PLUTUS IAS

CURRENT AFFAIRS

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Date –21- February 2025

EV BATTERIES: REVOLUTIONS TO ACHIEVE NET ZERO EMISSION BY 2070

WHY IN THE NEWS?

The Ministry of Heavy Industries (MHI) signed a Programme Agreement with Reliance New Energy Battery Limited under the ₹18,100 crore PLI scheme for Advanced Chemistry Cells (ACC). This grants Reliance a 10 GWh manufacturing capacity, bringing the total allocated capacity to 40 GWh out of the 50 GWh target. The PLI scheme, aimed at boosting India's battery manufacturing for electric vehicles and renewable energy, strengthens domestic production, reduces imports, and supports India's green energy goals.

WHAT ARE BATTERIES?

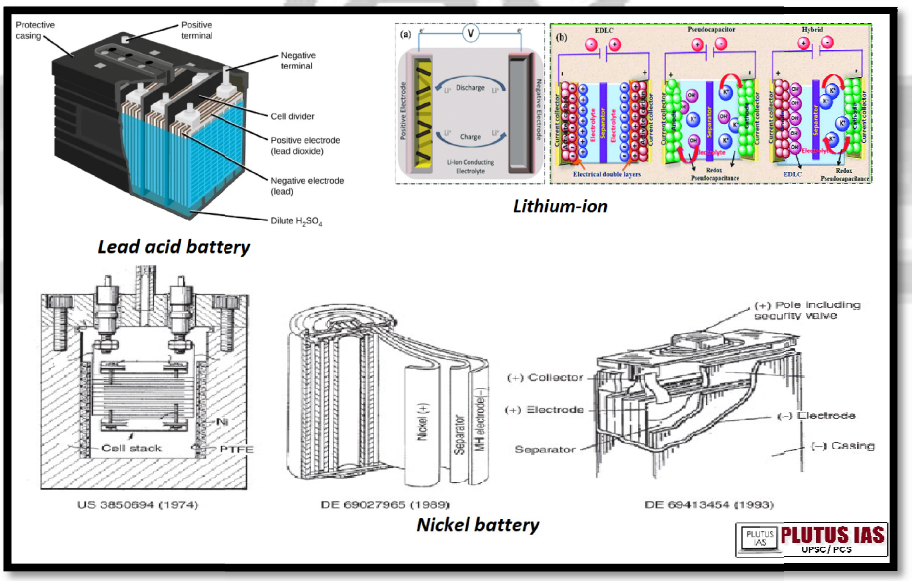
A battery is an electrochemical device that stores and releases electrical energy through chemical reactions. It typically consists of one or more electrochemical cells, where each cell has two electrodes (an anode and a cathode) separated by an electrolyte. When the battery is discharging, chemical reactions occur at the electrodes, releasing electrons and generating an electric current. The battery can be recharged (in the case of rechargeable batteries) by reversing these chemical reactions. Batteries are categorized into two main types:

1. Primary Batteries: These can only be used once. After they are discharged, they cannot be recharged and are discarded. The reactions inside these batteries are irreversible, making them "use-and-throw" devices.

2. Secondary Batteries: These are rechargeable and can be used for many cycles of charging and discharging. The chemical reactions in secondary batteries are reversible, allowing the battery to be recharged by applying an electric current to reverse the discharge reaction.

VARIOUS TYPES OF BATTERIES AND THEIR FEATURE:

Battery Type	Inventor/Origin	Key Characteristics	Common Applications
Lead-Acid Battery	Gaston Planté (1859)	– High energy-to-volume ratio, low energy-to-weight ratio – Strong surge currents – Inexpensive – Holds charge for up to 3 years	– Automotive (car batteries) – Emergency power backup
Nickel-Cadmium (NiCad) Battery	–	– Fast and even discharge – Varying discharge rates – Inexpensive – Used in small electronics and toys	– Toys – TV remotes – Small electronic devices
Lithium-Ion (LIB) Battery	–	– High energy capacity – No memory effect (except LFP cells) – Low self-discharge – Reversible lithium-ion flow	– Mobile phones – Laptops – Electric vehicles



WHAT ARE THE INITIATIVES LAUNCHED BY THE GOVT OF INDIA?

