POZNAN UNIVERSITY OF TECHNOLOGY

EUROPEAN CREDIT TRANSFER AND ACCUMULATION SYSTEM (ECTS)

COURSE DESCRIPTION CARD - SYLLABUS

Course name
Quantum communication [S2ETI1>KK]

Course

Field of study
Education in Technology and Informatics

Year/Semester
1/2

Area of study (specialization)
–

Profile of study
general academic

Level of study
second-cycle

Course offered in
polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
15

Laboratory classes
0

Other (e.g. online)
0

Tutorials
0

Projects/seminars
15

Number of credit points

2,00

Coordinators

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Lecturers

Prerequisites

Knowledge and skills in line with the directional learning outcomes of engineering studies in the field of IT education (1st and 2nd degree education), in particular in the field of: quantum computer science, optics, fiber optics, electrical engineering, higher mathematics (linear algebra, calculus, calculus) probabilities). Ability to analytically solve problems in the above-mentioned areas. Openness to expand one"s competences in the field of new technologies. Ability to work in a team.

Course objective

The module presents the physical conditions, limitations, selected solutions and perspectives for the development of quantum communication based on the protocols of quantum distribution of the encryption key.

Course-related learning outcomes

Knowledge:
1.the student, using the concepts and methods of quantum information theory, defines the conditions and limitations of the systems of quantum distribution of the encryption key. [k2_w14, k2_w1].
2. the student, referring to the findings of quantum physics, explains the selected physical

implementation of the indicated protocol for the quantum distribution of the encryption key, taking into account the impact of the parameters of the selected modules on the level of security of quantum communication. [k2_w14, k2_w03].

Skills:
1.the student analyzes the main phases (layers) of the selected quantum encryption key distribution protocol and simulates the indicated layer [k2_u18, k2_u11, k2_u01].
2.the student plans the physical configuration of the demonstration system for the quantum distribution of the encryption key and prepares the specification of the physical modules of the selected implementation of this system. [k2_u18, k2_u22, k2_u11, k2_u05, k2_u04]

Social competences:
1.the student is aware of the importance and security of information systems and the dynamics of changes in this area conditioned by quantum achievements. [k2_k01, k2_k02]
2. the student conscientiously, timely and ethically fulfills the assigned duties and responsibilities within the team. [k2_k03]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning outcomes presented above are verified as follows:
1. Lecture (learning outcome: W01, U01, K01):
- form and components (percentage) of assessment: summary test (80%) ; constructive activity during lectures (20%)
- assessment criteria /grade: 96% - /5,0; 86%- 95% /4,5; 76%-85% /4; 66 -75% /3,5; 50%-65.0% /3; < 50% /2.
2. Project (learning outcome:W02, U02, K02,):
- form and components (percentage) of assessment: substantive implementation of the project (50%), individual participation and defense of the project (30%), timeliness 20%;
- assessment criteria /grade: 96% - /5,0; 86%- 95% /4,5; 76%-85% /4; 66 -75% /3,5; 50%-65.0% /3; < 50% /2.

Programme content

Wykład:
1. Physical foundations of quantum communication - elements of quantum description of selected states of light.
2. Elements of quantum information theory.
3. Selected protocols of quantum distribution of the encryption key.
4. Systems of quantum distribution of the encryption key in implementations on single photons.
5. Cipher key quantum distribution systems - alternative implementations.
6. Light sources and detectors used in quantum communication.
7. Physical elements and prospects for the development of quantum communication networks.
Projekt:
1. Simulation of a quantum encryption key simulation protocol on a quantum computer simulator.
2. Project of an educational system concerning a selected quantum encryption key distribution protocol, based on commercially available functional modules.

Teaching methods

1. Lecture: multimedia presentation supplemented with examples given on the blackboard.
2. Project : individual project work of the student supported by systematic consultations, discussion of solutions.

Bibliography

Basic
1.Ivan B. Djordjevic, Physical-Layer Security and Quantum Key Distribution, Springer 2019 (w wersji elektronicznej) . the item is available in the form of an e-book through the E-resources of the Library of the Poznań University of Technology
2. 2. Abraham Asfaw, Luciano Bello, Yael Ben-Haim, Sergey Bravyi, Nicholas Bronn, Lauren Capelluto,

Almudena Carrera Vazquez, Jack Ceroni, Richard Chen, Albert Frisch, Jay Gambetta, Shelly Garion, Leron Gil, Salvador De La Puente Gonzalez, Francis Harkins, Takashi Imamichi, David McKay, Antonio Mezzacapo, Zlatko Minev, Ramis Movassagh, Giacomo Nannicni, Paul Nation, Anna Phan, Marco Pistoia, Arthur Rattew, Joachim Schaefer, Javad Shabani, John Smolin, Kristan Temme, Madeleine Tod, Stephen Wood, James Wootton, "Learn Quantum Computation Using Qiskit", http://community.qiskit.org/textbook.
Additional
1. Gianfranco Cariolaro, Quantum Communications, Springer 2015 (w wersji elektronicznej), pozycja dostępna w formie e-booka poprzez E-Zasoby Biblioteki Politechniki Poznańskiej
2. M. Le Bellac, Wstęp do informatyki kwantowej. PWN 2015
3. Selected articles in scientific journals:

Breakdown of average student's workload

	Hours	ECTS
Total workload	62	2,00
Classes requiring direct contact with the teacher	32	1,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	30	1,00