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CURRENT AFFAIRS

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NATIONAL QUANTUM MISSION: PIONEERING INDIA'S LEAP INTO QUANTUM TECHNOLOGY

This article covers "Daily Current Affairs" and topic details of the National Quantum Mission.

SYLLABUS MAPPING:

GS-3- Science and Technology: Recent development in the field of Computer technology.

FOR PRELIMS:

What is the National Quantum Mission; What are cloud computing and quantum computing? Various terms related to it.

FOR MAINS:

What are the features of the National Quantum Computing Mission: its implementation and indigenization of technology in India?

WHY IN THE NEWS?

India is set to unveil its first quantum computer, which will be capable of performing computations with 6 qubits. This development will provide a foundation for further advancements in quantum computing and bolster India's position in this cutting-edge technology. India has seen the emergence of over 40 Quantum Technology start-ups in the past two years, with some showing global potential. Dr. Jitendra Singh emphasized the importance of these start-ups and highlighted the success of 'QuNu Labs,' a Bangalore-based start-up incubated by IIT Madras, which is developing security products based on quantum technologies.
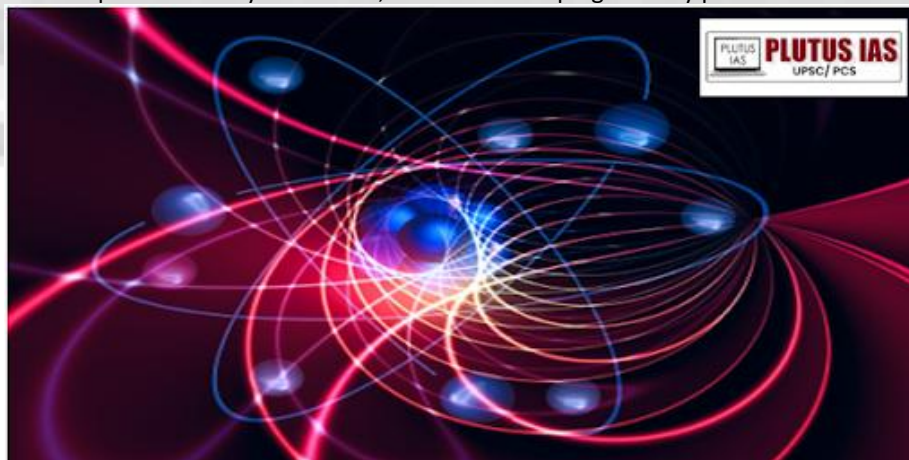
WHAT IS QUANTUM COMPUTING?

Quantum computing is a type of computing that leverages the principles of quantum mechanics to process information in fundamentally different ways compared to classical computing.

QUANTUM TECHNOLOGY KEY CHARACTERISTICS:

1. Quantum Bits (Qubits): The fundamental unit of quantum information is the qubit. In contrast to classical bits, which can be either 0 or 1, qubits can be in a superposition of states, allowing them to simultaneously represent both 0 and 1.

2. Superposition: A qubit in superposition can perform multiple calculations at once. This allows quantum computers to process a vast amount of possibilities simultaneously, rather than sequentially.

3. Entanglement: Qubits can be entangled, meaning the state of one qubit can depend on the state of another, no matter how far apart they are. This correlation allows quantum computers to solve complex problems more efficiently than classical computers.

4. Quantum Gates: Operations on qubits are performed using quantum gates, which manipulate the probabilities of qubit states. These gates allow for complex operations that are not possible with classical logic gates.

5. Quantum Speedup: Quantum computers can potentially solve certain problems much faster than classical computers by exploring many possible solutions simultaneously. For example, they are expected to be particularly effective at factoring large numbers and simulating quantum systems.