1. Subsidies:

PM E-DRIVE Scheme: ₹10,900 crore for subsidizing charging stations for two- and three-wheelers.

FAME-II & Advanced Chemistry Cell PLI Schemes: Incentives for EVs, batteries, and storage systems manufacturers.

2. Charging Infrastructure:

Revised guidelines from the Ministry of Power to expand public charging infrastructure.

Oil Marketing Companies to set up EV stations in cities and on highways.

3. Manufacturing Incentives:

PLI Scheme: Financial incentives for EV and battery manufacturers.

SPMEPCI (March 2024): Promotes manufacturing of electric passenger cars.

4. Other Initiatives:

Battery Swapping Policy: This policy encourages battery swapping as a viable alternative to charging, helping reduce downtime for EVs and promoting more sustainable usage of batteries.

Green Hydrogen Mission: This initiative supports the development and manufacturing of fuel cells and green hydrogen technology, which are expected to decarbonize the transportation sector.

EV-Mission: Aimed at fostering research and development in EV adoption, this mission supports the innovation of new technologies and solutions to advance the EV ecosystem in India.

5. Tax Incentives: The Indian government has reduced the Goods and Services Tax (GST) on electric vehicles and chargers, making EVs more affordable and attractive to buyers.

WHY INDIA IS FOCUSING ON EV- BATTERIES

1. Environmental Impact: EVs are central to reducing carbon emissions, and batteries are the heart of these vehicles.

2. Energy Security: Developing domestic battery production reduces reliance on foreign imports, ensuring a stable supply and minimizing risks from supply chain disruptions.

3. Economic Growth: A robust EV battery manufacturing industry can generate jobs, stimulate growth, and support India's green economy.

4. Government Initiatives: Policies like the Production Linked Incentive (PLI) scheme are encouraging domestic EV battery manufacturing.

5. Technological Advancement: India aims to advance in battery technology to produce high-performance, cost-effective batteries.

6. Market Potential: With a large and growing population, India's EV market is expected to expand, making battery production a promising sector.

CHALLENGES TO BECOME SELF-RELIANT IN EV BATTERIES

1. Raw Material Dependency: India depends heavily on imports of essential materials like lithium, cobalt, and nickel needed for batteries.

2. Supply Chain Complexity: Developing a local supply chain, including recycling facilities, is crucial for sustainable battery production.

3. High Initial Costs: The high upfront costs of EVs remain a barrier to adoption for many consumers.

4. Charging Infrastructure: Widespread and accessible charging infrastructure is essential to ease range anxiety and drive EV usage.

5. Technological Gaps: Lack of advanced research and development in battery technology.

6. Skilled Workforce Shortage: Insufficient expertise in battery manufacturing and engineering.

7. Regulatory Uncertainty: Inconsistent policies around battery production and recycling hinder long-term investment.

CONCLUSION

India is focusing on EV batteries to reduce carbon emissions, enhance energy security, and promote economic growth. Government initiatives like the PLI scheme for battery manufacturing and subsidies for charging infrastructure are key to boosting domestic production and reducing import dependency. Challenges such as raw material dependency, supply chain issues, and high initial costs remain. Overcoming technological gaps, workforce shortages, and regulatory uncertainty is vital for achieving self-reliance in EV battery production. With strong market potential and supportive policies, India is well-positioned to become a leader in the EV sector.

PRELIMS QUESTIONS:

Q. Which of the following statements are correct about India's Electric Vehicle (EV) initiatives?

1. The government has launched the PM E-DRIVE scheme to subsidize charging stations for two- and three-wheelers.
2. The Production Linked Incentive (PLI) scheme aims to promote the manufacturing of electric passenger cars only.
3. India's government is actively working on a Battery Swapping Policy to reduce downtime for electric vehicles.

