation and defence of the masters dissertation. Prospectively, it offers adequate provision of doctoral studies and advanced scientific research in Romania and the European Union both in state and private venues of tertiary education and learning. It also provides students with the necessary information for individual and team work regarding institutionalized scientific productions.

10. Evaluation / Grading

Activity type	**Evaluation criteria**	**Evaluation methods**	**Percentage of the final grade**
Lecture	**Exam**	Personal involvement in questions, comments, and analysis. The frequency and pertinence of personal interaction during the lectures is vital.	**50%**
Seminar /	Exam	Personal involvement in the preparation and analysis of the proposed assignments.	
		The frequency and pertinence of personal interaction during the seminar is vital.	
Projects	Writing a scientific paper on a certain subject		50.00%
Minimal performance standard: 50%			

Date	Signature of the course coordinator	Signature of the seminar/laboratory/project coordinator
	Corneliu C. Simut	

Date of Department Approval	Signature of the Head of the Department
25.09.2020	

SYLLABUS[1]

1. Study programme

1.1 Higher education institution	„Aurel Vlaicu" University of Arad
1.2 Faculty	Faculty of Exact Sciences
1.3 Department	Department of Mathematics and Computer Science
1.4 Field of study	Mathermatics
1.5 Study level	II - Master
1.6 Study programme / Qualification	**Mathematical Modelling in Research and Didactics**

2. Course details

2.1 Name of the course	**Dilation Theory and Operatorial Models**
2.2 Course coordinator	**Assoc. Prof. Gaşpar Păstorel, Ph.D.**
2.3 Seminar/laboratory/project coordinator	**Assoc. Prof. Gaşpar Păstorel, Ph.D.**
2.4 Study year	1
2.5 Semester	2
2.6 Evaluation type	Exam
2.7 Course type	Compulsory

3. Estimated total time (hours per semester)

3.1 Hours per week	3	of which 3.2 lecture	2	3.3 seminar/laboratory/project	1
3.4 Total hours per curriculum	42	of which 3.5 lecture	28	3.6 seminar/laboratory/project	14
Time division					Hrs
Independent study from textbooks, course support, bibliography and notes					28
Additional reading (libraries, specialized electronic platforms and field research)					14
Preparing of seminars/laboratories/projects, homework, papers, portfolios and essays					50
Tutorial coaching					12
Examinations					4
Other activities					-
3.7 Total individual study hours					**108**
3.8. Total hours per curriculum (3.4) + Total individual study hours (3.7)					**150**
3.9 Total hours per semester					**150**
3.10 Number of ECTS credits					**6**

4. Prerequisites (if applicable)

4.1 curriculum related	Real and Complex Analysis, Functional Analysis
4.2 competence related	N. A.

5. Conditions (if applicable)

5.1 for the lecture	Classroom with Black or White Board
5.2 for the seminar/laboratory/project	Classroom with Black or White Board, Beamer

6. Specific educational objectives (competences to be acquired)

Professional competences	**C1.** Operating with notions and advanced methods of functional and numerical analysis. **C4.** Conceiving and applying mathematical models for the analysis of phenomena and processes.
Transversal competences	**CT1.** Showing a responsible attitude towards the scientific and didactical domain, valuating the own potential professionally, respecting the rules of rigorous and efficient labor for executing complex professional tasks. **CT3.** Selecting informational resources, efficient use of professional formation sources, developing the correlation capacity of the professional capacity to the requirements of a dynamical society.

7. Course outcomes (resulting from the specific educational objectives to be acquired)

7.1 General outcomes	• Basic knowledge of dilation of contractions and functional models for operators • Ability to properly apply the accumulated knowledge to solve various types of problems • Develop the analytic capacity
7.2 Specific outcomes	• The students are capable to prove to have gained sufficient knowledge to understand concepts like Hilbert space contraction, characteristic function of a Hilbert space contraction. • The students gain the capability of applying correctly methods and basic principles in solving complex problems. • Capability to develop a project for the mathematical modelling of some problems.

8. Course outline

8.1 Lecture	**Teaching methods**	**Remarks**
1. Unitary extensions of isometric operators. Subnormal operators.	▪ Participative lecture, proof.	4 hrs
2. Hilbert space contractions and their canonical decomposition.	▪ Participative lecture, proof.	4 hrs
3. Hardy space of Hilbert space valued functions.	▪ Participative lecture, proof.	4 hrs
4. Unilateral translations and their functional model	▪ Participative lecture, proof.	4 hrs
5. Functional calculus for Hilbert space contractions.	▪ Participative lecture, proof.	4 hrs
6. Unitary dilation of Hilbert space contractions. The geometric structure of the dilation space.	▪ Participative lecture, proof.	4 hrs
7. The characteristic function of a Hilbert space contraction and its operator-functional model.	▪ Participative lecture, proof.	4 hrs

8.2 Seminar / Laboratory / Project	**Teaching methods**	**Remarks**
1. Unitary extensions of isometric operators. Subnormal operators.	▪ Exercises, presentations, projects	2 hrs
2. Hilbert space contractions and their canonical decomposition.	▪ Exercises, presentations, projects	2 hrs

3. Hardy space of Hilbert space valued functions.	▪ Exercises, presentations, projects	2 hrs
4. Unilateral translations and their functional model	▪ Exercises, presentations, projects	2 hrs
5. Functional calculus for Hilbert space contractions.	▪ Exercises, presentations, projects	2 hrs
6. Unitary dilation of Hilbert space contractions. The geometric structure of the dilation space.	▪ Exercises, presentations, projects	2 hrs
7. The characteristic function of a Hilbert space contraction and its operator-functional model.	▪ Exercises, presentations, projects	2 hrs

8.3. References

1. A. Gheondea, *Operator models for Hilbert locally C*-modules*, Operators and matrices **11** (3), 2017, pp. 639 – 667.
2. D. Han, D. R. Larson, B. Liu, R. Liu, *Operator-valued measures, dilations, and the theory of frames*, Amer Mathematical Society, Memoirs of the American Mathematical Society 1075, 2014.
3. B. Sz.-Nagy, C. Foias, H. Bercovici, L. Kérchy, *Harmonic analysis of operators on Hilbert space*, Springer-Verlag New York, 2010.

9. Correlation of course outline with the expectations of the epistemic community, professional associations and representative employers within the field of the program

This course is taught in similar programs at many universities, both in Romania and abroad. For a better matching with the demands of the labor market, meetings with employers' representatives and specialty teachers from the pre-university education system have been organized. Using English brings and added value to the program, enabling the hiring of graduates by multinational companies (both abroad and in Romania).

10. Evaluation / Grading

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Percentage of the final grade
10.4 Lecture	- correct and complete knowledge of the material; - logical coherence; - assimilation of the specific language and terms;	Oral evaluation: - Free talk of the student; - Q&A session.	25%
	Thoroughness, ability for individual study, capacity of writing a scientific essay.	Written evaluation: scientific essay	25%
		Active participation at lectures and seminars	20%

10.5 Seminar / laboratory / project	- capacity to operate with the acquired notions; - capacity to apply the acquired knowledge;	Project for scientific essay	30%
10.6 Minimal performance standard:			
Aquiring basic concepts, mastering the specific terminology and succesfully applying the theory on examples			

Date
20.09.2020

Signature of the course coordinator

Assoc. Prof. Gaşpar Păstorel, Ph.D.

Signature of the seminar/

Assoc. Prof. Gaşpar Păstorel, Ph.D.

Date of Department Approval
25.09.2020

Signature of the Head of the Department
Lect. Lorena Popa Ph.D.

Signature of the Dean
A. Prof. dr. Marius Tomescu

SYLLABUS

1. Information regarding the program

1.1 Higher education institution	"Aurel Vlaicu" University of Arad
1.2 Faculty	Faculty of Exact Sciences
1.3 Department	Department of Mathematics and Computer Science
1.4 Field of study	Mathematics
1.5 Study cycle	Master
1.6 Study program / Qualification	Mathematical Modelling in Research and Didactics

2. Information regarding the discipline

2.1 Name of the discipline	**C * -algebras and Hilbert modules**
2.2 Course coordinator	Prof. Sorin Nădăban, Ph.D.
2.3 Laboratory coordinator	Lect. Sida Lavinia, Ph.D.
2.4. Year of study	I
2.5 Semester	2
2.6. Type of evaluation	E
2.7 Type of discipline	Compulsory

3. Total estimated time (hours/semester of didactic activities)

3.1 Hours per week	**3**	Of which: 3.2 course	**2**	3.3 seminar/laboratory	**1**
3.4 Total hours in the curriculum	**42**	Of which: 3.5 course	**28**	3.6 seminar/laboratory	**14**

Time division	**hours**
Learning using manual, course support, bibliography, course notes	30
Additional documentation (in libraries, on electronic platforms, field documentation)	30
Preparation for seminars/labs, homework, papers, portfolios and essays	39
Tutorship	30
Evaluations	4
Other activities:	
3.7 Total individual study hours	**133**
3.8. Total hours of curriculum (3.4)=42 + Total individual study hours (3.7)=133	**175**
3.9 Total hours per semester (25 hours/1 ECTS) 25 x 7= 175	**175**
3.10 Number of ECTS credits	**7**

4. Prerequisites (if necessary)

4.1. curriculum related	-
4.2. competence related	-

5. Conditions (if necessary)

5.1. for the course	-
5.2. for the seminar /lab activities	-

6. Specific competences acquired

Professional competencies	C1. Operation with notions and advanced methods of functional and numerical analysis
Transversal competencies	• Manifestation of a responsible attitude towards the scientific and didactic field, capitalizing on own professional potential, observing the rigorous and working rules for the execution of complex professional tasks. • Coordination and efficient management of activities organized in a team or in an interdisciplinary group • Selection of information resources, efficient use of training sources, development of the ability to correlate professional activity to the requirements of a dynamic society.

