UNIVERSIDADE FEDERAL DO CEARÁ

FEDERAL UNIVERSITY OF CEARÁ
OFFICE OF THE VICE PROVOST FOR UNDERGRADUATION (PROGRAD)
COORDINATION FOR PROJECT AND CURRICULUM DEVELOPMENT
CURRICULUM DEVELOPMENT DIVISION

1. Academic unit offering the curricular component (Faculty, Center, Institute, Campus)**:**

Center of Technology

2. Department offering the curricular component (when applicable)**:**

Teleinformatics Engineering Department

3. Undergraduate course(s) offering the curricular component

Code of the Course	Name of the Course	Course Degree[1]	Curriculum (Year/ Semester)	Nature of the Component[2]	Semester of Offer[3]	Habilitation[4]
91	Telecommunications Engineering	Bachelor	2015.1	Optional	-	-

4. Name of the curricular component:
Quantum Physics for Telecommunications

5. Code of the curricular component (filled by PROGRAD)**:**
TI0122

6. Prerequisites	No ( )	Yes (x)	
		Code	Name of the curricular component / activity
		TI0060	Electronic and Optoelectronic Materials

7. Corequisite	No (x)	Yes ( )	
		Code	Name of the curricular component / activity

8. Equivalences	No ( )	Yes (x)	
		Code	Name of the curricular component / activity
		TI0098	Quantum Physics for Teleinformatics

9. Day period of the curricular component (more than one option can be selected)**:**
(x) Morning (x) Afternoon (x) Night

1 **Fill with *Bachelor (Engineer), Licenciate,* or *Technologist.***
2 **Fill with *Mandatory, Optional,* or *Elective.***
3 **Fill when mandatory.**
4 **When elective, fill with the habilitation or emphasis to which the curricular component is linked.**

10. Regime of the curricular component:

(x) Semester ( ) Yearly ( ) Modular

11. Justificatory for the creation/regulamentation of this curricular component

In this course we will study the concepts of quantum physics important for the understanding of communication and computing systems based on quantum effects.

12. Objectives fo the curricular component:

Provide the student with the conceptualization and understanding of the relationships that exist between physics and information, making him/her apt to understand the physical concepts used in quantum communication and quantum computing.

13. Syllabus:

Linear Algebra and Dirac Notation; Qubits and Quantum Mechanics; Quantum Computing Model; Quantum Communication Protocols; Quantum Computing Algorithms; Correction of Quantum Errors.

14. Program:

1. **Linear Algebra and Dirac Notation:** Dirac notation and Hilbert space, operators, spectral theorem, operator function, tensor product, Schmidt's decomposition theorem.
2. **Qubits and Quantum Mechanics:** The state of a quantum system, temporal evolution of a closed system, compound systems, measurements, mixed states, partial trace.
3. **Quantum Computing Model:** The quantum circuit model, quantum gates.
4. **Quantum Communication Protocols:** Quantum distribution of keys, quantum teleportation, superdense code.
5. **Quantum Computing Algorithms:** Deutsch-Jozsa's Algorithm, Simon's algorithm, Fourier quantum transform, Shor's algorithm, Grover quantum algorithm, amplitude amplification algorithm.
6. **Correction of Quantum Errors:** Error models in communication and quantum computing, coding, error recovery, quantum codes

15. Workload description

Number of Weeks:	Number of Credits:	Total Workload in Hours:	Theory Workload in Hours:	Practice Workload in Hours:
16	04	64	64	-

16. Basic bibliography:

1- A Short Introduction to Quantum Information and Quantum Computation, Michel Le Bellac, Cambridge University Express, 1st edition (2006).

2- An Introduction to Quantum Computing, P. Kaye, R. Laflamme, M. Mosca, Oxford

University Express, 1st edition (2007).

3- Quantum Computation and Quantum Information, M. A. Nielsen, I. L. Chuang, Cambridge University Express, 1st edition (2000).

17. Complementary bibliography:

1- Quantum Information Theory, Mark M. Wilde, Cambridge University Express, 1st edition (2013).

2- Quantum Computing and Communications: An Bacheloring Approach, S. Imre, F. Balazs, Wiley, 1st edition (2005).

3- Quantum Computing: A Gentle Introduction, E. G. Rieffel, W. H. Polak, The MIT Press, 1st edition (2011).

4- Elements of Quantum Computation and Quantum Communication, Anirban Pathak, CRC Press, 1st edition (2013).

5- Quantum Computing for Computer Scientists, N. S. Yanofsky, M. A. Mannucci, Cambridge University Press, 1st edition (2008).