Select the correct answer using the code given below:

A. 1 and 2 only
B. 2 and 3 only
C. 1 and 3 only
D. 1, 2 and 3

Answer: C

MAINS QUESTIONS:

Q. Discuss the various government initiatives aimed at promoting electric vehicle (EV) adoption and battery manufacturing in India. How do these initiatives support India's green energy goals?
(250 words, 15 marks)

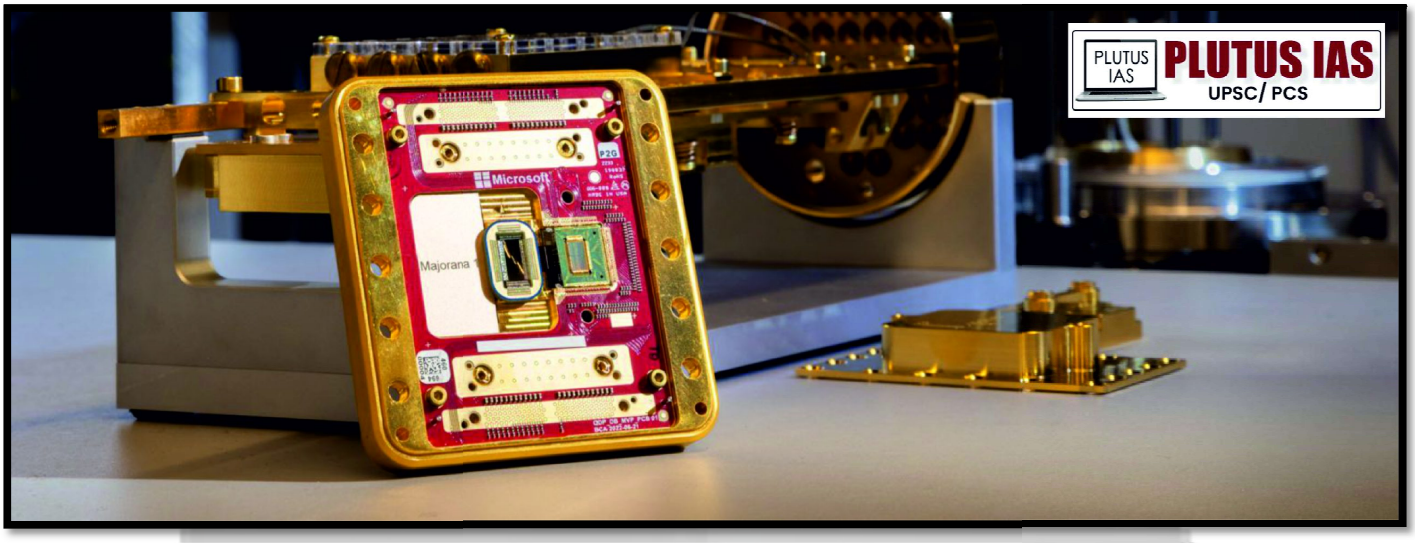
Ritik singh

QUANTUM COMPUTING: THE NEXT TECHNOLOGICAL REVOLUTION

WHY IN THE NEWS:

Microsoft, on Wednesday, unveiled a new chip that it said showed quantum computing is "years, not decades" away, joining Google and IBM in predicting that a fundamental change in computing technology is much closer than recently believed.

Quantum computing holds the promise of carrying out calculations that would take today's systems millions of years and could unlock discoveries in medicine, chemistry, and many other fields where near-infinite seas of possible combinations of molecules confound classical computers.



WHAT IS QUANTUM COMPUTING

Quantum computing is a field of study that applies the principles of quantum mechanics to computing. Unlike classical computers that operate on bits, quantum computers use qubits (quantum bits), which can exist in multiple states simultaneously due to the principles of superposition and entanglement. This allows them to perform complex computations at speeds unimaginable for classical computers.

Superpostion: A qubit can exist in both 0 and 1 states simultaneously, unlike classical bits.

Entanglement: When qubits become entangled, the state of one qubit is instantly linked to the state of another, regardless of distance.

Quantum interfernce: The probability of qubit states can be manipulated, enhancing computation efficiency.

FEATURES OF QUANTUM COMPUTING

1. Exponential Speedup: Quantum computers can solve problems exponentially faster than classical computers. For instance, a quantum computer could factor large prime numbers in seconds, a task that would take classical computers thousands of years.Parallelism: Unlike classical systems that process information sequentially, quantum computers leverage superposition to perform multiple calculations at once.

2.High efficiency in optimization problem: Quantum computing is particularly powerful in solving optimization problems that involve multiple variables and constraints, such as supply chain management and financial modeling.