7. Course objectives (based on the grid competencies acquired)

7.1 General objective of the discipline	-The student should know the basics of C *-algebras and Hilbert modules and understand the important theorems. -The student to develop the skills to correctly apply the knowledge gained to solve different classes of problems. -The student must train and develop his analytical ability.
7.2 Specific objectives of the discipline	-The student is able to demonstrate that he has acquired sufficient knowledge to understand concepts such as: C * -algebras, W * -algebras, C * -Hilbert modules, orthogonality in Hilbert modules, operators that admit adjoint on Hilbert modules, inductive and projectives topologies, local C *-algebras - The student is able to correctly apply the basic methods and principles in solving complex problems. - The student is able to recognize the main classes / types of C * -algebra problems and to select the appropriate methods and techniques for solving them. - The student can make projects for the mathematical modeling of a concrete problem.

8. Contents

8.1 Course	**Teaching methods**	**Remarks**
1. C * -algebre 1.1. Definition and examples; 1.2. Gelfand Representation; 1.3. The spectrum in Banach algebra; 1.4. Adding the unit; 1.5. Positive elements; 1.6. Approximation of the unit; 1.7. Ideals and quanta; 1.8. Positive linear representations and functions.	Lecture, debate, proof, exemplification	6 hours
2. W * -algebre 2.1. Locally convex spaces; 2.2. Projective topologies; 2.3. Topological tensor products; 2.4. W * -algebre;	Lecture, debate, proof, exemplification	8 hours

2.5. Topologies on B (H); 2.6. Algebra von Neumann.		
3. Hilbert module 3.1. Introduction; 3.2. Examples; 3.3. Orthogonality in Hilbert modules; 3.4. Operators admitting adjoint on C *-module Hilbert; 3.5. Unbounded operators on Hilbert modules.	Lecture, debate, proof, exemplification	8 hours
4. Hilbert modules over local C * -algebras 4.1. Inductive topologies; 4.2. C * -local algebra; 4.3. Hilbert modules over local C * -algebras; 4.4. Operators on Hilbert modules.	Lecture, debate, proof, exemplification	6 hours

8.2 Seminar/laboratory	**Teaching methods**	**Remarks**
1. C * -algebre 1.1. Definition and examples; 1.2. Gelfand Representation; 1.3. The spectrum in Banach algebra; 1.4. Adding the unit; 1.5. Positive elements; 1.6. Approximation of the unit; 1.7. Ideals and quanta; 1.8. Positive linear representations and functions.	Exercise, discussions and debate, modeling, project	4 hours
2. W * -algebre 2.1. Locally convex spaces; 2.2. Projective topologies; 2.3. Topological tensor products; 2.4. W * -algebre; 2.5. Topologies on B (H); 2.6. Algebra von Neumann.	Exercise, discussions and debate, modeling, project	4 hours
3. Hilbert module 3.1. Introduction; 3.2. Examples; 3.3. Orthogonality in Hilbert modules; 3.4. Operators admitting adjoint on C *-module Hilbert; 3.5. Unbounded operators on Hilbert modules.	Exercise, discussions and debate, modeling, project	4 hours
4. Hilbert modules over local C * -algebras 4.1. Inductive topologies; 4.2. C * -local algebra; 4.3. Hilbert modules over local C * -algebras; 4.4. Operators on Hilbert modules.		2 hours

Bibliography

1. M. Fragoulopoulou, *On locally W*-algebras*, Yokohama Mathematical Journal, vol.34, 1986, 35-51.
2. A. Inoue, *Locally C*-algebras,* Memoirs of the Faculty of Science, Kyushu University, Ser. A, vol. 25, no. 2, 1971, 197-235.
3. M. Joiţa, *Hilbert modules over locally C*- algebras*, Editura Universităţii din Bucureşti, 2006.
4. S.Năd ăban, *C*-algebras and Hilbert modules*, lecture notes, 2017.
5. S.Năd ăban, *Spectral theory on quotient spaces,* Editura Universităţii de Vest din Timişoara, Colecţia Monografii Matematice, Vol. 73, 2001.
6. S.Năd ăban, *Isomorphism Theorems for Quotient Hilbert Spaces,* Analele Universităţii de Vest din Timişoara, Seria Matematică-Informatică, Vol.XLV, Fasc.2, 2007, 93-98, ISSN 1841-3293.
7. S.Năd ăban, *On the Spectrum of a Morphism in Quotient Hilbert Spaces,* Surveys in Mathematics and its Applications – Proceedings of Operator Models and Applications – OMA 2006, Editura Academica Brâncuşi, Volume 1(2006), 13-22, ISSN 1843-7265.
8. S.Năd ăban, *A Special Subcategory in the Category of Quotient Banach Spaces,* Analele Universităţii de Vest din Timişoara, Seria Matematică-Informatică, Vol.XLIII, Fasc.1, 2005, 73-82, ISSN 1841-3293.
9. W.L. Paschke, *Inner product modules over B*- algebras*, Transaction of the American Mathematical Society, vol. 182, 1973, 443-468.
10. D. Popovici, *Wold-Type Decompositions*, Editura Eurostampa, Timişoara, 2006.
11. N.H. Schaefer, M.P. Wolff, *Topological vector spaces*, Second Edition, Springer, 1999.
12. Yu. I. Zhuraev, F. Sharipov, *Hilbert modules over C*- algebras*, arXiv: mathOA/0011053v3, 24 Jan. 2001.

9. Corroborating the content of the discipline with the expectations of the epistemic community, professional associations and representative employers within the field of the program

The content of the discipline is in line with what is done in other university centers abroad.

10. Evaluation

Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Share in the grade (%)
10.4 Course	- correctness and completeness of knowledge; - logical coherence; - the degree of assimilation of the specialized language;	Oral evaluation: - Free exposure of the student; - Evaluation conversation; - Oral questionnaire.	25%
	- criteria regarding the attitudinal aspects:	Written evaluation: paper.	25%

	conscientiousness, interest in individual study.	Active participation at courses and seminars	20%
10.5 Seminar	ability to operate with assimilated knowledge; - ability to apply in practice;	Project	30%
10.6 Minimum performance standards: learning the basic concepts, using specialized language, making a simple application.			

Date
20.09.2020

Signature of course coordinator
Prof. Sorin Nadaban, Ph.D.

Signature of seminar coordinator
Lect. Sida Lavinia, Ph.D.

Date of Department Approval
25.09.2020

Signature of the Head of the Department
Lect. Lorena Popa,Phd

Signature of the Dean
A. Prof. dr. Marius Tomescu

MINISTERUL EDUCAŢIEI ȘI CERCETĂRII
UNIVERSITATEA „AUREL VLAICU“ DIN ARAD
310130 Arad, B-dul Revoluției nr. 77, P.O. BOX 2/158 AR
Tel : 0040-257- 283010; fax. 0040-257- 280070
http://www.uav.ro; e-mail: rectorat@uav.ro
Operator de date cu caracter personal nr.2929

SYLLABUS

1. Study programme

1.1. Higher education institution	**„AUREL VLAICU" UNIVERSITY OF ARAD**
1.2. Faculty	**Faculty of Exact Sciences**
1.3. Department	**Department of Mathematics and Computer Science**
1.4. Field of study	**Mathematics**
1.5. Academic year	**2020-2021**
1.6. Study level	**Master**
1.7. Study programme	**Mathematical Modeling in Research and Didactics**
1.8. Form of education	**Full-time education**

2. Course details

2.1. Name of the course	**Convex Analysis**
2.2. Course coordinator	**Moţ Ghiocel, PhD**
2.3. Seminar/laboratory/project coordinator	**Moţ Ghiocel, PhD**
2.4. Study year	**1**
2.5. Semester	**2**
2.6. Evaluation type	**SE**
2.7. Course type	**Compulsory**

3. Estimated total time (hours per semester)

3.1. Hours per week	**3**
3.2. Lecture hours per week	**2**
3.3. Seminar/laboratory/project hours per week	**1**
3.4. Total hours per curriculum	**42**
3.5. Lecture hours per per curriculum	**28**
3.6. Seminar/laboratory/project hours per curriculum	**14**
	Time division [Hours]
3.4.1. Independent study from textbooks, course support, bibliography and notes	**30**

3.4.2. Additional reading	**35**
3.4.3. Preparing of seminars/laboratories/projects, homework, papers, portfolios and essay	**40**
3.4.4. Tutorial coaching	**24**
3.4.5. Examinations	**4**
3.4.6. Other activities	**0**
3.7. Total individual study hours	**133**
3.8. Total hours per semester	**175**
3.9. Number of ECTS credits	**7**

4. Prerequisites (if applicable)

4.1. Curriculum related	-
4.2. Competence related	-

5. Conditions (if applicable)

5.1. Conditions for the lecture	**Whiteboard, Projector, Internet Connection**
5.2. Conditions for the seminar	**Whiteboard, Computers, Internet Connection**
5.3. Conditions for the laboratory	-
5.4. Conditions for the project	-

6. Specific educational objectives (competences to be acquired)

6.1. Professional competences	**C1. Operation with notions and advanced methods of functional and numerical analysis.** **C4. Designing and applying mathematical models for the analysis of phenomena and processes.** **C5. Problem solving of financial, actuarial mathematics.**
6.2. Transversal competences	**CT1. Managing a responsible attitude towards the scientific and didactic field, capitalizing on own professional potential, observing the rigorous and efficient working rules for the execution of complex professional tasks.** **CT2. Effective coordination and leadership of teamwork or interdisciplinary activities.**

