



## India & Quantum Computing

**For Prelims:** Quantum Computing, Qiskit Challenge, quantum computing laboratory, National Mission on quantum technologies and applications, Centre for Development of Telematics (C-DOT), I-HUB Quantum Technology Foundation, Centre for Development of Advanced Computing (C-DAC), National Mission on quantum technologies and applications.

**For Mains:** Significance of Quantum Computing.

### Why in News?

According to a study by IBM, **India is witnessing a growing interest in quantum computing**, with students, developers, and academia actively participating. Consequently, the country is **emerging as a talent hub for quantum computing**.

### What is Quantum Computing?

#### ▪ About:

- Quantum computing is a **rapidly-emerging technology that harnesses the laws of quantum mechanics** to solve problems too complex for classical computers.
  - Quantum mechanics is a subfield of physics that describes the behavior of particles — atoms, electrons, photons, and almost everything in the molecular and submolecular realm.
- It is an exciting **new technology that will shape our world tomorrow** by providing us with an edge and a myriad of possibilities.
- It is a fundamentally **different way of processing information** compared to today's classical computing systems.

#### ▪ Features:

- **Different from Traditional Computers:**
  - While today's **classical computers store information as binary 0 and 1 states, quantum computers** draw on the fundamental laws of nature to **carry out calculations using quantum bits**.
  - Unlike a bit that has to be a 0 or a 1, a **qubit can be in a combination of states**, which allows for exponentially larger calculations and **gives them the potential to solve complex problems** which even the most powerful classical supercomputers are not capable of.

Bit

0

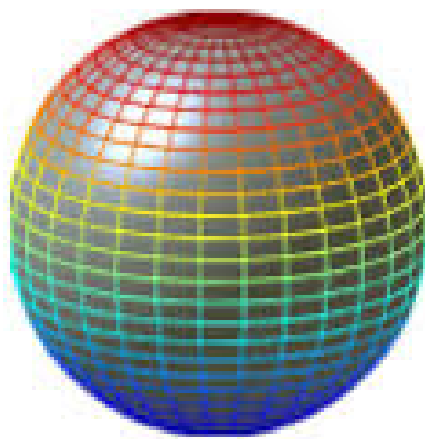


1



Qubit

0



1

▪ **Significance:**

- Quantum computers can tap into the quantum mechanical phenomenon to **manipulate information and are expected to shed light on processes of molecular and chemical interactions**, address difficult optimization problems, and boost the power of artificial intelligence.
- These could **open the door to new scientific discoveries**, life-saving drugs, and improvements in supply chains, logistics and the modelling of financial data.

### What are IBM India's Initiatives around Quantum Computing?

- **Qiskit Challenge:** Qiskit is an **open-source software development kit** built by IBM for the quantum developer community.
- **Qiskit India Week of Quantum:** IBM regularly organizes India-focused programmes such as Qiskit India Week of Quantum, which **celebrated women in quantum to kickstart their journeys in quantum**, and was attended by almost 300 students.
- **The Qiskit Textbook:** Qiskit textbook is available in Tamil, Bengali and Hindi and was accessed more than 30,000 times by students in India in 2021 alone.
- **IBM Quantum Educators Programme:** IBM is **collaborating with leading educational institutions in India** through the IBM Quantum Educators Programme.
  - The faculty and students of these institutions will be able to **access IBM Quantum systems, quantum learning resources and quantum tools** over IBM Cloud for educational purposes.

### What are the Key Initiatives taken by the Indian Government?

- **National Mission on quantum technologies and applications:** The Government in its 2021 budget allocated INR 8000 Crore towards the [National Mission on quantum technologies and applications](#) to spur developments in quantum computing, cryptography, communications, and material science.
- **Quantum Computing Laboratory:** In December 2021, the Indian Army set up a **quantum computing laboratory** and an AI centre at a military engineering institute at Mhow, Madhya Pradesh. It is also backed by the **National Security Council Secretariat (NSCS)**.
- **Quantum Communication Lab:** The **Centre for Development of Telematics (C-DOT)** launched a **quantum communication lab** in October 2021. It can support more than 100 km of standard optical fibre.

- **Collaborations:** The **Defence Institute of Advanced Technology (DIAT)** and the [Centre for Development of Advanced Computing \(C-DAC\)](#) agreed to collaborate and develop quantum computers.
- **I-HUB Quantum Technology Foundation:** The Department of Science and Technology and about 13 research groups from IISER Pune launched **I-HUB Quantum Technology Foundation (I-HUB QTF)** to further enhance the development of quantum tech.
- **Startups:** A number of Start-Ups such as **Qunu Labs, Bangalore; BosonQ, Bhilai** have also emerged and as a result, they are making inroads in this area.

## Way Forward

- Similar to the **fast-growing Artificial Intelligence market, quantum computing, as another technology, has created a wave among the countries and companies globally** to get into a race and acquire a leadership position.
- The need of the hour, therefore, is simultaneously to **build sufficient quantum computational capacity, develop skills** in building and operationalizing a **practical size and affordable cost quantum computer**, continue research into realizing the various practical applications, and **introduce contents into the educational courses at undergrad and post-grad levels** to develop quantum science and engineering as a discipline at the university level that will produce a large number of science and technology heads.

## UPSC Civil Services Examination Previous Year Question (PYQ)

### Prelims

**Q. Which one of the following is the context in which the term "qubit" is mentioned?**

- (a) Cloud Services
- (b) Quantum Computing
- (c) Visible Light Communication Technologies
- (d) Wireless Communication Technologies

**Ans: (b)**

**Exp:**

- **Quantum Supremacy**
  - Quantum computers compute in 'qubits' (or quantum bits). They exploit the properties of quantum mechanics, the science that governs how matter behaves on the atomic scale.
- **Hence, option (b) is correct.**

### Mains

**Q. "The emergence of the Fourth Industrial Revolution (Digital Revolution) has initiated e-Governance as an integral part of government". Discuss. (2020)**

**Source: TH**