INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES LYON

DPT TELECOMMUNICATIONS SERVICES ET USAGES
TELECOMMUNICATIONS, SERVICES & USAGES
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Télécommunications

Quantic Communications

IDENTIFICATION

CODE :	TC-5-S1-EC-CQN
ECTS :	2.0

HOURS

Lectures :	0.0 h
Seminars :	32.0 h
Laboratory :	0.0 h
Project :	0.0 h
Teacher-student contact :	32.0 h
Personal work :	0.0 h
Total :	32.0 h

ASSESSMENT METHOD

TEACHING AIDS

TEACHING LANGUAGE

English

CONTACT

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AIMS

The quantum approach will revolutionize the way we think / design / use / program telecommunications systems in the broad sense.
The objective of this course is to allow you to discover this approach, and to have the necessary knowlegde to be able to benefits from its potential.

CONTENT

Introductory session
Areas of application of quantum computing
Contribution of quantum
Bit, qubit and entanglement, a first intuition
Overview of the different physical platforms
NISQ (Noisy Intermediate Scale Quantum computing) and FTQC (Fault Tolerant Quantum Computing) approaches
Quantum industry and current initiatives

Introduction to the quantum model
Dirac ratings
Axioms of quantum mechanics
Bloch sphere
Quantum circuit model
Elementary arithmetic

Introduction to quantum programming
Presentation of IBM Quantum Experience
Introduction to the Python Qiskit library
Execution of quantum algorithms on classical simulators and quantum processors

Nonparametric quantum algorithms
Amplification of amplitude and Grover algorithm - Motivation, Operation
Quantum Fourier Transformation - Motivation, Operation
Shor algorithm - Motivation, Operation

Cryptography and quantum communication
Cryptography and quantum communication generation
Quantum generation of random numbers
Quantum teleportation
Superdense coding
Quantum shared secret
Quantum distribution of secret keys

Parametric quantum algorithms and hybrid approaches (as a function of the remaining time)
The variational principle in quantum mechanics
¿ VQE (Variational Quantum Eigensolver) algorithm
¿ Quantum Approximate Optimization Algorithm (QAOA)

¿ Noise modeling (as a function of time)
¿ notion of fidelity, coherent and inconsistent noise
¿ density operator formalism)
¿ benchmarking of quantum processors (consistency time measurement, randomized benchmarking,¿)

For each chapter, code tutorials - qiskit - will be used to practice immediately in session.

BIBLIOGRAPHY

"Quantum Computation and Quantum Information", Michael A. Nielsen & Isaac L. Chuang