COURSE PROGRAMME

1. Information about the programme

1.1 University	**University "Alexandru Ioan Cuza" of Iasi**
1.2 Faculty	**Faculty of Mathematics**
1.3 Department	**Department of Mathematics**
1.4 Domain	**Mathematics**
1.5 Cycle	**Masters**
1.6 Programme / Qualification	**Applied Mathematics**

2. Information about the course

2.1 Course Name			Special chapters on applied analysis				
2.2 Course taught by			Prof. PhD. EUGEN VARVARUCA				
2.3 Seminary / laboratory taught by			Prof. PhD. EUGEN VARVARUCA				
2.4 Year	I	**2.5** Semester	I	**2.6** Type of evaluation*	E	**2.7** Course type**	Ob

E – Exam / C – Colloquium / V – Verification
***OB – Obligatory / OP – Optionally / F – Facultative*

3. Total hours (estimated per semester and activities)

3.1 Number of hours per week	4	**3.2** course	2	**3.3** seminary/ laboratory	2
3.4 Total number of hours	56	**3.5** course	28	**3.6** seminary/ laboratory	28

Distribution	hours
Individual study using textbooks, course notes, bibliography items, etc.	75
Supplimentary study (library, on-line platforms, etc.)	20
Individual study for seminary/laboratory, homeworks, projects, etc.	20
Tutoring	0
Examination	4
Other activities	0
3.7 Total hours of individual activity*	119
3.8 Total hours per semester	175
3.9 Credit points	7

4. Pre-requisites - Curriculum (if necessary)

Mathematical Analysis, Functional Analysis and Measure and Integration Theory

5. Conditions (if necessary)

5.1 Course	classroom
5.2 Seminary / Laboratory	classroom

6. Objectives

Acquiring by the students of some notions and methods for the study of problems in Linear and Nonlinear Functional Analysis and Measure and Integration Theory; acquiring of techniques for the solution of standard problems.

Upon successful completion of this course, the students will be able to:
• describe the basic objects of Linear and Nonlinear Functional Analysis and of Measure and Integration Theory
• prove the fundamental properties of these objects
• explain the meaning and application of the main results
• use some techniques and basic notions in the solution of exercises and problems

7. Specific competencies/Learning outcomes

• applies scientific methods
• demonstrates disciplinary expertise
• thinks abstractly
• finds solutions to problems
• performs analytical mathematical calculations

8. Contents

8.1 Course	**Teaching methods**	**Remarks** (number oh hours, references)
Complements on the theory of compact metric spaces	Questioning, dialogue, lecture, proof	2 hours
The Peano Theorem for systems of ordinary differential equations	Questioning, dialogue, lecture, proof	2 hours
Differential Calculus in Banach spaces. Basic notions	Questioning, dialogue, lecture, proof	2 hours
The Inverse Function Theorem and the Implicit Function Theorem	Questioning, dialogue, lecture, proof	2 hours
The Crandall-Rabinowitz Local Bifurcation Theorem	Questioning, dialogue, lecture, proof	2 hours
Application to the study of waves with constant vorticity in water of finite depth	Questioning, dialogue, lecture, proof	2 hours
Algorithms for the approximation of solutions of fixed-point problems	Questioning, dialogue, lecture, proof	2 hours
Convergence of Newton’s Method	Questioning, dialogue, lecture, proof	2 hours
Compact operators on Banach spaces	Questioning, dialogue, lecture, proof	2 hours
Spectral theory of compact selfadjoint operators	Questioning, dialogue, lecture, proof	2 hours
The pointwise convergence of Fourier series	Questioning, dialogue, lecture, proof	2 hours
The Lebesgue measure in R^n	Questioning, dialogue, lecture, proof	2 hours
The Change of Variables Theorem for Lebesgue integrals	Questioning, dialogue, lecture, proof	2 hours

