1. **Silicon photonics vs. Traditional semiconductor chips:** Scientists from the US and Europe have fabricated the first miniaturised lasers directly on silicon wafers.
   - This marks a major advance in silicon photonics, boosting computing performance and energy efficiency.
   - **About:** Silicon photonics is a technology that combines the principles of photonics (using light for information transmission) with the advantages of silicon-based microchip fabrication.
     - **Applications:** Data centres, sensors, and quantum computing.
     - **Photon advantages**: Faster data transfer, higher capacity, and lower energy loss.
     - **Photonic Chip Components:** Source (electrons/photons) → Waveguides (photon paths) → Modulators (encode/decode data) → Photodetectors (light to electricity).
   - **Laser**: Hardest component to integrate due to **material limitations**.
   - **How Lasers Work**
     - **Laser principle:** Based on stimulated emission, creating a coherent light beam.
     - **Silicon drawback:** Has an indirect bandgap, poor for light emission.
     - **Common materials:** Gallium arsenide (direct bandgap) enables efficient light emission.
   - **About Semiconductor Chips:**
     - Semiconductors are materials that exhibit a conductivity level between conductors and insulators. They can be pure elements such as silicon or compounds like gallium arsenide.
     - **Significance:** Semiconductor chips serve as the fundamental building blocks and the "heart and brain" of modern electronics and information and communication technology (ICT) products.
2. **International Crop Research Institute for Semi-Arid Tropics (ICRISAT):** As per the findings by the ICRISAT, Land-holding farmers who engage in non-farming activity tend to improve labour efficiency on their farms.
   - Objective: To understand the impact of multiple job holding on farm labour use efficiency.
   - **About International Crop Research Institute for Semi-Arid Tropics (ICRISAT):** It is an internationally recognized International Organization focused on dryland farming and agri-food systems.
     - **Objective**: To tackle hunger, malnutrition, poverty, and environmental degradation for 2.1 billion people in drylands of Asia, Sub-Saharan Africa, and beyond.

- **Establishment**: Set up under a Memorandum of Agreement between the Government of India and CGIAR on 28 March 1972.
- **Legal Status**: Recognized as an "International Organisation" under Section 3 of the United Nations (Privileges and Immunities) Act, 1947 through Gazette Notification on 28 October 1972.
- **Innovations**: Mapped genome of cultivated groundnut (world first) → Released first commercial pigeonpea hybrid in India → Introduced Africa's first biofortified pearl millet.
- **Headquarters**: Located in India, with offices in Eastern & Southern Africa, West & Central Africa.
- **Research Programs**: Accelerated Crop Improvement, Resilient Farm and Food Systems, and Enabling Systems Transformation.
- **Focus Crops**: Chickpea, pigeonpea, groundnut, sorghum, pearl millet, finger millet, small millet, oilseeds.

- **Key Findings by the ICRISAT:** Non-farm participation changes labour allocation decisions between farm and non-farm work.
  - **Migration benefits:** Farmers migrating within/outside their State gain knowledge of new farm practices which they use upon return.
  - **Labour support:** Families or hired labour manage farms in the farmer's absence.
  - **Policy Recommendation:** Promote structured non-farm employment to maximise positive spillovers on farming.

3. **Dual Criminality:** Mehul Choksi, a key accused in the ₹13,500 crore Punjab National Bank (PNB) loan fraud case, was arrested in Belgium recently, on the basis of "dual criminality".
   - **About:** Dual criminality essentially means that an individual can be extradited only if her offence is punishable in both jurisdictions involved.
     - The treaty prohibits extradition for offences of political nature or in cases where the individual in question can prove she is being prosecuted in the requesting country for political reasons.
     - It also states that the fugitive arrested shall be released if the requesting country fails to present evidence of culpability within two months.

- **Extradition Treaty:** India first signed an extradition treaty with Belgium in 1901.
  - The treaty allows extradition on the basis of "dual criminality", including for financial crimes.
  - In 2020, India and Belgium signed the Mutual Legal Assistance Treaty for better cooperation on fugitives.

