Syllabus

1. Data about the program of study

1.1 Institution	Technical University of Cluj-Napoca
1.2 Faculty	Automation and Computer Science
1.3 Departament	Automation
1.4 Field of study	Systems Engineering
1.5 Cycle of study	Bachelor of Science
1.6 Program of study/Qualification	Automation and Applied Informatics (English)
1.7 Form of education	Full time
1.8 Code	55.10

2. Data about the subject

2.1 Subject name	***Optimization***					
2.2 Course responsible/lecturer	Prof.dr.ing. Zsofia Lendek, zsofia.lendek@aut.utcluj.ro					
2.3 Teachers in charge of applications	Prof.dr.ing. Zsofia Lendek, zsofia.lendek@aut.utcluj.ro					
2.4 Year of study	4	2.5 Semester	2	2.6 Assessment *(E/C/V)*		E
2.7 Type of subject	*DID – in the field*					DD
	DOP – elective					DO

3. Estimated total time

3.1 Number of hours per week	4	of which:	Course	2	Seminar	0	Laboratory	2	Project	0
3.2 Number of hours per semester	56	of which:	course	28	Seminar	0	Laboratory	28	Project	0
3.3 Individual study										
(a) Manual, lecture material and notes, bibliography										20
(b) Supplementary study in the library, online and in the field										10
(c) Preparation for seminars/laboratory works, homework, reports, portfolios, essays										33
(d) Tutoring										3
(e) Exams and tests										3
(f) Other activities:										0

3.4 Total hours of individual study (sum of (3.3(a)...3.3(f)))	69
3.5 Total hours per semester (3.2+3.4)	125
3.6 Number of credit points	5

4. Pre-requisites (where appropriate)

4.1 Curriculum	Numerical calculus, analysis, linear algebra, differential equations, Matlab
4.2 Competence	Numerical calculus, analysis, linear algebra, differential equations, Matlab

5. Requirements (where appropriate)

5.1. For the course	Attending at least 7 lectures is compulsory.
5.2. For the applications	Presence and successfully completing the lab/project applications are compulsory

6. Specific competences

6.1 Professional competences	**C1** Using knowledge of mathematics, physics, mechanical engineering, chemistry, electrical and electronic engineering in systems engineering **C3** Using basics of control engineering, methods of modeling, simulation, identification and analysis of processes, computer assisted design techniques.
6.2 Cross competences	

7. Course objectives

7.1 General objective	Mathematical formulation of an optimization problem Optimization methods Global optimization
7.2 Specific objectives	- Solving single variable optimization problems - Implementing optimization methods - Solving multivariable optimization problems - Applying optimization methods - Using genetic algorithms for particular applications

8. Contents

8.1 Lecture	No.hours	Teaching methods	Notes
Introduction. Stating an optimization problem.	2	Exposition Questions Discussions with students Proofs	Possibly online on Teams platform
Unconstrained optimization. Sufficient conditions. Constrained optimization.	2		
Optimization of single variable functions.	2		
Newton and gradient methods.	2		
Conjugate gradient and quasi-Newton methods.	2		
Algorithms for minimization without derivatives.	2		
Linear programming. Formulation.	2		
The simplex method.	2		
Quadratic programming.	2		
Active set methods.	2		
Genetic algorithms for numerical optimization	2		
Genetic algorithms for numerical optimization	2		
Applications.	2		
Applications.	2		

Bibliography

1. Optimal, predictive, and adaptive control, Edoardo Mosca, Englewood Cliffs, New Jersey, 195
2. Modern control design : with MATLAB and SIMULINK, Ashish Tewari, Wiley, 2002
3. Tehnici de optimizare, vol. 2, T. Colosi, P.Bikfalvi, D.Isoc, Cluj-Napoca : Institutul Politehnic Cluj-Napoca, 1989
4. Optimal control with engineering applications, Geering, H, Springer, 2007
5. Optimization, P. Raica, UTPress, 2010
6. Lecture notes available online at lendek.net/teaching

8.2 Aplications (seminar/laboratory/project)	No.hours	Teaching methods	Notes
Numerical methods in optimization.	2	Tutorials and application	Attendance mandatory. Matlab will be used. Possibly online on Teams platform
Unconstrained optimization. Applications	2		
Optimization of single variable functions.	2		
Optimization of single variable functions.	2		
Newton and gradient methods. Applications.	2		
Newton and gradient methods. Applications.	2		
Nelder-Mead and Rosenbrock methods. Applications.	2		
Nelder-Mead and Rosenbrock methods. Applications.	2		
Simplex method. Applications.	2		
Simplex method. Applications.	2		
Active set method. Applications.	2		
Active set method. Applications.	2		
Genetic algorithms. Applications.	2		
Genetic algorithms. Applications.	2		

Bibliography

1. Optimal, predictive, and adaptive control, Edoardo Mosca, Englewood Cliffs, New Jersey, 195
2. Modern control design : with MATLAB and SIMULINK, Ashish Tewari, Wiley, 2002
3. Tehnici de optimizare, vol. 2, T. Colosi, P.Bikfalvi, D.Isoc, Cluj-Napoca : Institutul Politehnic Cluj-Napoca, 1989
4. Optimal control with engineering applications, Geering, H, Springer, 2007

5. Optimization, P. Raica, UTPress, 2010
6. Lecture notes available online at lendek.net/teaching

9. Bridging course contents with the expectations of the representatives of the community, professional associations and employers in the field

The methods taught at this course represent the basis in optimization. Thus, the students will be capable to formulate mathematically an optimization problem, to analyze the problem, determine the methods that can be used to solve it and interpret the results. By doing the project, the students will be familiarized with the latest results in this domain and have the possibility to do research.
The knowledge acquired can be applied both in the academic community (research in optimization and optimal control) and in industry (optimal control, optimal design, improving/optimization of industrial processes)

10. Evaluation

Activity type	Assessment criteria	Assessment methods	Weight in the final grade
Course	Level of understanding of the material	Exam	0.4
Seminar			
Laboratory	Implementation, analysis, report, discussion	Partial exam	0.6
Project			
Minimum standard of performance: All lab exercises completed + final grade >5			

Date of filling in:		**Title Firstname NAME**	**Signature**
30.05.2024	Course	Prof.dr.ing. Zsofia Lendek	
	Applications	Prof.dr.ing. Zsofia Lendek	

Date of approval by the Department Board ……..

Head of Departament .....
Prof.dr.ing. Honoriu VĂLEAN

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Date of approval by the Faculty Council ……

Dean
Prof.dr.ing. Mihaela Dinsoreanu

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