7. Course outcomes (resulting from the specific educational objectives to be acquired)

7.1. General outcomes	**- The student should know the basic concepts of convex analysis and understand important theorems.** **- The student develops the skills to correctly apply the knowledge acquired to solve the different classes of problems.** **- The student must form and develop the ability to think and analyze the problems.**
7.2. Specific outcomes	**- The student is able to demonstrate that he / she has gained sufficient knowledge to** **• recognize objects of convex analysis: convex sets, convex functions, convex optimization problems;** **• describe the discipline's study objects;** **• define and explain the basic concepts of convex analysis;**

	• to formulate the basic principles and results of the convex analysis; • to interpret the extreme problem as a mathematical model of a real decision making problem (choosing the optimal variant); • define the notion of a solution to the extreme problem (local or global optimal); • classify issues of extreme unconditional or conditional nature according to the properties of their components; • to formulate and interpret geometric conditions, principles and optimality criteria for various classes of extreme problems; • solve extreme problems with analytical methods; • algorithmically concretize the ideas underlying the numerical methods of solving the main classes of extreme problems. - The student is able to correctly apply the basic methods and principles in solving complex problems • explain the essence, opportunity and importance of the basic concepts studied in the discipline; • explain the principle of duality; • to translate a real problem from the usual language of the specific field (economics, technology, informatics, etc.) into the language of extreme problems (objective function, restrictions, acceptable solutions, optimal local and global solutions, etc.); • explain the ideas behind the classic methods of solving extreme problems and implement them in the form of concrete algorithms; • use the theoretical knowledge to solve analytically simple problems in the basic computations of the mathematical optimization theory: linear programming, convex programming, nonlinear programming; • to select a suitable method for solving an extremely local or global problem, to argue the opportunity of selecting the method, to implement the numerical method in the form of algorithms and computer programs. - The student is able to recognize the main classes / types of problems • to investigate extreme issues not studied within the course, to define for them the right concepts of solution, to build criteria and principles of optimality and to demonstrate their fairness; • solve extreme problems in concrete areas of human activity through analytical and numerical methods; • can convert an unconvex optimization problem into a convex optimization when such a transformation is possible; • interpret the solution of a real problem in terms of the practical field and develop recommendations for decision-makers; • to adapt, improve and develop the knowledge and skills acquired within the given discipline and in other disciplines: variance calculation and optimal control, operational research, mathematical modeling, econometrics, computer programming, etc. • to solve the theoretical and practical skills solitaire. - The student can design projects for the mathematical modeling of a concrete problem.

8. Course outline

8.1 Lecture	Teaching methods	Remarks
1. Preliminaries 1.1. Affine sets 1.2. Convex sets 1.3. Cones 1.4. Properties 1.5. Algebra of convex sets 1.6. Separation theorems	Lecture, debate, proof exemplification	8 hours
2. Convex functions 2.1. Properties 2.2. Operations with convex functions 2.3. Convexity criteria of differentiable functions 2.4. Extreme properties of convex functions on convex sets 2.5. Convex optimization problems	Lecture, discussion, proof, exemplification	6 hours
3. Convex programming problem 3.1. Differentiation 3.2. Gradient 3.3. Derivatives by direction	Lecture, discussion, proof, exemplification	8 hours

3.4. Subgradient 3.5. Subdifferentials 3.6. Properties 3.7. Conditions of optimal **4. Convex structures** 4.1. Convex structures in the sense of Gudder 4.2. Convex structures in the direction of Takahashi 4.3. Convex structures in the sense of Michael	Lecture, discussion, proof, exemplification	6 hours

8.2 Lecture references

1. BERTSEKAS, D.P., NEDIC, A., OZDAGLAR, A.E., Convex Analysis and Optimization, Athena Scientific, 2003.
2. BRECKNER, B.E., POPOVICI, N., Convexity and Optimization. An Introduction, EFES, Cluj- Napoca, 2006.
3. BRECKNER, B.E., POPOVICI, N., Problems of operational research, EFES, Cluj-Napoca, 2006 (in romanian).
4. KRANTZ, S. G., Convex Analysis, CRC Press, 2014, 176 pag.
5. LUPSA, L., Numerical optimization methods. Special issues in discrete optimization, Cluj-Napoca: Risoprint, 2005.
6. MOȚ, G., Tipuri de convexitate în matematica modernă. Aplicaţii ale Teoriei alurii, Ed. Mirton, 1999, 193 pag.
7. MOȚ, G., Convexity and Allure in Elena Popoviciu'sense, Miracle Printers Publishing House, Vancouver, Washigton, USA., 2004,ISBN: 973-578-447-6, 106 pag.
8. MOȚ, G., PETRUȘEL, A., PETRUȘEL, G., Topics in Nonlinear Analysis and Applications to Mathematical Economics, House ofthe Book of Science, 2006, 153 pag., ISBN 973-686-952-0
9. MOȚ, G., Seminar and course notes-Convex Analysis , 2020.
10. NOCEDAL, J., WRIGHT, S.J., Numerical Optimization, Second Edition, New York: Springer, 2006 .
11. PETRUȘEL, A., MOȚ, G., Multivalued analysis, convexity and mathematical economics, House of the Book of Science, 2003,ISBN: 973-578-900-3, 166 pag.
12. VANDERBEI, R. J., Linear Programming. Foundations and extensions, International Series in Operations Research &Management Science 37, Kluwer Academic Publishers, Boston, 2001.
13. WEBSTER, R., Convexity, Oxford University Press, New York, 1994.

8.3 Seminar	Teaching methods	Remarks
1. Preliminaries 1.1. Affine sets 1.2. Convex sets 1.3. Cones 1.4. Properties 1.5. Algebra of convex sets 1.6. Separation theorems	Exercise, debate, modeling, project	4 hours
2. Convex functions 2.1. Properties 2.2. Operations with convex functions 2.3. Convexity criteria of differentiable functions 2.4. Extreme properties of convex functions on convex sets 2.5. Convex optimization problems	Exercise, debate, modeling, project	3 hours
3. Convex programming problem 3.1. Differentiation 3.2. Gradient 3.3. Derivatives by direction 3.4. Subgradient 3.5. Subdifferentials 3.6. Properties 3.7. Conditions of optimal	Exercise, debate, modeling, project	4 hours
4. Convex structures 4.1. Convex structures in the sense of Gudder 4.2. Convex structures in the direction of Takahashi 4.3. Convex structures in the sense of Michael	Exercise, debate, modeling, project	3 hours

8.4 Seminar references

1. BERTSEKAS, D.P., NEDIC, A., OZDAGLAR, A.E., Convex Analysis and Optimization, Athena Scientific, 2003.
2. BRECKNER, B.E., POPOVICI, N., Convexity and Optimization. An Introduction, EFES, Cluj- Napoca, 2006.
3. BRECKNER, B.E., POPOVICI, N., Problems of operational research, EFES, Cluj-Napoca, 2006 (in romanian).
4. KRANTZ, S. G., Convex Analysis, CRC Press, 2014, 176 pag.
5. LUPSA, L., Numerical optimization methods. Special issues in discrete optimization, Cluj-Napoca: Risoprint, 2005.
6. MOȚ, G., Tipuri de convexitate în matematica modernă. Aplicaţii ale Teoriei alurii, Ed. Mirton, 1999, 193 pag.

7. MOȚ, G., Convexity and Allure in Elena Popoviciu'sense, Miracle Printers Publishing House, Vancouver, Washigton, USA., 2004,ISBN: 973-578-447-6, 106 pag.
8. MOȚ, G., PETRUȘEL, A., PETRUȘEL, G., Topics in Nonlinear Analysis and Applications to Mathematical Economics, House ofthe Book of Science, 2006, 153 pag., ISBN 973-686-952-0
9. MOȚ, G., Seminar and course notes-Convex Analysis , 2020.
10. NOCEDAL, J., WRIGHT, S.J., Numerical Optimization, Second Edition, New York: Springer, 2006 .
11. PETRUȘEL, A., MOȚ, G., Multivalued analysis, convexity and mathematical economics, House of the Book of Science, 2003,ISBN: 973-578-900-3, 166 pag.
12. VANDERBEI, R. J., Linear Programming. Foundations and extensions, International Series in Operations Research &Management Science 37, Kluwer Academic Publishers, Boston, 2001.
13. WEBSTER, R., Convexity, Oxford University Press, New York, 1994.

8.5 / Laboratory	Teaching methods	Remarks
8.6 Laboratory references		
8.7 / Project	Teaching methods	Remarks
8.8 Project References		

9. **Corroboration / validation of course putline** (if applicable)

This course is taught in similar programs at many universities, both in Romania and abroad. For a better matching with the demands of the labor market, meetings with employers' representatives and specialty teachers from the pre-university education system have been organized. Using English brings and added value to the program, enabling the hiring of graduates by multinational companies (both abroad and in Romania).

10. **Evaluation / Grading**

Activity type	Evaluation criteria	Evaluation methods	Percentage of the final grade
10.1. Lecture	▪ knowledge; ▪ logical coherency; ▪ acquiring the specialty language; ▪ criteria that envisage attitudinal aspects: seriousness, conscientiousness and interest for the subject.	Oral Assessment (final exam period): ▪ presentation of a final project ▪ free exposure oral questionnaires. Active participation to the course.	40% 10%
10.2. Seminar	▪ capacity of using the acquired knowledge; ▪ capacity of applying in practice; ▪ conscientiousness and interest for the study.	Oral assessment (final exam period): preparation and submission of final project. Active participating to the seminar activities	40% 10%
10.3. Laboratory			%
10.4. Project			%

10.5 Minimal performance standard

Acquiring the fundamental concepts, using the specialty language and solving an application at basic level.