4. **ISRO's Crew Escape System:** NASA astronauts Sunita Williams and Barry Wilmore returned safely after a nine-month ISS mission, highlighting the importance of safety protocols in human spaceflight.
   - ISRO, preparing for its maiden human spaceflight mission Gaganyaan, is developing similar safety mechanisms based on past incidents and recent research.
   - **About ISRO's Crew Escape System:**
     - **Crew Escape System:** It is a tower-like structure atop the human-rated LVM3 rocket to pull the crew module away in case of a malfunction.
     - **Emergency exit device** is activated after ignition to protect crew, unlike satellite-launching **LVM3** which lacks such a system.
     - Tractor-type system in ISRO's Crew Escape design uses solid fuel engines to quickly lift the crew module.
     - Crew module is attached to the escape tower and disengages from the rocket during emergencies.
     - Pad abort scenarios activate both HEM and LEM motors to ensure rapid escape and splashdown in sea.
     - Crew Escape System becomes dead weight in normal flights; hence, the LEM is jettisoned at a set altitude to reduce mass.
     - **Soyuz T-10 (1983)** & **Blue Origin NS-23 (2022),** demonstrated successful use of escape systems.
   - **About Low-altitude Escape Motor (LEM) & High-altitude Escape Motor (HEM):**
     - LEM generates enough thrust at initial launch phase to separate crew module from launch vehicle.
     - HEM activates at higher altitudes to quickly pull the crew module away to safety.
     - Both LEM and HEM are triggered during pad aborts, ensuring rapid ascent and safe distance from the vehicle.

5. **QShield:** Recently, QShield launched on World Quantum Day to enable seamless cryptography management across cloud, on-premises, or hybrid environments.
   - **About QShield:** It empowers enterprises to protect their critical infrastructure at scale.
     - Solution built with QNu's patented Quantum Key Distribution (Armos), Quantum Random Number Generator (Tropos), Quantum Hardware Security Module (QHSM), and NIST-compliant Post-Quantum Cryptography (PQC).
     - Platform provides end-to-end security for sensitive data in transit and at rest.
     - QShield enables services like Qosmos (key generation), QConnect (secured connectivity), QVerse (secured collaboration), QSFS (secure file storage and sharing), and QVault (key management).
     - Platform empowers enterprises to quantum-safe their critical and diverse infrastructures.
     - QShield supports unified management, flexible deployment, and easy integration with third-party services.
     - Platform ensures protection of critical data today, preparing enterprises for a quantum-secured future.
     - Startup incubated at IIT Madras Research Park in 2016.
     - QNu Labs contributes to cybersecurity with quantum-safe solutions, positioning India as a global leader in quantum cryptography.
6. **International Technology Engagement Strategy (ITES):** Office of Principal Scientific Adviser (PSA) to GoI released the first edition of International Technology Engagement Strategy (ITES) for Quantum on World Quantum Day 2025 (April 14).
   - **About International Technology Engagement Strategy (ITES):** It a significant step toward articulating India's outward-facing strategy in Quantum Science, Technology and Innovation (QSTI). Aim is to accelerate discovery, foster innovation, and catalyse adoption across critical sectors.
   - **About National Quantum Mission (NQM):** Mission is efficiently rolled out by the Department of Science and Technology (DST) under its Secretary's leadership.
     - Mission covers the complete life cycle of quantum technology – from R&D to product development and market scale-up.

- Hub-and-spoke model implemented at the national scale involves 152 researchers from 43 institutions across 17 states and 2 UTs.

- **Highlights of ITES-Q Report:** Inaugural edition provides a comprehensive overview of global and national quantum ecosystems.
  - Report covers analysis of investments, talent development, institutional strengths, research publications, intellectual property, startups, supply chains, and industrial activity.
  - Report aims to facilitate impactful partnerships and strengthen bilateral and multilateral engagements for QSTI via Indian missions abroad.

7. **Underwater Acoustic Test Facility (ATF):** Recently, GOI hailed the global recognition and international certification of the Underwater Acoustic Test Facility (ATF) at NIOT Chennai.
   - **About Underwater Acoustic Test Facility (ATF):** Established in 2004 under the Ministry of Earth Sciences at NIOT Chennai.
     - ATF is India's only NABL-accredited facility for hydrophone calibration, maintaining accreditation since 2005.
     - Facility enables testing and calibration of hydrophones, transducers, and acoustic modems, vital for strategic and civilian applications.
     - ATF strengthens ocean observation capabilities, supports tsunami detection systems, and reinforces national security.
     - ATF caters to major users such as naval labs, IITs, universities, and companies like BEL, L&T, and Tata Power.
   - **Global Recognition:** ATF's competence validated in 2018 via a Key Comparison Test organized by the National Physical Laboratory, UK.
     - ATF participated alongside labs from US, UK, Russia, and other countries.
     - Calibration results matched international standards, proving parity with top global labs.
   - **Designation by BIPM (Paris):** ATF designated as India's "Designated Laboratory" in underwater acoustics by BIPM, Paris, through CSIR-NPL.
   - **Significance:** Deep-sea exploration and maritime security with precision and indigenous strength.