COMPARISON OF QUANTUM VS TRADITIONAL COMPUTING:

Aspect	Quantum Computing	Traditional Computing
Basic Unit	Qubit	Bit
State Representation	Superposition: Can represent both 0 and 1 simultaneously	Binary: Can represent only 0 or 1
Processing	Can process multiple possibilities simultaneously	Processes information sequentially
Entanglement	Yes, qubits can be entangled, influencing each other	No, bits operate independently
Operations	Quantum gates manipulate probabilities of qubit states	Classical gates perform logical operations (AND, OR, NOT)
Speedup Potential	Potentially exponential speedup for certain problems	Performance is limited by sequential processing
Problem-Solving Approach	Can explore many solutions at once due to superposition	Solves problems one step at a time
Complexity Handling	Effective for complex problems like factoring large numbers, quantum simulations	Handles a wide range of tasks but can be slower for certain complex problems
Current status	Developing stage	Well established technology

APPLICATIONS OF THE QUANTUM TECHNOLOGY IN VARIOUS FIELDS:

1. Cryptography and Cybersecurity: Quantum-resistant encryption will create new security methods immune to quantum attacks, such as lattice-based cryptography. Quantum Key Distribution (QKD) will enable ultra-secure communication, as seen in the use of QKD by the Chinese satellite Micius for secure data transmission.

2. Drug Discovery and Healthcare: Quantum computing will expedite drug development by simulating complex molecules rapidly, like the simulation of protein-folding processes for drug discovery. It will also allow for personalized medicine, exemplified by tailoring cancer treatments based on individual genetic profiles.

3. Optimization and Logistics: Quantum computing will enhance supply chain efficiency by optimizing delivery routes and inventory management, similar to IBM's Quantum Optimization for logistics problems.

4. Artificial Intelligence and Machine Learning: Quantum computing will develop faster and more accurate machine learning algorithms, such as quantum-enhanced support vector machines. It will improve the training and performance of AI models, exemplified by better neural network training for image recognition.

5. Climate Modeling and Environmental Science: Detailed simulations powered by quantum computing will improve climate change predictions, similar to simulating atmospheric chemical reactions. It will also enhance resource management, such as optimizing energy grid distribution for better conservation.

6. Finance and Economics: Quantum computing will advance financial risk modeling and predictive analytics, like improving risk assessment models for financial markets. It will develop sophisticated algorithms for more effective trading strategies, such as quantum algorithms for high-frequency trading.

7. Quantum Chemistry: Quantum computing will enable precise predictions of complex chemical reactions, such as simulating catalytic processes for better industrial chemical synthesis. It will also advance catalysis research, like developing new catalysts for efficient green chemistry.

8. Fundamental Physics and Research: Quantum computing will help simulate quantum systems, aiding in exploring new physics theories, such as quantum field theory simulations. It will assist in analyzing particle accelerator data, like studying Higgs boson interactions at the Large Hadron Collider.

9. Aerospace and Defense: The technology will enhance the precision of navigation and control systems for spacecraft, such as improving guidance systems for interplanetary missions. It will also develop advanced encryption for secure military communications, exemplified by quantum encryption in defense networks.

10. Telecommunications: Quantum computing will improve the efficiency and reliability of communication networks, such as optimizing network traffic using quantum algorithms. It will also use quantum technology to secure data, as seen in the development of quantum-secured communication networks by companies like ID Quantique.

National Quantum Mission (NQM)

On April 19, 2023, the Union Cabinet, under the leadership of Prime Minister Shri Narendra Modi, sanctioned the National Quantum Mission (NQM) with a total funding of ₹6,003.65 crore for the duration from 2023-24 to 2030-31. This mission aims to foster scientific and industrial R&D in Quantum Technology (QT) and establish India as a global leader in this field.

MISSION OBJECTIVES:

Quantum Computing Development:
Intermediate-Scale Quantum Computers: Develop quantum computers with 50-1000 physical qubits over the next 8 years.
Technological Platforms: Utilize superconducting and photonic technologies.

Quantum Communication:
Satellite-Based Communication: Establish secure quantum communication between ground stations across 2000 kilometers within India.

International Communication: Facilitate long-distance quantum communications with other countries.
Quantum Key Distribution: Implement inter-city quantum key distribution over 2000 km.
Multi-Node Quantum Networks: Develop networks with quantum memories.
Quantum Sensing and Metrology:
Magnetometers: Create highly sensitive magnetometers for advanced applications.
Atomic Clocks: Develop atomic clocks for precision timing, communications, and navigation.
Quantum Materials and Devices:
Material Development: Design and synthesize quantum materials, including superconductors, novel semiconductor structures, and topological materials.
Device Fabrication: Manufacture quantum devices utilizing these materials.
Photon Sources: Develop single-photon sources/detectors and entangled photon sources for various applications.
Mission Implementation:
Thematic Hubs (T-Hubs): Set up four hubs focusing on Quantum Computing, Quantum Communication, Quantum Sensing & Metrology, and Quantum Materials & Devices. A Call for Pre-Proposals for these hubs was issued on January 20, 2024. The T-Hubs will be established in four key domains: Quantum Computing, Quantum Communication, Quantum Sensing & Metrology, Quantum Materials & Devices

