

Syllabus

1. Information regarding the programme

1.1 Higher education institution	Babeş 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)	Classical and quantum communications Comunicare clasică și comunicare cuantică						
2.2 Course coordinator	Mihoc Tudor Dan						
2.3 Seminar coordinator	Mihoc Tudor Dan						
2.4. Year of study	1	2.5 Semester	1	2.6. Type of evaluation	E	2.7 Type of discipline	DF
2.8 Code of the discipline	PQE0003						

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

3.1 Hours per week	4	Of which: 3.2 course	2	3.3 seminar/laboratory	1
3.4 Total hours in the curriculum	20	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 calculus and linear algebra
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5.2. for the seminar /lab activities	· Basic programming skills in C++
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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 fulfillment 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 mathematical algorithms used in communication and cryptography from a classic and quantum perspective.
7.2 Specific objective of the discipline	· Number-theoretic and algebra algorithms will be studied and implemented in projects

8. Content

8.1 Course	Teaching methods	Remarks
1. Introduction in classical cryptography	Exposition, dialog, discussion	
2. Complexity theory and number theory background	Presentation, dialog, exemplification	
3. Pseudo-random number generators. Block ciphers. Pseudo-random functions.	Exemplification, exposition	
4. Private-key and public-key encryption	Interactive exposure, explanation, didactical demonstration	
5. Key distribution in classical cryptography	Presentation, dialog	
6. Schor's algorithm	Exemplification, exposition	
7. Post quantum cryptography. Quantum Computing Attacks on RSA	Presentation, dialog	
8. Quantum key distribution (QKD)	Presentation, dialog, , exemplification	

9.	Noise in QKD (eye dropper)	Presentation, dialog, exemplification	
10.	Overview of QKD networks	Presentation, dialog, exemplification	

Bibliography

1. Bellare, Mihir, and Shafi Goldwasser. "Lecture notes on cryptography." (2008).
2. Gisin, Nicolas, et al. "Quantum cryptography." *Reviews of modern physics* 74.1 (2002): 145.
3. Yan, Song Yuan. "Cryptanalytic attacks on RSA." (2007).
4. Bruß, Dagmar, and Norbert Lütkenhaus. "Quantum key distribution: from principles to practicalities." *Applicable Algebra in Engineering, Communication and Computing* 10.4 (2000): 383-399.
5. Shor, Peter W. "Polynomial-time algorithms for prime factorization and discrete logarithms on a quantum computer." *SIAM review* 41.2 (1999): 303-332.

8.2 Seminar / laboratory		Teaching methods	Remarks
1.	RSA (Rivest–Shamir–Adleman) algorithm	Problematization, example, algorithms implementation	
2.	Caesar Cypher.	Problematization, example, algorithms implementation	
3.	Electronic codebook mode	Problematization, example, algorithms implementation	
4.	Factoring Algorithms (Pollard's p-1 method, Lentra's elliptic curve factoring algorithm)	Problematization, example, algorithms implementation	
5.	Probability primality tests	Problematization, example, algorithms implementation	
6.	Quantum FFT	Problematization, example, algorithms implementation	
7.	Quantum Order Finding Attack	Problematization, example, algorithms implementation	
8.	Quantum Algorithm for Integer Factorization	Problematization, example, algorithms implementation	
9.	Quantum algorithm for discrete logarithms	Problematization, example, algorithms implementation	

Bibliography

1. Bellare, Mihir, and Shafi Goldwasser. "Lecture notes on cryptography." (2008).
2. Gisin, Nicolas, et al. "Quantum cryptography." *Reviews of modern physics* 74.1 (2002): 145.
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5. Shor, Peter W. "Polynomial-time algorithms for prime factorization and discrete logarithms on a quantum computer." *SIAM review* 41.2 (1999): 303-332.

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 classic communications and cryptography and to the transition towards Quantum communications . The topic is present in the computer science study programme of the major universities.

10. Evaluation

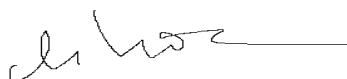
Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Share in the grade (%)
10.4 Course	Use of basic concepts in examples	Written examination	50
10.5 Seminar/lab activities	Implement course concepts and algorithms	Practical examination	50
10.6 Minimum performance standards			
<input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

Date

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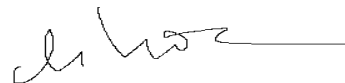
Signature of course coordinator

Univ. Lect. Dr. Mihoc Tudor Dan



Signature of seminar coordinator

Univ. Lect. Dr. Mihoc Tudor Dan



Date of approval

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Signature of the head of department

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