Data completarii 21.09.2020	Semnatura titularului de curs Prof. univ. Dr. Moț Ghiocel	Semnatura titularului de seminar Prof. univ. Dr. Moț Ghiocel
Data avizarii in departament 25.09.2020	DIRECTOR DEPARTAMENT Lector univ. dr. Popa Lorena	DECAN Conf.univ.dr. Marius-Lucian TOMESCU

SYLLABUS[1]

1. Study programme

1.1 Higher education institution	„Aurel Vlaicu" University of Arad
1.2 Faculty	Faculty of Exact Sciences
1.3 Department	Department of Mathematics and Computer Science
1.4 Field of study	Mathematics
1.5 Study level	II - Master
1.6 Study programme / Qualification	Mathematical Modelling in Research and Didactics

2. Course details

2.1 Name of the course	Practice Project A
2.2 Course coordinator	Prof. Codruţa Simona Stoica, PhD
2.3 Seminar/laboratory/project coordinator	Prof. Codruţa Simona Stoica, PhD
2.4 Study year	I
2.5 Semester	1
2.6 Evaluation type	Cn
2.7 Course type	Imposed compulsory discipline/ Synthesis discipline

3. Estimated total time (hours per semester)

3.1 Hours per week	2	of which 3.2 lecture	-	3.3 project	2
3.4 Total hours per curriculum	28	of which 3.5 lecture	-	3.6 project	28

Time division	hrs
Independent study from textbooks, course support, bibliography and notes	15
Additional reading (libraries, specialized electronic platforms and field research)	12
Preparing of seminars/laboratories/projects, homework, papers, portfolios and essays	25
Tutorial coaching	16
Examinations	4
3.7 Total individual study hours	72
3.8. Total hours per curriculum (3.4)=28 + Total individual study hours (3.7)=72	100
3.9 Total hours per semester (25 hrs/1 credit) 25 x 4 = 100	100
3.10 Number of ECTS credits	4

4. Prerequisites (if applicable)

4.1 curriculum related	-
4.2 competence related	-

5. Conditions (if applicable)

5.1 for the lecture	Classroom, equipped with whiteboard, laptop, projector, Internet connection

[1] Cf. M.O. of Romnia, Part I, Nr. 800 bis/13.XII.2011, Ministerial Decree nr. 5703 from Oct. 18, 2011

5.2 for the laboratory	Laboratory room, properly equipped with whiteboard, computers, network, Internet connection

6. Specific educational objectives (competences to be acquired)

Professional competences	**C1.** Operating with advanced notions and methods of functional and numerical analysis **C4.** Design and application of mathematical models for the analysis of some phenomena and processes
Transversal competences	**CT1.** Manifestation of a responsible attitude towards the scientific and didactic field, capitalization of one's own professional potential, observance of the rules of rigorous and efficient work for the execution of complex professional tasks **CT2.** Coordination and efficient management of activities organized in a team or in an interdisciplinary group **CT3.** Selection of information resources, efficient use of vocational training sources, development of the capacity to correlate professional activity to the requirements of a dynamic society.

7. Course outcomes (resulting from the specific educational objectives to be acquired)

7.1 General outcomes	- Initiation of the student in the methods of scientific research - The student would develop the skills to apply correctly and accumulated knowledge
7.2 Specific outcomes	– Presentation of the results obtained in a chosen field of research in mathematics - Writing projects/reports on a given topic - Skills in doing the scientific research and in writing a scientific paper

8. Course outline

Project **How to develop a research project**	**Teaching methods**	**Remarks**
1. RESEARCH PREMISES a. Motivation for the research topic b. Personal characteristics c. Available and accessible resources	▪ interactive exposure ▪ exemplifications ▪ problematization	2 hours
2. TECHNICAL REQUIREMENTS FOR WRITING THE PROJECT a. Dimension b. Writing c. Respecting of the rules of academic writing	▪ interactive exposure ▪ exemplifications ▪ problematization	2 hours
3. WHAT THE PROJECT MUST INCLUDE I A. Steps prior to drafting the research project 1) Choice of topic - What am I researching? a. Domain selection b. Theme formulation c. Project title 2) Delimitation of the study area a. Temporal delimitation b. Spatial delimitation	▪ interactive exposure ▪ exemplifications ▪ problematization	6 hours

c. Restricting the field of investigation d. Restricting the scope of research to a defined number of units of analysis 3) Project title		
4. WHAT THE PROJECT MUST INCLUDE II B. The structure of a research project 1) Introduction a) Scoring the issue of the study b) The objective(s) of the research project c) The significance of the study d) Research questions 2) Relevant literature 3) Research methodology a) Research procedure. Chosen methods b) Research tools c) Expected results 4) Conclusions 5) Bibliography	▪ interactive exposure ▪ exemplifications ▪ problematization	6 hours
5. Research project models	▪ interactive exposure ▪ exemplifications ▪ problematization	12 hours

References

1. B. Buchberger, *Thinking, Speaking, Writing*, http://www.risc.jku.at/people/buchberger/thinking_course.html
2. P.Edwards: *How to give an academic talk*, http://pne.people.si.umich.edu/PDF/howtotalk.pdf
3. Hirsch, *An index to quantify an individual's scientific research output*, http://www.pnas.org/content/102/46/16569.full
4. *The Clarivate Analytics Impact Factor*, https://clarivate.com/essays/impact-factor/
5. R.Kitchin & D. Fuller, *The Academic' Guide to Publishing*, SAGE Publications, London, 2005.
6. H.F. Moed, *Citation Analysis in Research Evaluation*, Springer, 2005.
7. M.A.Nielsen, *Principles of Effective Research*, http://michaelnielsen.org/blog/principles-of-effective-research/
8. University ranking, http://www.topuniversities.com/university-ranking-articles/
9. J.Radel, *Oral Presentations*, http://people.eku.edu/ritchisong/oralpres.html

9. Correlation of course outline with the expectations of the epistemic community, professional associations and representative employers within the field of the program

This course is taught in similar programs at many universities, both in Romania and abroad. For a better matching with the demands of the labor market, meetings with employers' representatives and specialty teachers from the pre-university education system have been organized. Using English brings and added value to the program, enabling the hiring of graduates by multinational companies (both abroad and in Romania).

10. Evaluation / Grading

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Percentage of the final grade

10.4 Project	• correctness and completeness of knowledge • logical consistency the degree of assimilation of specialty language	Oral assessment (final exam period): • presentation of the required project conversation evaluation.	30%
	• conscientiousness, interest in study	• active participation in courses	20%
	• ability to work with their knowledge • ability to apply the acquired knowledge	Evaluare orală (perioada finală de examen): • finalizarea proiectului necesar	30%
		• assignments	20%
10.5 Minimal performance standard:			
The student must prove that he is able to do a proper documention and to carry out a scientific work.			

Date	Signature of the course coordinator	Signature of the laboratory coordinator
21.09.2020	Prof. Codruţa Simona Stoica, PhD	Prof. Codruţa Simona Stoica, PhD

Date of Department Approval	Signature of the Head of the Department	Signature of the Dean
25.09.2020	Lect. dr. Lorena Popa	A. Prof. dr. Marius Tomescu

SYLLABUS[1]

1. Study programme

1.1 Higher education institution	„Aurel Vlaicu" University of Arad
1.2 Faculty	Faculty of Exact Sciences
1.3 Department	Department of Mathematics and Computer Science
1.4 Field of study	Mathematics
1.5 Study level	II – Master
1.6 Study programme / Qualification	Mathematical Modeling in Research and Didactics

2. Course details

2.1 Name of the course	**Use of software in teaching mathematics**
2.2 Course coordinator	**A. Prof. dr. Marius Tomescu**
2.3 Seminar/laboratory/project coordinator	**A. Prof. dr. Marius Tomescu**
2.4 Study year	I
2.5 Semester	2
2.6 Evaluation type	Exam
2.7 Course type	Compulsory Course

3. Estimated total time (hours per semester)

3.1 Hours per week	3	of which 3.2 lecture	2	3.3 seminar/laboratory/project	1
3.4 Total hours per curriculum	42	of which 3.5 lecture	28	3.6 seminar/laboratory/project	14
Time division					Hrs
Independent study from textbooks, course support, bibliography and notes					28
Additional reading (libraries, specialized electronic platforms and field research)					26
Preparing of seminars/laboratories/projects, homework, papers, portfolios and essays					28
Tutorial coaching					22
Examinations					4
Other activities					-
3.7 Total individual study hours					**108**
3.8. Total hours per curriculum (3.4) + Total individual study hours (3.7)					**150**
3.9 Total hours per semester (25 hrs /1 credit)					**150**
3.10 Number of ECTS credits					**6**

4. Prerequisites (if applicable)

4.1 curriculum related	Mathematical Analysis on R and Rn, Complex Analysis, Linear Algebra, Analytical geometry, Differential geometry, Differential equations, Partial derivative equations, Object-oriented programming.
4.2 competence related	Mathcad software (possibly Mathematica, Matlab or Maple)

5. Conditions (if applicable)

5.1 for the lecture	video projector, whiteboard, computers with Mathcad installed
5.2 for the seminar/laboratory/project	video projector, whiteboard, computers with Mathcad installed

[1] Cf. M.O. of Romnia, Part I, Nr. 800 bis/13.XII.2011, Ministerial Decree nr. 5703 from Oct. 18, 2011

6. Specific educational objectives (competences to be acquired)

Professional competences	C3: Use of computer tools in an interdisciplinary context: formation of symbolic calculation skills, formation of mathematical modeling skills, formation of solving skills with the help of symbolic calculation of complex mathematical problems.
Transversal competences	CT1: Applying the rules of organized and efficient work, of responsible attitudes towards the didactic and scientific field, for the creative capitalization of one's own potential, respecting the principles and norms of professional ethics. CT3: Use of effective methods and techniques for learning, information, research and development of the capacity to capitalize on knowledge, to adapt to the requirements of a dynamic society.