IMPACT AND BENEFITS:

Global Competitiveness: Position India's technology development ecosystem at a global level.
Sectoral Benefits: Enhance capabilities in communication, health, finance, energy, drug design, space, banking, and security.
National Priorities: Support key initiatives such as Digital India, Make in India, Skill India, Stand-up India, Start-up India, Self-reliant India, and Sustainable Development Goals (SDGs).

KEY CHALLENGES IN THE IMPLEMENTATION NATIONAL QUANTUM MISSION:

A. Quantum Hardware Development: Scaling quantum computers with many qubits and managing error rates due to decoherence and noise are significant challenges said Dr. John Preskill,
B. Quantum Software and Algorithms: According to The Quantum Software and Algorithms Committee in the USA, developing efficient quantum algorithms and robust software tools is complex and still evolving.
C. Integration with Classical Systems: Ensuring seamless interoperability between quantum and classical systems presents technical difficulties.
D. Funding and Resource Allocation: Securing adequate and sustained funding and managing resources efficiently are critical for long-term success. The National Quantum Mission Oversight Committee points out that consistent financial support is crucial for sustaining research and development efforts.
E. Economic Viability: Balancing the high costs of quantum technology development with economic feasibility is a major concern.
F. Talent and Expertise: The Quantum Workforce Development Panel highlights addressing the global shortage of quantum computing experts and developing effective training programs is essential.
G. Infrastructure and Facilities: Developing and maintaining advanced research facilities for quantum experiments is resource-intensive. The Research Facilities Enhancement Committee notes the importance of investing in state-of-the-art labs and infrastructure.
H. Security and Ethical Considerations: Developing quantum-resistant encryption and addressing ethical concerns around quantum technology use are crucial. Dr. Vanessa Fong, an expert in quantum cryptography, stresses the importance of preparing for the impact of quantum computing on existing security systems and ensuring ethical use.

THE POTENTIAL SOLUTION SUGGESTED BY EXPERTS:

1. Increased Funding and Infrastructure Development: The Expert Committee on Quantum Computing, chaired by Dr. Sandeep Joshi, advocates for sustained funding to support long-term quantum research and development. They also emphasize the need for developing and upgrading research facilities to support advanced quantum experiments and technology.
2. Public-Private Partnerships and International Collaboration: The National Quantum Strategy Group, led by Dr. R. Vijayaraghavan, encourages collaboration between public research institutions and private industry to speed up technology development. They also recommend fostering international research collaborations to leverage global expertise and resources.
3. Regulatory Framework and Research Grants: The High-Level Quantum Technology Task Force, chaired by Dr. Abhay Mehta, calls for the development of supportive regulatory frameworks to address ethical and security issues associated with quantum technologies. They also recommend increasing grant availability for fundamental and applied quantum research.

4. Standardization and Talent Retention: The Quantum Technology Advisory Board, led by Dr. Ashok Jhunjhunwala, suggests working on developing standards for quantum technology to facilitate interoperability. They also stress the importance of retaining top talent through competitive salaries and career development opportunities.

5. Interdisciplinary Research and Industry Engagement: The Quantum Technology Research Council, chaired by Dr. Satyajit Mayor, promotes interdisciplinary research to address complex quantum technology challenges and advocates for significant investments in research infrastructure. They also highlight the need for enhanced engagement with industry to transition research innovations into practical applications.

6. Policy Development and Global Positioning: The National Quantum Initiative Working Group, led by Dr. P. K. Iyengar, recommends developing comprehensive national policies to support the quantum technology sector and address potential risks. They also strategize to position India as a global leader in quantum technology and expand educational programs to build a steady pipeline of skilled professionals.

CONCLUSION:

The National Quantum Mission (NQM) represents a bold and transformative initiative for India, aiming to position the country at the forefront of global quantum technology advancements. Despite the promising potential of quantum computing and related fields, several challenges must be addressed to achieve the mission's objectives successfully.