3.Enhanced Cryptographic Capabilities: Quantum computers can break traditional encryption methods, necessitating the development of quantum-resistant cryptography.

4.Improved Simulation and Modeling: Quantum mechanics-based simulations, such as molecular and chemical modeling, are significantly more accurate and efficient using quantum computers.

DIFFERENCE BETWEEN QUANTUM COMPUTER & TRADITIONAL COMPUTER

Feature	Traditional computer	Quantum computer
Data Processing	Sequential processing	Parallel processing
Data Representation	Uses bits (0 or 1)	Uses qubits (0, 1, or both)

Computational Power	Limited by Moore's Law	Exponential speedup due to superposition and entanglement
Security	Uses classical cryptography	Can break classical encryption but enables quantum-safe encryption
Application areas	Business, gaming, AI, general-purpose computing	Cryptography, AI, scientific modeling, optimization, quantum simulations
State Dependency	Independent processing	Qubit entanglement allows state-dependent computation, improving efficiency
Error Sensitivity	Less error-prone	Requires error correction due to quantum decoherence

EVERYONE IS FOCUSING ON QUANTUM COMPUTING

1. Cybersecurity & cryptography: Quantum computing can break traditional encryption, making it crucial for governments and organizations to develop quantum-resistant encryption methods.

2. Advancement in AI & Machine learning: Quantum computing can enhance machine learning algorithms, leading to improved AI applications in healthcare, finance, and automation.

3. Pharmaceutical & Drug Discovery: Quantum simulations can significantly accelerate drug discovery and molecular analysis, reducing the time and cost of developing new medicines.

4. Climate Modeling & Scientific Research: Quantum computers can provide accurate climate predictions and aid in solving complex scientific problems.

5. Financial Modeling & Optimization: Quantum algorithms improve risk analysis, fraud detection, and investment strategies in financial institutions.

6. National Security & Defence: Countries are investing in quantum research to strengthen cybersecurity, intelligence, and defense capabilities.

WHERE INDIA IS STANDING-INITIATIVES & POLICIES

1. National Quantum Mission (NQM): Launched in 2023 with a budget of ₹6,000 crores, this mission aims to develop quantum technologies in computing, communications, and materials science.

2. Quantum Computing Labs & Research Centers: Organizations like ISRO, DRDO, IITs, IISc, and private players such as TCS and IBM are working on quantum computing research.

3. Public-Private Partnerships: Collaboration between government agencies, startups, and multinational tech firms to accelerate quantum advancements.

4. Quantum Communication Initiatives: India has successfully tested quantum key distribution (QKD) to enhance cybersecurity.

ISSUES INDIA IS FACING IN ADVANCEMENT OF QUANTUM COMPUTING

1. Lack of Infrastructure Quantum: High-cost quantum labs and equipment are needed to conduct cutting-edge research.

2. Talent Shortage: India lacks skilled quantum computing professionals.
3. Limited Industry Investment: Private sector funding in quantum computing is still in its nascent stage.
4. Technological Dependence: India relies on foreign companies for quantum hardware.
5. Scalability Issues: Building large-scale quantum computers requires significant breakthroughs in qubit stability and error correction.

WAYS TO MAKE INDIA AS GLOBAL POWER IN QUANTUM COMPUTING

1. Increase Government Investment: Expand funding for quantum research, infrastructure, and training programs.
2. Educational Reforms: Introduce quantum computing courses in universities and encourage research programs.
3.Strengthen Public-Private Partnerships: Collaborate with industry leaders and startups to accelerate innovation.
4. Develop Indigenous Quantum Hardware: Reduce reliance on foreign technology by building India's own quantum processors.
5. Boost International Collaborations: Partner with global leaders in quantum computing such as the US, EU, and China for knowledge exchange.
6. Promote Quantum Startups: Provide funding and mentorship to Indian startups focusing on quantum technology.
7. Enhance Cybersecurity Research: Invest in quantum cryptography to protect against future cyber threats.

CONCLUSION:

Quantum computing is set to redefine the future of technology, and India has a unique opportunity to establish itself as a key player in this domain. With strong government initiatives, increased funding, and a focus on education and infrastructure, India can overcome current challenges and emerge as a global quantum computing powerhouse. By fostering collaboration between academia, industry, and government, India can unlock the immense potential of quantum computing and drive innovation across multiple sectors.

