SYLLABUS

1. Information regarding the programme

1.1 Higher education institution	Babeș Bolyai University
1.2 Faculty	**Faculty of Mathematics and Computer Science**
1.3 Department	**Department of Computer Science**
1.4 Field of study	
1.5 Study cycle	
1.6 Study programme / Qualification	**Quantum Computing and Communication** (în limba engleză)

2. Information regarding the discipline

2.1 Name of the discipline (en) (ro)			Quantum technologies in modern Artificial Intelligence computation techniques Tehnologii cuantice în metode computaționale moderne de Inteligență Artificială				
2.2 Course coordinator			Mihoc Tudor Dan				
2.3 Seminar coordinator			Mihoc Tudor Dan				
2.4. Year of study	**1**	2.5 Semester	**2**	2.6. Type of evaluation	**E**	2.7 Type of discipline	**DF**
2.8 Code of the discipline	PQE0006						

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

3.1 Hours per week	6	Of which: 3.2 course	2	3.3 seminar/laboratory	1
3.4 Total hours in the curriculum	36	Of which: 3.5 course	20	3.6 seminar/laboratory	10
Time allotment:					hours
Learning using manual, course support, bibliography, course notes					15
Additional documentation (in libraries, on electronic platforms, field documentation)					15
Preparation for seminars/labs, homework, papers, portfolios and essays					10
Tutorship					5
Evaluations					2
Other activities:					

3.7 Total individual study hours	45
3.8 Total hours per semester	75
3.9 Number of ECTS credits	3

4. Prerequisites (if necessary)

4.1. curriculum	•
4.2. competencies	•

5. Conditions (if necessary)

5.1. for the course	• Basic knowledge of quantum computing and AI
5.2. for the seminar /lab activities	• Basic programming skills in C++ and Q#

6. Specific competencies acquired

Professional competencies	C1.5 Development of program units and corresponding documentation C3.3 Use of computer science and mathematical models and tools for solving specific problems in the application field
Transversal competencies	CT2 Efficient fulfilment of organized activities in an interdisciplinary group and development of empathic abilities of interpersonal communication, relationship and collaboration with various groups

7. Objectives of the discipline (outcome of the acquired competencies)

7.1 General objective of the discipline	• To present from a quantum perspective the main modern computation techiques.
7.2 Specific objective of the discipline	• Number-theoretic and algebra algorithms will be studied from a quantum point of view and implemented in projects

8. Content

8.1 Course	Teaching methods	Remarks
1. Introduction	Presentation, dialogue, exemplification	
2. Quantum materials and quantum devices	Exposition, dialogue, discussion	
3. Implementation of quantum computers	Exemplification, exposition	
4. Clustering Structure and Quantum Computing	Interactive exposure, explanation, didactic demonstration	
5. Quantum Pattern Recognition	Exemplification, exposition	
6. Quantum Classification	Presentation, dialogue	
7. Quantum Process Tomography and Regression	Exemplification, exposition	
8. Boosting and Adiabatic Quantum Computing	Presentation, dialogue	

9. Quantum Annealing	Presentation, dialogue	
10. Stochastic computing	Presentation, dialogue	
11. Adiabatic annealing	Presentation, dialogue	

Bibliography

1. P. Wittek, *Quantum machine learning: what quantum computing means to data mining,* Academic Press, Elsevier, 2014.
2. S. D. Sarma, D. Dong-Ling, and D. Lu-Ming, *Machine learning meets quantum physics, arXiv preprint arXiv:1903.03516,* 2019.
3. M. A. Nielsen, and I. L. Chuang, *Quantum Computation and Quantum Information*, Cambridge U. Press, 2010.

8.2 Seminar / laboratory	Teaching methods	Remarks
1. Clustering Structure and Quantum Computing	Problematization, example, algorithms implementation	
2. Quantum Pattern Recognition	Problematization, example, algorithms implementation	
3. Quantum Classification	Problematization, example, algorithms implementation	
4. Quantum Process Tomography and Regression	Problematization, example, algorithms implementation	
5. Boosting and Adiabatic Quantum Computing	Problematization, example, algorithms implementation	
6. Quantum Annealing	Problematization, example, algorithms implementation	
7. Stochastic computing	Problematization, example, algorithms implementation	

Bibliography

1. P. Wittek, *Quantum machine learning: what quantum computing means to data mining,* Academic Press, Elsevier, 2014.
2. S. D. Sarma, D. Dong-Ling, and D. Lu-Ming, *Machine learning meets quantum physics, arXiv preprint arXiv:1903.03516,* 2019.
3. M. A. Nielsen, and I. L. Chuang, *Quantum Computation and Quantum Information*, Cambridge U. Press, 2010.

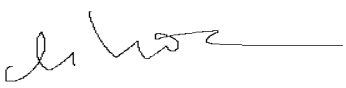
9. Corroborating the content of the discipline with the expectations of the epistemic community, professional associations and representative employers within the field of the program

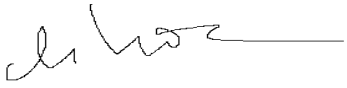
- The contents are directed towards practical applications in AI with quantum computation components. The topic is present in the computer science study programme of the major universities.

10. Evaluation

Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Share in the grade (%)
10.4 Course	Use of basic concepts in examples	Written examination	50
10.5 Seminar/lab activities	Implement course concepts and algorithms	Practical examination	50
10.6 Minimum performance standards			
➢ Grade 5			

Date	Signature of course coordinator	Signature of seminar coordinator
.....	Univ. Lect. Dr. Mihoc Tudor Dan	Univ. Lect. Dr. Mihoc Tudor Dan





Date of approval	Signature of the head of department
.....	Prof. dr. Laura Dioşan