PRELIMS QUESTION

Q**. With reference to the National Quantum Mission (NQM), Consider the following statement:**
1. The NQM was launched to harness the use of cloud computing.
2. The first quantum computer under the NQM is launched by the IIT Delhi.
3. The NQM has the potential to make India a superpower in quantum technology.
How many of the above-given statements are correct?
A. Only one
B. Only two
C. All three
D. None
ANSWER: A

MAINS QUESTION:

Given the launch of India's first quantum-based computer as a key milestone for the National Quantum Mission (NQM), what are the primary challenges that need to be addressed to effectively implement the mission and ensure its long-term success?

(250 words 15 marks)

PRELIMS BITS: NEW SINGLE-STRAIN ORAL CHOLERA VACCINE AND PRAGATI (PRO-ACTIVE GOVERNANCE AND TIMELY IMPLEMENTATION)

This article covers "Daily Current Affairs" and topic details of the Single-Strain Oral Cholera Vaccine

Syllabus mapping:
GS-3- Science and Technology: Recent development in the field of biotechnology.

FOR PRELIMS:

What is the new HILLCHOL? What is Cholera: signs symptoms and treatment?

RECENT CONTEXT:

Bharat Biotech International Limited (BBIL) has launched a new single-strain oral cholera vaccine, HILLCHOL®, in Hyderabad. Current global statistics reveal a shortfall of approximately 40 million doses of oral cholera vaccine, with only one manufacturer supplying the market. Despite being preventable and treatable, cholera has caused over 800,000 cases and 5,900 deaths across 31 countries in the past year. HILLCHOL® is administered in two doses, on Day 0 and Day 14, and is suitable for children over one year of age. It is provided as a single-dose oral vaccine and must be stored between 2°C and 8°C.

KEY FEATURES OF HILLCHOL®:

Formulation: It is a single-strain oral vaccine, meaning it is taken by mouth rather than injected.

Dosage: The vaccine is administered in two doses, with the second dose given 14 days after the first.

Target Population: It is suitable for children older than one year.

Production Capacity: Bharat Biotech plans to produce up to 200 million doses annually, with facilities in Hyderabad and Bhubaneswar.

Global Impact: The vaccine aims to address the global shortage of cholera vaccines, which currently faces a deficit of about 40 million doses per year.

WHAT IS CHOLERA?

Cholera is an acute diarrheal disease caused by ingesting food or water contaminated with the bacterium Vibrio cholerae. According to the WHO, It remains a significant global health threat and reflects issues of social inequality and inadequate development. Annually, it is estimated that between 1.3 to 4.0 million cases of cholera occur, leading to 21,000 to 143,000 deaths worldwide.

SIGNS AND SYMPTOMS

1. Diarrhea: Often watery and can be profuse.

2. Vomiting: Common and can contribute to dehydration.

3. Dehydration: Rapid loss of fluids and electrolytes can lead to dry mouth, intense thirst, and reduced urine output.

4. Muscle Cramps: Resulting from electrolyte imbalances.

5. Rapid Heart Rate: Due to low blood volume.

6. Sunken Eyes: Indicating severe dehydration.

TYPES

Epidemic Cholera: Outbreaks that occur in areas with poor sanitation and hygiene.

Endemic Cholera: Persistent presence in certain regions, often linked to inadequate water and sanitation infrastructure.

PREVENTION AND CONTROL

Cholera is preventable and can be controlled by ensuring access to clean water, adequate sanitation, and practicing good hygiene. Effective management and prevention involve improving water and sanitation infrastructure and maintaining hygiene practices to safeguard public health.

TREATMENT

1. Rehydration Therapy: The primary treatment for cholera is oral rehydration therapy (ORT), using solutions that replace lost fluids and electrolytes.

2. Antibiotics: In severe cases, antibiotics such as doxycycline or azithromycin may be used to shorten the duration of symptoms and reduce the spread.

3. Intravenous Fluids: For very severe cases, intravenous fluids may be required to quickly restore lost fluids and electrolytes.

CHOLERA VACCINES:

Oral Cholera Vaccines (OCVs): These are effective in preventing cholera. Commonly used vaccines include:

Dukoral: A bivalent vaccine offering protection against Vibrio cholerae serogroups O1 and O139.

Shanchol: A bivalent vaccine covering serogroups O1 and O139.

Vaxchora: Used for travelers to endemic regions.

HILLCHOL: New agent in this list.

CHOLERA AND INDIA:

National Immunization Program: In India, cholera vaccination is part of the broader National Immunization Program, specially targeted in endemic and high-risk areas.

