COURSE OUTLINE

(1) GENERAL

SCHOOL	School of Sciences		
ACADEMIC UNIT	Department of Informatics		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	720SKEC	**SEMESTER**	7th
COURSE TITLE	Quantum Computing		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	2	5
Tutorial Exercices	1	
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Specialized General Knowledge, Skills Development
PREREQUISITE COURSES:	-
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO
COURSE WEBSITE (URL)	

(2) LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

The course aims to introduce students to the fundamental concepts, principles and techniques of quantum computing and quantum machine learning. It examines how quantum states are represented with qubits, how quantum circuits are designed and how fundamental quantum algorithms such as those of Grover and Shor are analyzed, with emphasis on the principles of superposition, entanglement and measurement, on the basic architectures of quantum computers, on computational complexity and on the limitations imposed by the noise and errors of current technology. At the same time, it presents methods of quantum computing for various methods in cryptography, machine learning, optimization problems, with practical implementation through modern software libraries such as Qiskit and PennyLane and through the study of current scientific literature and research developments in the field.

Upon successful completion of the course, the student will be able to:

- explain the fundamental principles of quantum mechanics related to quantum computing, such as superposition, entanglement, measurement etc.,
- use the fundamental mathematics of quantum computing in order to design circuits and algorithms,
- understand the ways in which the basic architectures of quantum computers operate,
- represent quantum states using qubits and perform computations with quantum gates and quantum circuits,
- analyze the operation of fundamental quantum algorithms such as those of Grover and Shor,
- understand the complexity and computational power required by quantum algorithms on both quantum and classical computer,
- understand the limitations of quantum computing, such as noise and errors based on its current level of development,
- design algorithms based on quantum computing, recognizing the existing design approaches such as hybrid forms or fully quantum,
- understand and analyze the operation of quantum computing in various applications such as cryptography, optimization, machine learning,
- implement quantum programs and quantum machine learning models using modern software libraries, such as Qiskit and PennyLane,
- study scientific literature and current research developments in the field.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Adapting to new situations
Decision-making
Working independently
Team work
Working in an international environment
Working in an interdisciplinary environment
Production of new research ideas

Project planning and management
Respect for difference and multiculturalism
Respect for the natural environment
Showing social, professional and ethical responsibility and sensitivity to gender issues
Criticism and self-criticism
Production of free, creative and inductive thinking
……
Others…
…….

Search for, analysis and synthesis of data and information, with the use of the necessary technology
Working independently
Team work
Generation of new research ideas

(3) SYLLABUS

1. Introduction to Quantum Computing
2. Fundamental principles of quantum mechanics
3. Architectures of quantum computers
4. Mathematical and physical concepts of quantum computing
5. Quantum gates and quantum circuit design
6. Fundamental quantum algorithms and quantum algorithm design strategies
7. Quantum computational complexity and comparison with classical algorithms
8. Quantum computing methods across various fields
9. Applications of quantum computing
10. Current research developments in quantum computing
11. Tools for implementing quantum algorithms

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face-to-face
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Learning process support through the moodle online platform (interaction, assignments, auxiliary material) Announcements via central department website Use email to communicate.
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	see table below
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	Final Grade = Final Exam Grade (80%) + Team Project Presentation (20%)

Activity	***Semester workload***
Lectures	26x2=52
Tutorial Exercises	13x2=26
Team project	25
Independent Study	25
Course total	***128***

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:
- Related academic journals:

- “ΚΒΑΝΤΙΚΗ ΥΠΟΛΟΓΙΣΤΙΚΗ: Από τη Θεωρία στην Πράξη,” Εκδόσεις ΤΖΙΟΛΑ. Accessed: May 28, 2026. [Online]. Available: https://www.tziola.gr/book/kvantiki-ypologistiki/
- J. van Griensven Thé, R. A. Fraser, and J. Rosas-Bustos, Quantum Computing and Quantum Machine Learning for Engineers and Developers, 1st ed. 2025. Cham: Springer Nature Switzerland, 2025. doi: 10.1007/978-3-031-98245-3.
- J. D. Hidary, Quantum computing: an applied approach, Second edition. Cham, Switzerland: Springer, 2021.
- T. G. Wong, Introduction to classical and quantum computing. Omaha, Nebraska: Rooted Grove, 2022.