7. Course outcomes (resulting from the specific educational objectives to be acquired)

7.1 General outcomes	The general objective of the discipline: the formation of the skills of symbolic calculation, of mathematical modeling, of solving mathematical problems with the help of symbolic calculation.
7.2 Specific outcomes	Specific objectives: these skills are needed to be able to do in scientific research. The knowledge can be used in doctoral study cycles.

8. Course outline

8.1 Lecture	**Teaching methods**	**Remarks**
1.Mathcad window and menus	▪ Lecturing ▪ Exemplifying	2 hrs
2.Mathcad palletes	▪ Lecturing ▪ Exemplifying	2 hrs
3.Symbolic pallete and Symbolic menu	▪ Exemplifying ▪ Conversation	2 hrs
4. Evaluation function (Symbolically, Floating Point and Complex)	▪ Lecturing ▪ Exemplifying ▪ Questioning ▪ Modeling	2 hrs
5. Simplify and Expandat functions	▪ Lecturing ▪ Exemplifying ▪ Modeling	2 hrs
6. Factor, Collect and Coeffs functions	▪ Interactive Exposure ▪ Individual Study ▪ Questioning ▪ Modeling	2 hrs
7.Functions related to variables (Solve, Substitute, Differentiate)	▪ Interactive Exposure ▪ Exemplifying ▪ Questioning ▪ Modeling	2 hrs
8.Functions related to variables (Integrated, Expand Series, Convert to Partial Fraction)	▪ Interactive Exposure ▪ Exemplifying ▪ Questioning ▪ Modeling	2 hrs

9. Symbolic functions for matrices (Transpose, Invert and Determinant)	▪ Interactive Exposure ▪ Exemplifying ▪ Questioning ▪ Modeling	2 hrs
10.Symbolic transformation functions (Fourier, Laplace, Z, Inverse Fourier, Laplace and Z)	▪ Interactive Exposure ▪ Exemplifying ▪ Questioning ▪ Modeling	2 hrs
11. Symbolic calculation of derivatives, integrals, limits and series	▪ Interactive Exposure ▪ Exemplifying ▪ Questioning ▪ Modeling	2 hrs
12.Symbolic solving of differential equations	▪ Interactive Exposure ▪ Exemplifying ▪ Questioning ▪ Modeling	2 hrs
13.Solving complex topics	▪ Interactive Exposure ▪ Exemplifying ▪ Questioning ▪ Modeling	2 hrs
14.Automatic proof of theorems	▪ Interactive Exposure ▪ Exemplifying ▪ Questioning ▪ Modeling	2 hrs

8.2 Seminar / Laboratory / Project	**Teaching methods**	**Remarks**
1.Mathcad window and menus	▪ Interactive Exposure ▪ Exemplifying ▪ Questioning ▪ Modeling	1 hrs
2.Mathcad palletes	▪ Interactive Exposure ▪ Exemplifying ▪ Questioning ▪ Modeling	1 hrs
3.Symbolic pallete and Symbolic menu	▪ Interactive Exposure ▪ Exemplifying ▪ Questioning ▪ Modeling	1 hrs
4. Evaluation function (Symbolically, Floating Point and Complex)	▪ Interactive Exposure ▪ Exemplifying ▪ Questioning ▪ Modeling	1 hrs
5. Simplify and Expandat functions	▪ Exemplifying ▪ Modeling	1 hrs
6. Factor, Collect and Coeffs functions	▪ Interactive Exposure ▪ Individual Study ▪ Questioning ▪ Modeling	1 hrs

7.Functions related to variables (Solve, Substitute, Differentiate)	▪ Interactive Exposure ▪ Exemplifying ▪ Questioning ▪ Modeling	1 hrs
8.Functions related to variables (Integrated, Expand Series, Convert to Partial Fraction)	▪ Interactive Exposure ▪ Exemplifying ▪ Questioning ▪ Modeling	1 hrs
9. Symbolic functions for matrices (Transpose, Invert and Determinant	▪ Interactive Exposure ▪ Exemplifying ▪ Questioning ▪ Modeling	1 hrs
10.Symbolic transformation functions (Fourier, Laplace, Z, Inverse Fourier, Laplace and Z)	▪ Interactive Exposure ▪ Exemplifying ▪ Questioning ▪ Modeling	1 hrs
11. Symbolic calculation of derivatives, integrals, limits and series	▪ Interactive Exposure ▪ Exemplifying ▪ Questioning ▪ Modeling	1 hrs
12.Symbolic solving of differential equations	▪ Interactive Exposure ▪ Exemplifying ▪ Questioning ▪ Modeling	1 hrs
13.Solving complex topics	▪ Interactive Exposure ▪ Exemplifying ▪ Questioning ▪ Modeling	1 hrs
14.Automatic proof of theorems	▪ Interactive Exposure ▪ Exemplifying ▪ Questioning ▪ Modeling	1 hrs

References

[1] Cira, O., Lecţii de Mathcad, Ed. Albastra, Cluj-Napoca, 2000-2002, (3 ediţii)

[2] Cira, O., Lecţii de Mathcad 2001, Ed. Albastra, Cluj-Napoca, 2003-2005, (2 ediţii)

[3] Cira, O., Metode numerice pentru rezolvarea ecuaţiilor algebrice, Ed. Academiei, Bucureşti, 2005

[4] Cira, O., Maruşter S, t., Metode numerice pentru ecuaţii neliniare, Ed. MatrixRom, Bucureşti, 2008

[5] Cira, O., Aplicaţii, probleme şi exerciţii rezolvate cu Mathcad-ul, Ed. MatrixRom, Bucureşti, 2010

[6] Cira, O., The Convergence Simultaneous Inclusion Methods, Ed. MatrixRom, Bucureşti, 2012

[7] ***, Mathcad 14 User0 s Guide, Mathsoft Engineering & Education, Parametric Technology Corporation, 140 Kendrick Street, Needham, MA 02494 USA, February 2007

[8] ***, Getting Started Guide, Mathcad 15.0, Parametric Technology Corporation, 140 Kendrick Street, Needham, MA 02494 USA, June 2010

[9] ***, Mathcad Prime 1.0 Migration Guide, Parametric Technology Corporation, 140 Kendrick Street, Needham, MA 02494 USA, December 2010

[10] ***, Mathcad Prime 2.0 Curriculum Guide, Parametric Technology Corporation, 140 Kendrick Street, Needham, MA 02494 USA, August 2012
[11] htpp://www.ptc.com/products/ptc-university/

9. Correlation of course outline with the expectations of the epistemic community, professional associations and representative employers within the field of the program

The content of the discipline is in line with what is done in other university centers abroad.

10. Evaluation / Grading

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Percentage of the final grade
10.4 Lecture	-the correctness and completeness of the knowledge from the free exposure of the student; -logical coherence from the evaluation conversation; - the degree of assimilation of the specialized language through oral questionnaires;	Oral assessment (final exam): ▪ project presentation ▪ the conversation evaluation ▪ Free Exposure	10% 50%
10.5 Seminar / laboratory / project	-participation in laboratory works consciousness; - interest in individual study; -how to prepare a scientific paper;	-written and reported evaluation criteria - ability to use symbolic calculus -the conversation evaluation	10% 15% 15%
10.6 Minimal performance standard: Learning the basic concepts, using specialized language, making a simple application.			

Date
22.09.2020

Signature of the course coordinator
A. Prof. dr. Marius Tomescu

Signature laboratory,
A. Prof. dr. Marius Tomescu

Date of Department Approval
25.09.2020

Signature of the Head of the Department
Lect. Dr. Lorena Popa

Signature of the Dean
A. Prof. dr. Marius Tomescu

SYLLABUS[1]

1. Study programme

1.1 Higher education institution	„Aurel Vlaicu" University of Arad
1.2 Faculty	Faculty of Exact Sciences
1.3 Department	Department of Mathematics and Computer Science
1.4 Field of study	Mathematics
1.5 Study level	II - Master
1.6 Study programme / Qualification	Mathematical Modelling in Research and Didactics

2. Course details

2.1 Name of the course	Special Chapters of Stability Theory
2.2 Course coordinator	Prof. Codruţa Simona Stoica, PhD
2.3 Seminar/laboratory/project coordinator	Prof. Codruţa Simona Stoica, PhD
2.4 Study year	I
2.5 Semester	1
2.6 Evaluation type	Exam
2.7 Course type	Optional compulsory discipline/ Synthesis discipline

3. Estimated total time (hours per semester)

3.1 Hours per week	3	of which 3.2 lecture	2	3.3 seminar/laboratory/project	1
3.4 Total hours per curriculum	42	of which 3.5 lecture	28	3.6 seminar/laboratory/project	14

Time division	hrs
Independent study from textbooks, course support, bibliography and notes	22
Additional reading (libraries, specialized electronic platforms and field research)	30
Preparing of seminars/laboratories/projects, homework, papers, portfolios and essays	30
Tutorial coaching	22
Examinations	4
3.7 Total individual study hours	108
3.8. Total hours per curriculum (3.4)=42 + Total individual study hours (3.7)=108	150
3.9 Total hours per semester (25 hrs/1 credit) 25 x 6 = 150	150
3.10 Number of ECTS credits	6

4. Prerequisites (if applicable)

4.1 curriculum related	Differential equations and partial differential equations
4.2 competence related	Operating with advanced notions and methods of mathematical analysis

5. Conditions (if applicable)

5.1 for the lecture	Classroom, equipped with whiteboard, laptop, projector

[1] Cf. M.O. of Romnia, Part I, Nr. 800 bis/13.XII.2011, Ministerial Decree nr. 5703 from Oct. 18, 2011

5.2 for the seminar	Seminar room, properly equipped with whiteboard, laptop, projector

6. Specific educational objectives (competences to be acquired)

Professional competences	**C1.** Operating with advanced notions and methods of functional and numerical analysis **C4.** Design and application of mathematical models for the analysis of some phenomena and processes
Transversal competences	**CT1.** Manifestation of a responsible attitude towards the scientific and didactic field, capitalization of one's own professional potential, observance of the rules of rigorous and efficient work for the execution of complex professional tasks **CT2.** Coordination and efficient management of activities organized in a team or in an interdisciplinary group **CT3.** Selection of information resources, efficient use of vocational training sources, development of the capacity to correlate professional activity to the requirements of a dynamic society.

