SYLLABUS

1. Data about the program of study

1.1	Institution	The Technical University of Cluj-Napoca
1.2	Faculty	Faculty of Automation and Computer Science
1.3	Department	Automation
1.4	Field of study	System Engineering
1.5	Cycle of study	Master of Science
1.6	Program of study/Qualification	Cyber-physical systems
1.7	Form of education	Full time
1.8	Subject code	2.00

2. Data about the subject

2.1	Subject name			Evolutive systems			
2.2	Subject area			Science			
2.2	Course responsible/lecturer			*Prof.dr.eng. Honoriu Vălean* Honoriu.Valean@aut.utcluj.ro			
2.3	Teachers in charge of seminars			*Lect.dr.eng. Dan Goța* Dan.Gota@aut.utcluj.ro			
2.4 Year of study	1	2.5 Semester	1	2.6 Assessment			E
2.7 Subject category	Formative category						DA, DI
	Optionality						

3. Estimated total time

3.1 Number of hours per week	3	of which	3.2 Course	2	3.3 Seminars		3.3 Laboratory	1	3.3 Project	
3.4 Total hours in the curriculum	100	of which	3.5 Course	28	3.6 Seminars		3.6 Laboratory	14	3.6 Project	

3.7 Individual study:	
(a) Manual, lecture material and notes, bibliography	28
(b) Supplementary study in the library, online and in the field	10
(c) Preparation for seminars/laboratory works, homework, reports, portfolios, essays	17
(d) Tutoring	
(e) Exams and tests	3
(f) Other activities	
3.8 Total hours of individual study (summ (3.7(a)...3.7(f)))	58
3.9 Total hours per semester (3.4+3.8)	100
3.10 Number of credit points	4

4. Pre-requisites (where appropriate)

4.1	Curriculum	
4.2	Competence	

5. Requirements (where appropriate)

5.1	For the course	
5.2	For the applications	Mandatory attendance

6. Specific competences

Professional competences	1. Analysis and solution of modeling and design problems in the case of cyber-physical systems using knowledge of advanced mathematics and fundamental concepts of automation 2. Research, development and implementation of complex autonomous systems 3. Use of advanced programming concepts to design and implement computer applications for cyber-physical systems 4. Design, develop and analyze control applications using advanced systems engineering strategies and knowledge 5. Identifying, formulating and solving engineering problems that integrate physical, management, communication and informatics aspects 6. Selection and appropriate use of techniques, skills and tools to solve complex engineering problems and evaluate aspects related to operational safety and reliability of the solution
Cross competences	1. Effective communication in transdisciplinary teams 2. Managing the roles, responsibilities and way of communication in a team, monitoring and controlling the activities carried out to effectively achieve the objectives 3. Identifying the needs and opportunities for continuous training, demonstrating critical and innovative thinking skills and effectively utilizing learning resources for personal development.

7. Discipline objectives (as results from the *key competences gained*)

7.1	General objective	The use of multidisciplinary knowledge in the field of systems engineering, computers and information technology in order to analyze, design, optimize, implement and test evolutionary mechanisms in the field of cyber-physical systems.
7.2	Specific objectives	- to design and implement solutions based on evolutionary algorithms - to solve simple or complex optimization problems - to solve problems specific to different engineering fields with the help of evolutionary algorithms

8. Contents

8.1. Lecture (syllabus)	Number of hours	Teaching methods	Notes
Evolutionary algorithms, evolutionary systems	2	Interactive presentation with examples on the projector. In case of force majeure, online on Teams	
Genetic algorithms	2		
Swarm intelligence	2		
Artifficial immune system	2		
Evolutionary algorithms in optimization problems	2		
Multimodal optimization	2		
Multiobjective optization	2		
Parallel and distributed evolutionary algorithms	2		
GA in NN and Fuzzy systems	2		
GA in planning problems	2		
GA in transport problems	2		
Genetic programming	2		
GP in control systems	4		

Bibliography

1. X. Yu, M. Gen. Introduction to evolutionary algorythms. Springer, e-ISBN 978-1-84996-129-5
2. S.V. Sivanandam, S.V. Deepa. Introduction to genetic algorythms. Springer, ISBN 978-3-540-73189-4
3. D.E. Goldberg. Genetic Algorythms in search, optimization and machine learning. Addison-Wesley, ISBN 0-201-15767-5
4. M.Gen, R. Cheng. Genetic algorythms and engineering optimization. John Wiley & Sons.
5. K. Miettinen , P. Neittaanmaki , M. M. Makela , J. Pkriaux . Evolutionary algorithms in engineering and computer science. John Wiley & Sons. ISBN 0-471-99902-4
6. R. Poli, W.B. Langdon, N.F. McPhee, J.R. Koza. A field guide to genetic programming. https://www.researchgate.net/publication/216301261
7. J. Koza. Genetic programming IV. Kluwer academic publishers, ISBN: 1-4020-7446-8

8.2. Seminars /Laboratory/Project	Number of hours	Teaching methods	Notes
GA implementation in Python	2	Practical applications on computer	
SI implementation in Python	2		
AIS implementation in Python	2		
GA in optimization problems	2		
GA in transport peoblems	2		
GA for controller sytnthesis	2		
Laboratory assessment	2		

Bibliography

1. X. Yu, M. Gen. Introduction to evolutionary algorythms. Springer, e-ISBN 978-1-84996-129-5
2. S.V. Sivanandam, S.V. Deepa. Introduction to genetic algorythms. Springer, ISBN 978-3-540-73189-4
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5. K. Miettinen , P. Neittaanmaki , M. M. Makela , J. Pkriaux . Evolutionary algorithms in engineering and computer science. John Wiley & Sons. ISBN 0-471-99902-4
6. R. Poli, W.B. Langdon, N.F. McPhee, J.R. Koza. A field guide to genetic programming. https://www.researchgate.net/publication/216301261
7. J. Koza. Genetic programming IV. Kluwer academic publishers, ISBN: 1-4020-7446-8

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

The course is essential in cyber-physical systems. The material is continuously adapted to the requirements of potential employers and to the feedback of already employed graduates.

10. Evaluation

Activity type	10.1 Assessment criteria	10.2 Assessment methods	10.3 Weight in the final grade
10.4 Course	Assessment of knowledge using a test based on the knowledge acquired following participation in the course	Presentation of a physical or online project on Teams in case of force majeure	50%

10.5 Seminars /Laboratory/Project	Assessment of the practical skills and knowledge acquired during thw laboratory.	Practical or online Teams assessment (in case of force majeure).	50%
10.6 Minimum standard of performance			
Exam grade >= 5 and lab assessment grade >= 5			

Date of filling in: 16.03.2023.		**Title Surname Name**	**Signature**
	Lecturer	Prof.dr.eng. Honoriu Vălean	
	Teachers in charge of application	Lect.dr.ing. Dan Goța	

Date of approval in the Department of Automation

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Head of department
Prof.dr.ing. Honoriu Vălean

Date of approval in the Faculty of Automation and Computer Science

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Dean
Prof.dr.ing. Liviu Miclea