EVA STALIN IAS ACADEMY – BEST IAS COACHING IN CHENNAI
12/24, Muthurangan Muthali St, West Tambaram, Chennai - 600045
https://www.evastaliniasacademy.in/
Contact Number – +91-8678969915, +91-9940332851

EDITORIAL ANALYSIS → 20 MAY 2023 → THE INDIAN EXPRESS

QUANTUM COMPUTING TECHNOLOGY IN INDIA:

- **Context:**

- Recently, government approved the National Quantum Mission (NQM) at a total cost of Rs.6003.65 crore from 2023-24 to 2030-31, aiming to seed, nurture and scale up scientific and industrial R&D and create a vibrant & innovative ecosystem in Quantum Technology (QT).

- **Status and Potential of Quantum Computing:**

- 2023 Quantum Technology Monitor by McKinsey shows that the four industries likely to see the earliest economic impact from quantum computing—automotive, chemicals, financial services, and life sciences —stand to potentially gain up to $1.3 trillion in value by 2035.
- McKinsey report says Quantum technology can generate approximately 350,000 jobs per year worldwide.
- India estimates that the percentage of businesses using quantum technology will increase from less than one percent in 2022 to between 35 and 45% by 2030.
- Nasscom's study indicates that quantum technology across industries could contribute $280-310 billion to the Indian economy by 2030.

- **Indian Achievements in Quantum domain:**

- In 2021, ISRO announced that it has successfully demonstrated free-space Quantum Communication over a distance of 300 m, making India as part of handful of nations including the US, the UK, China, Canada and Japan.
- In 2021, India's first-ever Quantum Computer Simulator (QSim) Toolkit has been launched by the Ministry of Electronics and Information Technology (MeitY), Government of India.

- The QSim project is being executed collaboratively by IISC Bangalore, C-DAC, and IIT Roorkee with the support of MeitY.
- This indigenous toolkit will serve as an important educational and research tool through allowing writing and debugging Quantum Code to develop Quantum Algorithms.
- In 2021, Quantum Communication Lab was inaugurated in Delhi at Centre for the Development of Telematics (C-DOT), the premier Telecom R&D centre of the Department of Telecommunications, Ministry of Communications, Government of India.
- The indigenously developed Quantum Key Distribution (QKD) can support a 100 km distance on standard optical fiber, enabling Quantum Secure telecom products & solutions for strategic and defence sector.
- In 2021, Indian Army, with support from the National Security Council Secretariat (NSCS) has recently established the Quantum Lab to spearhead research and training in this key developing field.
- It will help develop next-generation communication through Post Quantum Cryptography (PQC).
- Key thrust areas are quantum key distribution, quantum communication, post-quantum cryptography and quantum computing.
- In 2022, a joint team of the Defence Research and Development Organisation (DRDO) and IIT-Delhi successfully demonstrated a Quantum Key Distribution link between two cities in UP — Prayagraj and Vindhyachal — located 100 km apart.

- **Quantum Technology:**

- A quantum computer is a computer that exploits quantum mechanical phenomena.
- At small scales, physical matter exhibits properties of both particles and waves, and quantum computing leverages this behavior using specialized hardware.
- Classical physics cannot explain the operation of these quantum devices, and a scalable quantum computer could perform some calculations exponentially faster than any modern "classical" computer.
- In particular, a large-scale quantum computer could break widely used encryption schemes and aid physicists in performing physical simulations; however, the current state of the art is largely experimental.
- The basic unit of information in quantum computing is the qubit, similar to the bit in traditional digital electronics.
- Unlike a classical bit, a qubit can exist in a superposition of its two "basis" states, which loosely means that it is in both states simultaneously.
- When measuring a qubit, the result is a probabilistic output of a classical bit.
- If a quantum computer manipulates the qubit in a particular way, wave interference effects can amplify the desired measurement results.

- The design of quantum algorithms involves creating procedures that allow a quantum computer to perform calculations efficiently.

- **Potential Applications of Quantum Technology:**

- **Secure communications:**

- It can help in developing cyber secure products and solutions apart from strategic and defence solutions for next generation warfare.
- Research and Development:
- It can aid fundamental research in Quantum Physics and chemistry.
- It can explore problems in chemistry, life sciences and pharma related to protein folding and drug design.

- **Disaster management and Climate Change:**

- It can help address climate change through new computing methods in areas like computational chemistry for new materials and energy solutions.
- Financial Applications:
- It can help in currency arbitrage, credit scoring and portfolio optimisation apart finance and logistics, for a client in the financial services domain can be explored.
- Industrial revolution 4.0:
- Quantum computing can help leveraging other new technologies like the Internet-of-Things, machine learning, robotics, and artificial intelligence.
- Supercomputers: Quantum computers are machines that use the properties of quantum physics to store data and perform computations.
- This can be extremely advantageous for certain tasks where they could vastly outperform even our best supercomputers.

- **Issues and Challenges in Quantum domain:**

- High precision: Controlling quantum superposition in a highly controlled manner. The qubits tend to be very fragile and lose their “quantumness” if not controlled properly.
- Expensive hardware: The quantum infrastructure like superconductors, non-linear optical crystals, ultra fast transistors, etc are very expensive

- Still in the Budding Stage: On the theoretical front lies the challenge of creating the algorithms and applications for quantum computers.
- These projects will also place new demands on classical control hardware as well as software platforms.
- Further, Information technology-based security infrastructure would never be the same once quantum systems become a reality, given the ultra fast speed of computing power.
- New Warfare and conflict strategies:
- Need to develop integrated war-theatre strategies factoring in quantum technologies.

- **Lack of adequate skilled manpower:**

- **Steps taken by the Government:**

- In 2018, the government initiated serious discussions in quantum technologies and kick-started research projects across 51 organisations under QUEST – Quantum Enabled Science and Technology.
- Government of India declared quantum tech as a "mission of national importance" in 2019.
- About 100 government-funded projects on quantum and allied technologies have expanded various stages.
- In 2021, Department of Science and Technology and around 13 research groups from IISER Pune have established the I-HUB Quantum Technology Foundation (I-HUB QTF).
- In 2021, a Quantum Computing Applications Lab was launched by the Ministry of Electronics and Information Technology (MeitY) in collaboration with Amazon Web Services.
- In 2023, National Quantum Mission was launched with a plan of 8 years to develop key infrastructure and capabilities in the Quantum domain.