7. Course outcomes (resulting from the specific educational objectives to be acquired)

7.1 General outcomes	-
7.2 Specific outcomes	-

8. Course outline

8.1 Lecture	**Teaching methods**	**Remarks**
1. Stability theory. General issues	▪ interactive exposure ▪ exemplifications ▪ problematization ▪ modelling	4 hours
2. Types of stability. Criteria of stability	▪ interactive exposure ▪ exemplifications ▪ problematization ▪ modelling	4 hours
3. On families of operators in the study of differential and difference equations	▪ interactive exposure ▪ exemplifications ▪ problematization ▪ modelling	6 hours
4. Asymptotic properties for skew-evolution semiflows: stability and instability	▪ interactive exposure ▪ exemplifications ▪ problematization ▪ modelling	6 hours
5. On classes of dichotomy for skew-evolution semiflows	▪ interactive exposure ▪ exemplifications ▪ problematization ▪ modelling	4 hours
6. On classes of trichotomy for skew-evolution semiflows	▪ interactive exposure ▪ exemplifications ▪ problematization	4 hours

	▪ modelling	

8.2 Seminar	Teaching methods	Remarks
1. Stability theory. General issues	▪ exercises ▪ discussions ▪ modelling ▪ project	2 hours
2. Types of stability. Criteria of stability	▪ exercises ▪ discussions ▪ modelling ▪ project	2 hours
3. On families of operators in the study of differential and difference equations	▪ exercises ▪ discussions ▪ modelling ▪ project	2 hours
4. Asymptotic properties for skew-evolution semiflows: stability and instability	▪ exercises ▪ discussions ▪ modelling ▪ project	4 hours
5. On classes of dichotomy for skew-evolution semiflows	▪ exercises ▪ discussions ▪ modelling ▪ project	2 hours
6. On classes of trichotomy for skew-evolution semiflows	▪ exercises ▪ discussions ▪ modelling ▪ project	2 hours

References

1. J.T. Baldwin, *Fundamentals of Stability Theory*, Cambridge University Press, 2017
2. S. Buechler, *Essential Stability Theory*, Cambridge University Press, 2017
3. M. Megan, A.L. Sasu, B. Sasu, *Asymptotic Behaviours of Evolution Families*, Ed. Mirton, 2003
4. D.A. Sanchez, *Ordinary Differential Equations and Stability Theory*, Courier Dover Publications, 2019
5. C. Stoica, *Uniform Asymptotic Behaviors for Skew-Evolution Semiflows on Banach Spaces*, Ed. Mirton, 2010
6. L. Wen, *Differentiable Dynamical Systems: An Introduction to Structural Stability and Hyperbolicity*, American Mathematical Society, 2016

9. Correlation of course outline with the expectations of the epistemic community, professional associations and representative employers within the field of the program

This course is taught in similar programs at many universities, both in Romania and abroad. For a better matching with the demands of the labor market, meetings with employers' representatives and specialty teachers from the pre-university education system have been organized. Using English brings and added value to the program, enabling the hiring of graduates by multinational companies (both abroad and in Romania).

10. Evaluation / Grading

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Percentage of the final grade
10.4 Lecture	• correctness and completeness of knowledge • logical consistency • the degree of assimilation of specialty language	Oral assessment (final exam period): • presentation of the required project • conversation evaluation	30%
	• conscientiousness, interest in study	• active participation in courses	10%
10.5 Seminar	• ability to work with their knowledge • ability to apply the acquired knowledge	Oral assessment (final exam period): • finalization of the required project	30%
		• assignments	10%
	• conscientiousness, interest in study	• active participation in seminars	20%
10.6 Minimal performance standard:			
Correct acquisition of basic theoretical notions and their application in the study of the stability of solutions of differential equations.			

Date
21.09.2020

Signature of the course coordinator
Prof. Codruţa Simona Stoica, PhD

Signature of the laboratory coordinator
Prof. Codruța Simona Stoica, PhD

Date of Department Approval
25.09.2020

Signature of the Head of the Department
Lect. Dr. Lorena Popa

Signature of the Dean
A. Prof. dr. Marius Tomescu

MINISTERUL EDUCAŢIEI ȘI CERCETĂRII
UNIVERSITATEA „AUREL VLAICU“ DIN ARAD
310130 Arad, B-dul Revoluției nr. 77, P.O. BOX 2/158 AR
Tel : 0040-257- 283010; fax. 0040-257- 280070
http://www.uav.ro; e-mail: rectorat@uav.ro
Operator de date cu caracter personal nr.2929

SYLLABUS

1. Study programme

1.1. Higher education institution	**„AUREL VLAICU" UNIVERSITY OF ARAD**
1.2. Faculty	**Faculty of Exact Sciences**
1.3. Department	**Department of Mathematics and Computer Science**
1.4. Field of study	**Mathematics**
1.5. Academic year	**2020-2021**
1.6. Study level	**Master**
1.7. Study programme	**Mathematical Models in Didactics and Research**
1.8. Form of education	**Full-time education**

2. Course details

2.1. Name of the course	**GmET2A21 Fuzzy Systems**
2.2. Course coordinator	**A. Prof. dr. Marius Tomescu**
2.3. Seminar/laboratory/project coordinator	**A. Prof. dr. Marius Tomescu**
2.4. Study year	**I**
2.5. Semester	2
2.6. Evaluation type	**Exam**
2.7. Course type	**(C) Compulsory**

3. Estimated total time (hours per semester)

3.1. Hours per week	**3**
3.2. Lecture hours per week	**1**
3.3. Seminar/laboratory/project hours per week	**2**
3.4. Total hours per curriculum	**42**
3.5. Lecture hours per per curriculum	**14**
3.6. Seminar/laboratory/project hours per curriculum	**28**
	Time division [Hours]
3.4.1. Independent study from textbooks, course support, bibliography and notes	30

3.4.2. Additional reading	**30**
3.4.3. Preparing of seminars/laboratories/projects, homework, papers, portfolios and essay	**20**
3.4.4. Tutorial coaching	**25**
3.4.5. Examinations	**3**
3.4.6. Other activities	**0**
3.7. Total individual study hours	**108**
3.8. Total hours per semester	**150**
3.9. Number of ECTS credits	**6**

4. Prerequisites (if applicable)

4.1. Curriculum related	Nonlinear systems. Lyapunov stability.
4.2. Competence related	

5. Conditions (if applicable)

5.1. Conditions for the lecture	Classroom, equipped with laptop, video projector and suitable software
5.2. Conditions for the seminar	Laboratory room, properly equipped: computers, network, Internet connection, specialized software.
5.3. Conditions for the laboratory	
5.4. Conditions for the project	

6. Specific educational objectives (competences to be acquired)

6.1. Professional competences	**C3. Solving problems of dynamic systems, optimal control and operational research.** **C4. Ability to perform advanced data analysis and present results to support decision-making processes.**
6.2. Transversal competences	**CT1. General knowledge of integrated information systems for various types of organizations; the ability to become familiar with new concepts and to adapt quickly to new technologies emerging in the field of informatics.** **CT2. Ability to communicate professionally and in writing on professional topics with computer scientists, engineers and economists and to prepare technical reports or scientific articles.** **CT3. Selection of information resources, efficient use of vocational training sources, development of the capacity to correlate professional activity to the requirements of a dynamic society.**

7. Course outcomes (resulting from the specific educational objectives to be acquired)

7.1. General outcomes	**Acquisition by the student of knowledge and skills for the design and implementation of modern management solutions based on fuzzy control systems.**
7.2. Specific outcomes	**Ability to design and develop fuzzy control systems.**

8. Course outline

8.1 Lecture	Teaching methods	Remarks
1. Overview Fuzzy Systems. A brief summary of the evolution and applications with expert systems based on fuzzy logic: - Basic concepts in the theory of fuzzy systems - The concept of fuzzy set - Linguistic variables and terms - Fuzzy sentences - Fuzzy logical operators - Fuzzy logical negation - Fuzzy logical disjunction and conjunction - Fuzzy logical disjunction and conjunction of several variables - Fuzzy logical implication. 2. Design of fuzzy expert systems - Mamdani type regulators - TakagiSugeno type regulators - Fuzzy inference mechanism. 3. Stability analysis and methods for stabilizing nonlinear systems, using Takagi-Sugeno fuzzy systems. - The main concepts and results of the stability theory used fuzzy systems - Methods for analyzing the stability of nonlinear processes with Takagi-Sugeno type FLC - Methods for stabilizing systems with automatic regulation with Takagi-Sugeno type FLC - Wong-Leung-Tam method analysis of the stability of a fuzzy system - Stabilization algorithm resulting from the Wong-Leung-Tam method Advantages and disadvantages of the WongLeung-Tam method - Lyapunov-type stability analysis of a class of nonlinear systems with Takagi-Sugeno-type FLC - LaSalle-type stability analysis of a class of nonlinear systems with Takagi-Sugeno type FLC - Advantages and disadvantages of the proposed methods. Comparative analysis in relation to other methods of stability analysis. 4. The inference engine of an expert system. facts and rules, probabilistic reasoning, fuzzy reasoning. 5. Testing and validation of an expert system; system knowledge: correct, complete, consistent. Verification and validation methods. 6. Carrying out a project, case study.	Participatory lecture, debate, presentation, problematization. Interactive exposure documentation on web exemplification.	C1. 2 hours, C2. 2 hours, C3. 3 hours, C4. 2 hours, C5. 2 hours, C6. 3 hours.