Bibliography

1. N. Katzourakis, E. Vărvărucă, An illustrative introduction to modern analysis, CRC Press, 2018
2. I. Vrabie, Ordinary differential equations: an introduction to basic concepts, results and applications, World Scientific, 2004
3. B. Buffoni, J.F. Toland, Analytic theory of global bifurcation: an introduction, Princeton University Press, 2002
4. A. Precupanu, Bazele analizei matematice, Editura UAIC, 1993
5. A. Constantin, E. Vărvărucă, Steady periodic water waves with constant vorticity: regularity and local bifurcation, Arch. Ration. Mech. Anal. 199 (2011), 33-67.
6. A. Quarteroni, R. Sacco, F. Saleri, Numerical mathematics, 2nd edition, Springer, 2007
7. E. Kreyszig, Introductory functional analysis with applications, Wiley, 1978
8. B. Rynne, M. Youngson, Linear functional analysis, 2nd edition, Springer, 2008
9. A. Precupanu, Analiză matematică: funcții reale, Editura Didactică și Pedegogică, 1976
10. G. B. Folland, Real analysis: modern techniques and their applications, 2nd edition, Wiley, 1999

8.2 Seminary / Laboratory	**Teaching methods**	**Remarks** (number oh hours, references)
Complements on the theory of compact metric spaces	Exercise, dialogue	2 hours
The Peano Theorem for systems of ordinary differential equations	Exercise, dialogue	2 hours
Differential Calculus in Banach spaces. Basic notions	Exercise, dialogue	2 hours
The Inverse Function Theorem and the Implicit Function Theorem	Exercise, dialogue	2 hours
The Crandall-Rabinowitz Local Bifurcation Theorem	Exercise, dialogue	2 hours
Application to the study of waves with constant vorticity in water of finite depth	Exercise, dialogue	2 hours
Algorithms for the approximation of solutions of fixed-point problems	Exercise, dialogue	2 hours
Convergence of Newton’s Method	Exercise, dialogue	2 hours
Compact operators on Banach spaces	Exercise, dialogue	2 hours
Spectral theory of compact operators	Exercise, dialogue	2 hours
Spectral theory of compact selfadjoint operators	Exercise, dialogue	2 hours
The pointwise convergence of Fourier series	Exercise, dialogue	2 hours
The Lebesgue measure in R^n	Exercise, dialogue	2 hours
The Change of Variables Theorem for Lebesgue integrals	Exercise, dialogue	2 hours

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9. Coordination of the contents with the expectations of the community representatives, professional associations and relevant employers in the corresponding domain

The course and the seminar will offer the students a framework for the applications of the abstract notions and the important results from Linear and Nonlinear Functional Analysis and from Measure and Integration Theory in applied branches of Mathematics.

10. Assessment and examination

<table>
<tr><td colspan="2">10.1 Continuous assessment</td><td colspan="2">Percentage (min. 30%)</td><td>30</td></tr>
<tr><td rowspan="4">Course</td><td colspan="3">Assessment type</td><td>Mixed assessment</td></tr>
<tr><td colspan="3">Percentage</td><td>50</td></tr>
<tr><td colspan="3">Failure to pass the continuous assessment results in failure to pass the final assessment</td><td>No</td></tr>
<tr><td>Assessment methods</td><td colspan="3"><table><tr><td>Details</td><td>Percentage</td><td>with reexamination</td></tr><tr><td>Current assessment</td><td>50</td><td>No</td></tr><tr><td>Continuous written assessment</td><td>50</td><td>No</td></tr></table></td></tr>
<tr><td rowspan="4">Seminary / Laboratory</td><td colspan="3">Assessment type</td><td>Mixed assessment</td></tr>
<tr><td colspan="3">Percentage</td><td>50</td></tr>
<tr><td colspan="3">Failure to pass the continuous assessment results in failure to pass the final assessment</td><td>No</td></tr>
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</table>

10.2 Final assessment	Percentage (max. 70%)	70
	Assessment type	Final mixed assessment

10.3 Special notes (special situations is assessment)	

10.4 Minimum performance standard
Knowledge of fundamental notions, understanding of the main theoretical results. Ability to solve simple exercises and problems.

Date, **Course coordinator,**
Prof. PhD. EUGEN VARVARUCA

Seminary coordinator,
Prof. PhD. EUGEN VARVARUCA

Aproval date in the department,

Head of the departament,
Prof. PhD. IONEL DUMITREL GHIBA