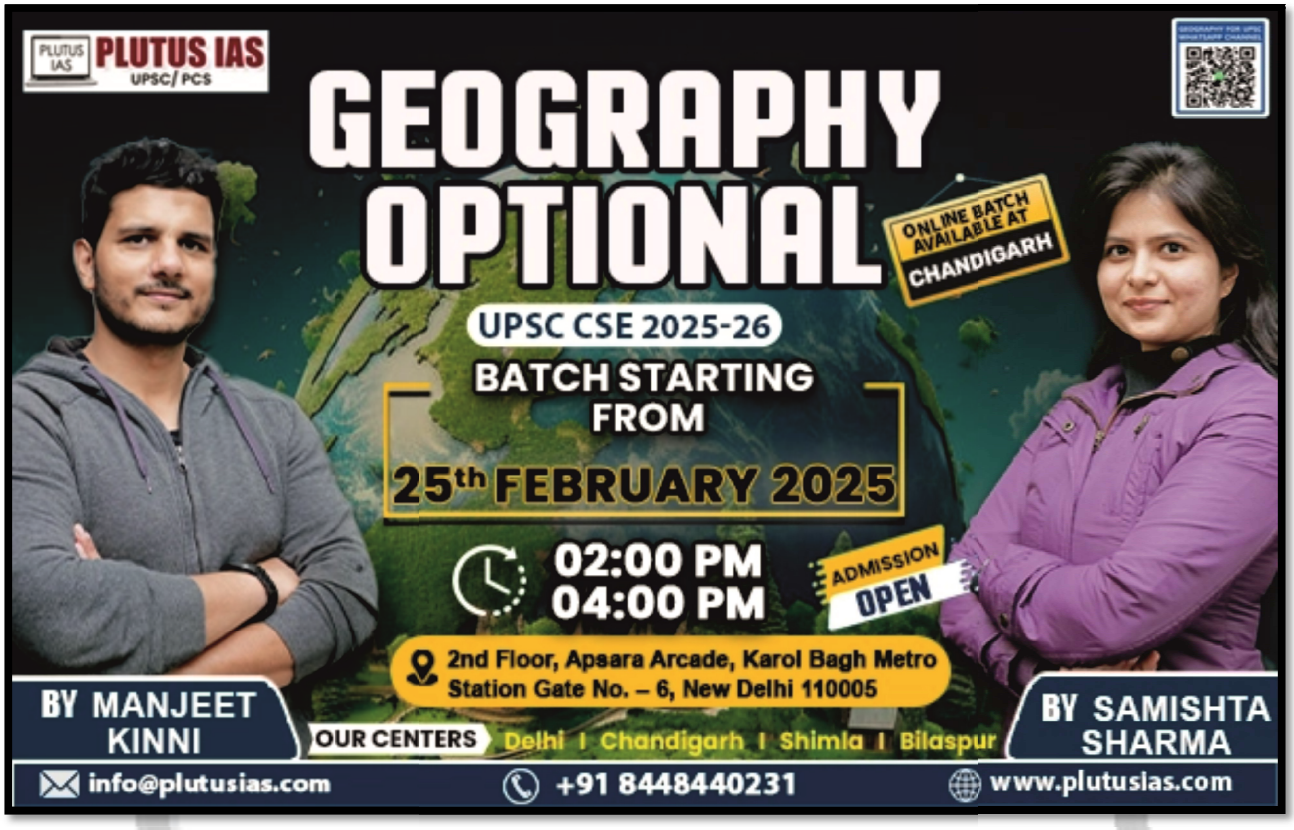
PRELIMS QUESTIONS:

Which of the following statements is true about quantum entanglement?
a) It allows a single qubit to hold multiple values at once
b) It ensures qubits maintain independent states
c) It links qubits such that the state of one qubit instantly affects another, regardless of distance
d) It only works at absolute zero temperature.
ANSWER: C

MAINS QUESTIONS:

Q. Discuss the key differences between Quantum Computing and Classical computing. How can quantum computing revolutionize industries such as healthcare, finance, and cybersecurity?
(250 words, 15 marks)

Nishant2356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