8.2 Lecture references

1. **Clarence W. de Silva , Intelligent Control: Fuzzy Logic Applications (Mechatronics), CRC Press; 1 edition (May 2,**
2. **2018),**
3. **Jerry M. Mendel, Uncertain Rule-Based Fuzzy Systems: Introduction and New Directions, 2nd Edition, Springer, 2017.**
4. **Ştefan Preitl, Radu-Emil Precup, Marius-Lucian Tomescu, Mircea-Bogdan Radac, Emil M. Petriu, and ClaudiaAdina Dragoş (2009): Model - Based Design Issues in Fuzzy Logic Control.**
   in Towards Intelligent Engineering and Information Technology,Series: Studies in Computational Intelligence , Vol. 243.Rudas, Imre J.; Fodor, János; Kacprzyk, Janusz (Eds.)
   Publisher: Springer-Verlag Berlin Heidelberg 2009. Springer; 1 edition (August 18, 2009)
5. **R.-E. Precup, M. L. Tomescu, M.-B. Radac, E. M. Petriu, S. Preitl, C.-A. Dragos, Iterative performance improvement of fuzzy control systems for three tank systems, Expert Systems with Applications, vol. 39, no. 9, pp. 82888299, July 2012, ISSN 0957-4174.**
6. **Precup, RE, Tomescu, ML, Petriu, EM, Preitl, S, Dragos, CA, Stable Design of a Class of Nonlinear Discrete-Time MIMO Fuzzy Control Systems. ACTA POLYTECHNICA HUNGARICA, Volume: 9, Issue: 2, Pages: 57-76 Published:2012.**
7. **Precup, R.-E., Rădac, M.-B., Tomescu, M. L., Petriu, E. M. and Preitl, St. (2013): Stable and convergent iterative feedback tuning of fuzzy controllers for discrete-time SISO systems. Expert Systems with Applications (Elsevier Science), vol. 40, no. 1, pp. 188-199, ISSN 0957-4174. SCI impact factor = 2.203, SCI impact factor in 2011 = 2.203. [7] Radu-Emil Precup, Marius L. Tomescu, Stefan Preitl, Emil M. Petriu, János Fodor and Claudiu Pozna, Stability analysis and design of a class of MIMO fuzzy control systems, Journal of Intelligent & Fuzzy Systems, DOI:10.3233/IFS-2012-0621**
8. **M. N. Anthony, H. Ling, and L. Derong. Stability of Dynamical Systems Continuous, Discontinuous, and Discrete Systems. Systems & Control: Foundations & Applications. Birkhäuser, Boston, 2008.**
9. **M. Kai, F. Klawonn, R. Kruse, and A. Nürnberger. Fuzzy Control: Fundamentals, Stability and Design of Fuzzy Controllers. Studies in Fuzziness and Soft Computing. Springer-Verlag New York, Inc., 2006.**
10. **L. A. Zadeh. Fuzzy sets. Information and Control, (8):338 – 353, 1965.**
11. **L. A. Zadeh, George J. Klir, and Bo Yuan. Fuzzy Sets, Fuzzy Logic, and Fuzzy Systems: Selected Papers by Lotfi A. Zedeh, volume 6 of Advances in Fuzzy Systems - Applications and Theory. World Scientific Publishing Co., Inc.,River Edge, NJ, USA, 1996.**
12. **S. H. Zak. Systems and Control. Oxford University Press, Oxford New York, 2003.**
13. **M. Tomescu Note de curs, Platforma SUMS 2020**

8.3 Seminar	Teaching methods	Remarks
1. Development of a fuzzy system for regulating the liquid level in a spherical tank (1STS). **2. Development of a fuzzy system for regulating the liquid level in a cylindrical tank (1CTS)** **3. Realization of a fuzzy system for stabilizing a Lorenz type system.** **4. Realization of a fuzzy system for stabilizing a Liénard type system.** **5. Realization of a fuzzy system for stabilizing a system with magnetic levitation.** **6. Making a fuzzy system to stabilize the reverse pendulum system.** **7. Study of the complexity of the calculation in the case of FLCs.**	**Exercise, discussions and debate, modeling, design. Usage specialized software applications web documentation organized group work.**	S1. 4 h, S2. 4 h, S3. 4 h, S4. 4 h, S5. 4 h, S6. 4 h, S7. 4 h.

8.4 Seminar references

1. **Clarence W. de Silva, Intelligent Control: Fuzzy Logic Applications (Mechatronics), CRC Press; 1 edition (May 2,**
2. **2018),**
3. **Jerry M. Mendel, Uncertain Rule-Based Fuzzy Systems: Introduction and New Directions, 2nd Edition, Springer, 2017.**

4. Ştefan Preitl, Radu-Emil Precup, Marius-Lucian Tomescu, Mircea-Bogdan Radac, Emil M. Petriu, and Claudia Adina Dragoş (2009): Model - Based Design Issues in Fuzzy Logic Control. in Towards Intelligent Engineering and Information Technology,Series: Studies in Computational Intelligence , Vol. 243.Rudas, Imre J.; Fodor, János; Kacprzyk, Janusz (Eds.) Publisher: Springer-Verlag Berlin Heidelberg 2009. Springer; 1 edition (August 18, 2009)..
5. R.-E. Precup, M. L. Tomescu, M.-B. Radac, E. M. Petriu, S. Preitl, C.-A. Dragos, Iterative performance improvement of fuzzy control systems for three tank systems, Expert Systems with Applications, vol. 39, no. 9, pp. 82888299, July 2012, ISSN 0957-4174.
6. Precup, RE, Tomescu, ML, Petriu, EM, Preitl, S, Dragos, CA, Stable Design of a Class of Nonlinear Discrete-Time MIMO Fuzzy Control Systems. ACTA POLYTECHNICA HUNGARICA, Volume: 9, Issue: 2, Pages: 57-76 Published:2012.
7. Precup, R.-E., Rădac, M.-B., Tomescu, M. L., Petriu, E. M. and Preitl, St. (2013): Stable and convergent iterative feedback tuning of fuzzy controllers for discrete-time SISO systems. Expert Systems with Applications (Elsevier Science), vol. 40, no. 1, pp. 188-199, ISSN 0957-4174. SCI impact factor = 2.203, SCI impact factor in 2011 = 2.203. [7] Radu-Emil Precup, Marius L. Tomescu, Stefan Preitl, Emil M. Petriu, János Fodor and Claudiu Pozna, Stability analysis and design of a class of MIMO fuzzy control systems, Journal of Intelligent & Fuzzy Systems, DOI:10.3233/IFS-2012-0621
8. M. N. Anthony, H. Ling, and L. Derong. Stability of Dynamical Systems Continuous, Discontinuous, and Discrete Systems. Systems & Control: Foundations & Applications. Birkhäuser, Boston, 2008.
9. M. Kai, F. Klawonn, R. Kruse, and A. Nürnberger. Fuzzy Control: Fundamentals, Stability and Design of Fuzzy Controllers. Studies in Fuzziness and Soft Computing. Springer-Verlag New York, Inc., 2006.
10. L. A. Zadeh. Fuzzy sets. Information and Control, (8):338 – 353, 1965.
11. L. A. Zadeh, George J. Klir, and Bo Yuan. Fuzzy Sets, Fuzzy Logic, and Fuzzy Systems: Selected Papers by Lotfi A. Zedeh, volume 6 of Advances in Fuzzy Systems - Applications and Theory. World Scientific Publishing Co., Inc.,River Edge, NJ, USA, 1996.
12. S. H. Zak. Systems and Control. Oxford University Press, Oxford New York, 2003.
13. **M. Tomescu Note de curs, Platforma SUMS 2020**

8.5 / Laboratory		Remarks
8.6 Laboratory references		
8.7 / Project	Teaching methods	Remarks
8.8 Project References		

9. Corroboration / validation of course put line (if applicable)

The content of the discipline is in line with what is done in other university centers in the country and abroad. For a better adaptation to the requirements of the labor market of the content of the discipline, meetings were held both with representatives of the business environment and with teachers of mathematics and informatics in pre-university education.