PRELIMS QUESTION:

Q. With reference to the HILLCHOL VACCINE, Consider the following statement:

1. This is the first single-strain cholera vaccine developed in India.

2. It is completely free from side effects
3. This vaccine is suitable for children aged more than one year.
How many of the above-given statements are correct?
A. Only one
B. Only two
C. All three
D. None
ANSWER: B

PRAGATI (PRO-ACTIVE GOVERNANCE AND TIMELY IMPLEMENTATION)

This article covers "Daily Current Affairs" and topic details of the PRAGATI (Pro-Active Governance and Timely Implementation)

SYLLABUS MAPPING:

GS-2- governance: Developmental policies and programs.

FOR PRELIMS:

What is the PRAGATI platform?

RECENT CONTEXT:

Prime Minister Narendra Modi presided over the 44th edition of PRAGATI (Pro-Active Governance and Timely Implementation), a multi-modal ICT platform designed to enhance governance and ensure timely project execution. This was the first PRAGATI meeting of Prime Minister Modi's third term.

KEY FUCUS OF THE RECENT MEETING

Review of AMRUT 2.0 and Jal Jeevan Mission:
AMRUT 2.0: Focus on improving water issues in urban areas. Emphasized the need for Chief Secretaries to personally oversee the implementation and ensure that planning aligns with future urban growth.

Jal Jeevan Mission: Addressed public grievances related to water supply in rural areas, stressing that water is a fundamental need and the importance of efficient grievance resolution.

Urban Planning and Governance:
Reforms Needed: Urged for reforms in urban governance, comprehensive urban planning, urban transport planning, and municipal finance to address rapid urbanization challenges.

Energy Needs: Recommend leveraging initiatives like PM Surya Ghar Muft Bijli Yojana to meet the growing energy demands of urban areas.

Mission Amrit Sarovar:
Maintenance: Directed that water catchment areas of Amrit Sarovar should be maintained and desilted as needed with the involvement of Village Committees.

WHAT IS PRAGATI?

PRAGATI (Pro-Active Governance and Timely Implementation) is an ICT-based multi-modal platform launched by the Government of India to improve governance and project implementation

PURPOSE AND OBJECTIVES:

Enhanced Governance: PRAGATI aims to facilitate proactive governance by providing a real-time, transparent mechanism for monitoring and reviewing the progress of projects across various sectors.

Timely Implementation: The platform seeks to ensure the timely execution of projects by addressing bottlenecks and delays that may arise during implementation.

Coordination Between Government Levels: It serves as a bridge between central and state governments, facilitating better coordination and problem-solving for projects that involve multiple stakeholders.

KEY FEATURES:

Multi-Modal Interface: PRAGATI integrates various modes of communication, including video conferencing, GIS (Geographic Information System), and real-time data analytics, to review and manage projects.

Project Monitoring: The platform enables the monitoring of major projects across different sectors, such as infrastructure, energy, and social development, ensuring that they are on track.

Stakeholder Engagement: It involves direct interactions between the Prime Minister, senior officials, and state governments, fostering collaborative problem-solving and timely decision-making.

Problem Resolution: The platform allows for the identification and resolution of issues affecting project progress, with actionable insights and recommendations provided during meetings.

FUNCTIONING:

Regular Meetings: PRAGATI meetings are held periodically, during which the Prime Minister reviews the status of key projects, assesses progress, and addresses any challenges.

Project Review: During these meetings, project managers and officials present updates on the status, challenges, and achievements of various projects.

Actionable Insights: The platform helps take corrective actions, streamline processes, and ensure that projects are completed within the stipulated time frame and budget.

PRELIMS QUESTION:

Q. Consider the following statements:

Statement I: PRAGATI is an ICT-based multi-modal platform launched by the Government of India to facilitate effective governance and timely implementation of projects.

Statement II: The use of Information and communication technology has increased in governance over the last two decades for speedy decision-making.

Which one of the following is correct in respect of the above statements?

A. Both Statement I and Statement II are correct and Statement II is the correct explanation for Statement I

B. Both Statement I and Statement II are correct and Statement II is not the correct explanation for Statement I

C. Statement I is correct but Statement II is incorrect

D. Statement I is incorrect but Statement II is correct

ANSWER: A.

Munde Dhananjay Navnath