QX01 – Introduction to quantum information

Open to undergraduate students with basics in mathematics, computer science, and physics.

Introduction :

Quantum technologies have developed for several years already within the field of what was initially called quantum information. For the past 3-4 years, it has been referred to as quantum technologies because potential applications are currently being developed and so it is now not only about theoretical concepts or about proving experiential principles. Major companies such as Google, Microsoft, Intel, IBM and more recently ATOS have shown a real interest in these new innovative technologies. Besides, there has been an exponential number of start-ups on these topics, the adoption of a European flagship project, and of a bill has been approved by the American Congress on this question. More recently, in January 2021, France has announced its 5-year, 1.8-billion euro quantum plan.

On top of these significant milestones, it is important to understand that these technologies lie essentially on properties and laws from quantum physics that are by no means predictive and therefore require short, mid and long term investment on research and training. UTT wants to be a leader on both these aspects in partnership with academics and industrialists such as ATOS and IBM, but also with government agencies such as the French DGA and DGSE.

Contents :

As mentioned above, quantum technologies involve knowing about quantum physics. Then, these technologies are based on some completely non-predictive physics principles such as quantum super position, quantum entanglement, or even non-cloning. Current engineering students at Universities worldwide do not all have the necessary background to understand these technologies and so we deem it essential to provide them early in their curriculum with academic training on these technologies as they are likely to be faced with them in their career.

Objectives :

This course gives the essential basics to understand the forthcoming new technologies in communications, calculus, or sensors. Industrialists will also contribute from time to time.

Provisional program :

All lectures to be delivered live on UTT's Youtube channel at from 10:00 am to 12:00, French time (GMT+1)

16/02/2021 Lecture 1: Introduction to quantum information & technologies
23/02/2021 Lecture 2: Classical information & computation
02/03/2021 Holidays
09/03/2021 Lecture 3 : The qubit
16/03/2021 Lecture 4: Quantum sensors : Quantum magnetometry
23/03/2021 Lecture 5: Multiple Qubit and entanglement
30/03/2021 Lecture 6: Quantum cryptography
06/04/2021 Lecture 7: Measurements and operators
13/04/2021 Lecture 8: Quantum gates

20/04/2021 Lecture 9: Quantum algorithm + quantum parallelism
27/04/2021 Holidays
04/05/2021 Lecture 11: Shor's algorithm
18/05/2021 Lecture 12: Quantum Error Correction
25/05/2021 Crunch
01/06/2021 Lecture 13: Introduction to Quantum Learning Machine
08/06/2021 Lecture 14: Quantum technologies 1
15/06/2021 Lecture 15: Quantum technologies 2

Related links and information :

UTT's Youtube channel : https://www.youtube.com/c/ChaineUTT

UTT's research : https://recherche.utt.fr/

UTT's Pr Christophe Couteau's webpage: https://recherche.utt.fr/light-nanomaterials-nanotechnologies-l2n/members/christophe-couteau

UTT's Graduate school : https://nano-phot.utt.fr/