10. Evaluation / Grading

Activity type	Evaluation criteria	Evaluation methods	Percentage of the final grade
10.1. Lecture	**- correctness and completeness of knowledge; logical coherence; - the degree of assimilation of the language of specialty; - criteria regarding the attitudinal aspects: conscientiousness, interest in individual study.**	**Oral assessment (final in the exam session): - Free exposure of the student; - Evaluation conversation; - Oral questionnaire.**	**50%**
10.2. Seminar	**- ability to operate with assimilated knowledge; ability to apply in practice; - criteria regarding the attitudinal aspects: conscientiousness, interest in individual study.**	**Current written works: homework, projects. Final written assessment (in the exam session) Active participation in seminars.**	**50%**
10.3. Laboratory			
10.4. Project			%

10.5 Minimal performance standard

Minimum performance standard: knowledge of the fundamental elements of theory and practice, solving a simple application.

Date **20.09.2020**	Signature of the course coordinator **A. Prof. Marius Tomescu**	Signature of the seminar/ laboratory/project **A. Prof. Marius Tomescu**
Date of Department Approval **25.09.2020**	Signature of the Head of the Department **Lect. Dr. Lorena Popa**	Signature of the Dean **A. Prof. Marius Tomescu**

SYLLABUS[1]

1. Study programme

1.1 Higher education institution	„Aurel Vlaicu" University of Arad
1.2 Faculty	Faculty of Exact Sciences
1.3 Department	Department of Mathematics and Computer Science
1.4 Field of study	Mathematics
1.5 Study level	II – Master
1.6 Study programme / Qualification	Mathematical Modeling in Research and Didactics

2. Course details

2.1 Name of the course	**Analysis and processing of statistical data**
2.2 Course coordinator	**Prof. Mariana Nagy, PhD**
2.3 Seminar/laboratory/project coordinator	**Prof. Mariana Nagy, PhD**
2.4 Study year	I
2.5 Semester	2 (2)
2.6 Evaluation type	Exam
2.7 Course type	Elective Course

3. Estimated total time (hours per semester)

3.1 Hours per week	3	of which 3.2 lecture	1	3.3 seminar/laboratory/project	2
3.4 Total hours per curriculum	42	of which 3.5 lecture	14	3.6 seminar/laboratory/project	28
Time division					Hrs
Independent study from textbooks, course support, bibliography and notes					30
Additional reading (libraries, specialized electronic platforms and field research)					30
Preparing of seminars/laboratories/projects, homework, papers, portfolios and essays					30
Tutorial coaching					14
Examinations					4
Other activities					-
3.7 Total individual study hours					**108**
3.8. Total hours per curriculum (3.4) + Total individual study hours (3.7)					**150**
3.9 Total hours per semester (25 hrs /1 credit)					**150**
3.10 Number of ECTS credits					**6**

4. Prerequisites (if applicable)

4.1 curriculum related	Probability and Statistics – basic course
4.2 competence related	-

5. Conditions (if applicable)

5.1 for the lecture	Lecture room equipped with laptop, projector and proper software
5.2 for the seminar/laboratory/project	Laboratory Room, equipped properly with:computers, computer network, Internet connection

6. Specific educational objectives (competences to be acquired)

Professional competences	**C2.** Data processing, analysing aleatory processes and phenomena. **C4.** Developing and applying mathematical models for analysing processes and phenomena **C5.** Solving financial and actuarial mathematical problems
Transversal competences	**CT2.** Coordinating and managing activities organized in teams or inter-disciplinary groups **CT3.** Choosing the information resources, efficient use of the learning resources developing the capability of corelating professional activity with the demands of a dynamic society

7. Course outcomes (resulting from the specific educational objectives to be acquired)

7.1 General outcomes	Training Skills for students to use data processing techniques in order to obtain aggregated information of statistical type. Emphasizing and broadening understanding of the basic concepts used in a wide variety of business applications.
7.2 Specific outcomes	Students will be able to demonstrate that they have acquired knowledge on: - Using data processing techniques based on statistical methods. - Familiarity with guidance on interpreting the results in various fields, in order to facilitate the collaboration with customer. - Use of general spreadsheet environments and a specific software.

8. Course outline

8.1 Lecture	**Teaching methods**	**Remarks**
Statistical approach of datasets - Classification of information. I - Data. Information. Knowledge. Interpretation. Decision. - Statistics Variable. - Statistics Distribution. - Sample. Sampling techniques.	▪ Lecturing ▪ Exemplifying ▪ Conversation	1 hrs
Descriptive Analysis - Numerical characteristics: - Use of computer technology: applications MS-Excel, SPSS and Fast Statistics	▪ Lecturing ▪ Exemplifying ▪ Questioning	2 hrs
Graphical representation of statistical distributions - Charts types - Histograms.	▪ Documentation on the Web ▪ Exemplifying ▪ Conversation	1 hrs
Statistical Predictions - Estimation Theory - Average, Mobile Average, Standard Deviation - Chart Prediction	▪ Lecturing ▪ Exemplifying ▪ Questioning ▪ Modeling	2 hrs
Comparative analysis of datasets - Normal Distribution - Correlation. Covariance. - Regression.	▪ Lecturing ▪ Exemplifying ▪ Modeling	1 hrs
Probability Repartitions. Statistical Assumptions.	▪ Interactive Exposure	3 hrs

- Classical statistical repartitions - Hypothesis testing	▪ Individual Study ▪ Questioning ▪ Modeling	
Using clusters for data processing - Clusters Definition and Typology - Space Clusters	▪ Interactive Exposure ▪ Exemplifying ▪ Questioning ▪ Modeling	2 hrs
Approaching a Problem with Real Data - Data Sampling - Data analysis	▪ Analysis ▪ Individual Study ▪ Documentation on the Web ▪ Questioning ▪ Modeling	2 hrs

8.2 Seminar / Laboratory / Project	Teaching methods	Remarks
Statistical approach of datasets - Classification of information. I - Data. Information. Knowledge. Interpretation. Decision. - Statistics Variable. Statistics Distribution. - Sample. Sampling techniques.	▪ Exemplifying ▪ Conversation	2 hrs
Descriptive Analysis - Numerical characteristics: - Use of computer technology: applications MS-Excel, SPSS and Fast Statistics	▪ Exemplifying ▪ Questioning	4 hrs
Graphical representation of statistical distributions - Charts types - Histograms.	▪ Documentation on the Web ▪ Exemplifying ▪ Conversation	2 hrs
Statistical Predictions - Estimation Theory - Average, Mobile Average, Standard Deviation - Chart Prediction	▪ Exemplifying ▪ Questioning ▪ Modeling	2 hrs
Comparative analysis of datasets - Normal Distribution - Correlation. Covariance. - Regression.	▪ Exemplifying ▪ Modeling	2 hrs
Probability Repartitions. Statistical Assumptions. - Classical statistical repartitions - Hypothesis testing	▪ Interactive Exposure ▪ Individual Study ▪ Questioning ▪ Modeling	6 hrs
Using clusters for data processing - Clusters Definition and Typology - Space Clusters	▪ Interactive Exposure ▪ Exemplifying ▪ Questioning ▪ Modeling	4 hrs
Approaching a Problem with Real Data - Data Sampling - Data analysis	▪ Analysis ▪ Individual Study ▪ Documentation on the Web ▪ Modeling	6 hrs
References		

1. Nagy M, Lecture notes (electronic learning material)
2. Babucea AG, Analiza datelor – Metode statistice avansate , Ed. Universitaria, Craiova, 2010
3. Besag J., Newell J. (1991). The detection of clusters in rare diseases, Journal of the Royal Statistical Society, Series A, 154, 143-155;
4. Kulldorff, M. (1997). A spatial scan statistic. Statistics–Theory and Methods, 26, 1481-96;
5. Nădăban S., Teoria probabilităţilor şi statistică matematică, Editura Didactică şi Pedagogică, Bucureşti, 2007
6. Pintilescu C., Analiza statistică multivariată, Ed. Universitatii „Alexandru Ioan Cuza", Iasi, 2007
7. Spircu L., Calciu M., Spircu T., Analiza datelor de marketing., Seria Oeconomica, ed. All, Bucureşti,1994/2000
8. Tapscott A., Tapscott D, Revoluția Blockchain, Ed. Act și Politon, 2017
9. *** Documentaţia programelor folosite: MS-Excel, SPSS, Fast statistics, Excel-Lent marketing, ClusterSeer(2012)
10. *** Handbooks and guides on the Internet

9. Correlation of course outline with the expectations of the epistemic community, professional associations and representative employers within the field of the program

This course is taught in similar programs at many universities, both in Romania and abroad. For a better matching with the demands of the labor market, meetings with employers' representatives and specialty teachers from the pre-university education system have been organized. Using English brings and added value to the program, enabling the hiring of graduates by multinational companies (both abroad and in Romania).

10. Evaluation / Grading

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Percentage of the final grade
10.4 Lecture	▪ correctness and completeness of knowledge ▪ logical consistency ▪ the degree of assimilation	Oral assessment (final exam): ▪ project presentation ▪ the conversation evaluation ▪ Free Exposure ▪ Oral Questioning	40%
	▪ conscientiousness, interest in study	active participation in courses	10%
10.5 Seminar / laboratory / project	▪ ability to apply the acquired knowledge	▪ finalization of the required project	30%
10.6 Minimal performance standard:	▪ conscientiousness, interest in study	active participation in seminars	20%
The appropriate acquirement of basic thehrstical concepts and the capability to apply them in the specific projects .			

Date	Signature of the course coordinator	Signature of the seminar/ laboratory/project coordinator
22.09.2020	Prof. Mariana Nagy, PhD	Prof. Mariana Nagy, PhD

Date of Department Approval	Signature of the Head of the Department	Signature of the Dean
25.09.2020	Lect. Lorena Popa, PhD	A. Prof. dr. Marius Tomescu