COURSE PROGRAMME

1. Information about the programme

1.1 University	**University “Alexandru Ioan Cuza” of Iaşi**
1.2 Faculty	**Faculty of Mathematics**
1.3 Department	**Mathematics**
1.4 Domain	**Mathematics**
1.5 Cycle	**Master**
1.6 Programme / Qualification	**Applied Mathematics**

2. Information about the course

2.1 Course Name			**Practical Optimization**				
2.2 Course taught by			**Prof. PhD Marius DUREA**				
2.3 Seminary / laboratory taught by			**Prof. PhD Marius DUREA**				
2.4 Year	**2**	**2.5** Semester	**3**	**2.6** Type of evaluation	**E**	**2.7** Course type	OB

* *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.	**40**
Supplimentary study (library, on-line platforms, etc.)	**25**
Individual study for seminary/laboratory, homeworks, projects, etc.	**25**
Tutoring	
Examination	**4**
Other activities.....	

3.7 Total hours of individual activity	**94**
3.8 Total hours per semester	**150**
3.9 Credit points	**6**

4. Pre-requisites

4.1	Curriculum	Mathematical Analysis, nonlinear optimization theory
4.2	Competencies	Basic knowledge of Computer Programming and Matlab/Octave environment

5. Conditions (if necessary)

5.1	Course	Laboratory room (computers with MATLAB/Octave installed)
5.2	Seminary / Laboratory	Laboratory room(computers with MATLAB installed)

6. Specific competencies acquired

	C1 Manipulating notions, methods and mathematical models, specific techniques in scientific calculus and applications – 2 credits C2 Being able to construct and apply mathematical methods for analyzing and simulating some processes – 1 credit C3 Being able to develop, analyze and test algorithms and specific programming languages; being able to use them for solving problems in applied mathematics – 1 credit
	CT1 Having a responsible attitude towards scientific research and teaching, being able to fully develop the personal potential in the professional career, respecting the principles of a rigorous and efficient work in order to fulfill complex tasks, respecting the ethical norms and principles in the professional activity – 1 credit CT2 Being able to make a selection of information resources and to use them efficiently, in Romanian or other language of international circulation – 1 credit

7. Course objectives

1.7. General objective	Understand and apply optimization algorithms in order to find and/or approximate the solutions of certain real problems, to obtain numerical algorithms, and to implement them in Matlab/Octave. Being able to generalize the results, when practice will demand.
2.7. Specific objectives	If successfull at the final examination, students will be able to: - Explain the basic methods used during the semester. - Describe the analitical methods of solving the studied problems. - Use the studied numerical algorithms and the basic optimization tehniques. - Analyze the solutions of the specific studied problems. - Use Matlab/Octave as a calculus tool

8. Contents

8.1	Course	Teaching methods	Remarks (number oh hours; references)
1.	Karush-Kuhn-Tucker conditions in nonlinear smooth constrained optimization (recapitulation)	Questioning, dialogue, lecture, proof	3 h; [2, 3]
2.	Fritz John conditions and second order conditions	Questioning, dialogue, lecture, proof	5h; [2, 3]
3.	Complexity for some optimization numerical methods. Algorithms for unconstrained optimization: golden section, Fibonacci method	Questioning, dialogue, lecture, proof	5h; [3, 4]
4.	Algorithms for unconstrained optimization: line search method, conjugate gradient method, Newton method, other related methods	Questioning, dialogue, lecture, proof	10 h; [3, 4]
5.	Algorithms for unconstrained optimization: penalty methods; barrier methods	Questioning, dialogue, lecture, proof	5 h; [1, 2]

Bibliography

Main references:

1. A. Beck, *First-order methods in optimization*, SIAM, 2017.
2. M. Durea, R. Strugariu, *An introduction to nonlinear optimization theory*, De Gruyter, 2014.
3. O. Guler, *Foundations of optimization*, Springer, 2010.
4. J. Nocedal, S.J. Wright, *Numerical optimization*, Springer, 2006.
5. P. Pedregal, *Optimization and approximation*, Springer, 2

8.2	Seminary / Laboratory	Teaching methods	Remarks
1.	Karush-Kuhn-Tucker conditions in nonlinear smooth constrained optimization (recapitulation)	Questioning, dialogue, exercises	3h; [2, 3, 4]
2.	Fritz John conditions and second order conditions	Questioning, dialogue, exercises	5h; [1, 5]
3.	Complexity for some optimization numerical methods. Algorithms for unconstrained optimization: golden section, Fibonacci method	Questioning, dialogue, exercises	5h; [1, 5]
4.	Algorithms for unconstrained optimization: line search method, conjugate gradient method, Newton method	Questioning, dialogue, exercises	10h; [4, 5]
5.	Algorithms for unconstrained optimization: penalty methods; barrier methods	Questioning, dialogue, exercises	5h; [1, 3]
		exercises	

Bibliography

Main references:

1. M. Ancau, *Practical optimization with Matlab*, Combridge Scholars Publishing, 2019.
2. A. Beck, *First-order methods in optimization*, SIAM, 2017.
3. M. Durea, R. Strugariu, *An introduction to nonlinear optimization theory*, De Gruyter, 2014.
4. P. Pedregal, *Optimization and approximation*, Springer, 2017.
5. J.A. Snyman, D.N. Wilke, *Practical mathematical optimization. Basic optimization theory and gradient-based algorithms*, Springer 2005.

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

The aim of *Practical Optimization* is to give students the opportunity to understand how they may use the acquired theoretical knowledge in order to obtain solutions of some practical problems using some algorithms and some well -known mathematical software.

10. Assessment and examination

Activity	**10.1 Criteria**	**10.2 Modes**	**10.3 Weight in the final grade (%)**
10.4 Course	Knowledge and correct use of fundamental concepts, results and algorithms	Written and oral examination N1	67
10.5 Seminary/ Laboratory	Application of analytical and numerical methods for solving some optimization problems	Written test N2	33
10.6 Minimal requirements			
- Knowledge of the fundamental notions, understanding the main results - Development of algorithms for solving a problem of low-difficulty grade N1>=5; (2*N1/3+N2/3) >=5			

Date
29.09.2023

Course coordinator
Prof. PhD. Marius Durea

Seminary coordinator
Prof. PhD. Marius Durea

Aproval date in the department

Head of the departament
Prof. PhD. Ioan Bucataru