Today's Prelims Topics

New Way to Detect Radioactive Materials Using Lasers

Context

A **team of US physicists** has developed a **new method** to detect **radioactive materials remotely** using **carbon-dioxide lasers**.

What is Avalanche Breakdown

- Some materials naturally **release energy and particles**—this is called **radioactive decay**. These released **particles move through the air** and **knock electrons off atoms**, creating a type of energy-filled air called **plasma** (like the glowing part of a flame or lightning).
- The process of more and more electrons getting knocked off and spreading is called **avalanche breakdown** (like a small snowball rolling down a hill and getting bigger).
- **Key findings of the experiment:**
    - **Detected radiation from 10 meters away** – This is **10 times farther** than previous methods.

How Do Lasers Help Detect Radiation?

- Scientists used a **special type of laser (carbon-dioxide laser)** that gives off **infrared light** (like the heat from a TV remote).
- This laser helps **accelerate electrons**, making it easier to see the plasma caused by radioactive particles.
- When the laser shines through the air, the plasma **bounces the light back** in a way that can be measured.

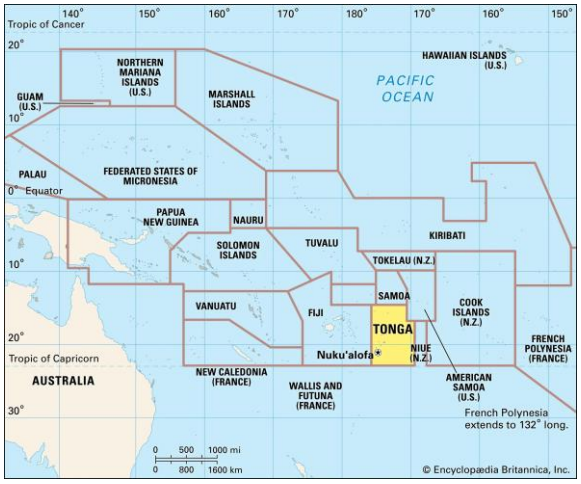
Source:

- The Hindu - Laser allows long-range detection

Places in News

Tonga

- Recently a powerful **7.1 magnitude** earthquake struck near Tonga.



- **Location:** Polynesia, South Pacific Ocean
- It consists of some 170 islands divided into 3 main island groups: Tongatapu in the south, Haʻapai in the centre and Vavaʻu in the north.
- Tonga is a member of the **Commonwealth and United Nations.**
- It is part of the **Pacific Ring of Fire**, making it **prone to earthquakes and tsunamis**.

Source:

- Hindustan times - Tonga

News in Shorts

Why Naini Lake is shrinking

- **Location:** It is a Kidney shaped lake situated in **Nainital, Uttarakhand**, it is one of the most famous natural lakes in India. It is surrounded by **seven hills**.
- It was discovered by **P. Barron**, a British businessman, in the **mid-19th century**.
- It is not a **Ramsar site.**

Factors Contributing to Water Depletion

- Increased Population and Tourism Pressure.
- **Unplanned construction** and **encroachments** near the lake.
- **Degradation of recharge zones**, particularly **Sukhatal Lake**, a **major aquifer recharge area** for Naini Lake.
- **Discharge of untreated wastewater** into the lake.
- **Decreasing Rainfall:**
  - **In 2022:** Uttarakhand received **2,400 mm** annual rainfall.
  - **2024:** The rainfall dropped to **2,000 mm**.

Facts

- **Asan Conservation Reserve** is the only Ramsar site in **Uttarakhand.**

Source:

- Indian Express - Naini Lake

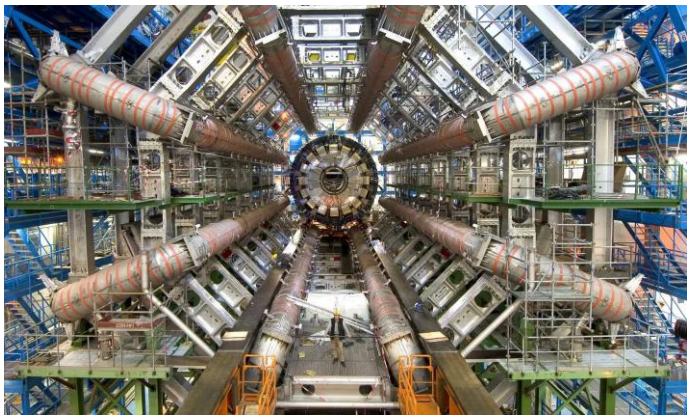
What is Vibe Coding ?

- Vibe coding" is a new approach to coding where users rely entirely on Large Language Models (LLMs) to generate code, without deeply engaging with its structure or technical details.
- **How does it work ?**
  - Users give a text prompt describing the kind of code they need.
  - The AI generates the required code.
  - Users copy, paste and run the code without focusing on its underlying logic.
  - Errors can be fixed by feeding them back into the AI.

Source:

- The Hindu - Vibe Codin

Future Circular Collider (FCC): The World's Biggest Machine



- **FCC** is a proposed **next-generation particle accelerator** by **CERN**. It is a planned **91 km circular tunnel** beneath the **Swiss-French border**.
- FCC is expected to be completed in **2035** and will have a significantly higher energy than previous colliders.
- It will succeed the **Large Hadron Collider which discovered the Higgs boson in 2012.**
- **Scientific Objectives:**
    - Understand the Higgs Boson in greater detail.
    - Study fundamental forces and the nature of matter.
    - Explore mysteries like dark matter and antimatter asymmetry.
    - **Go beyond the discoveries of the LHC**, which found the **Higgs boson in 2012**.

Source:

- The Guardian - FCC

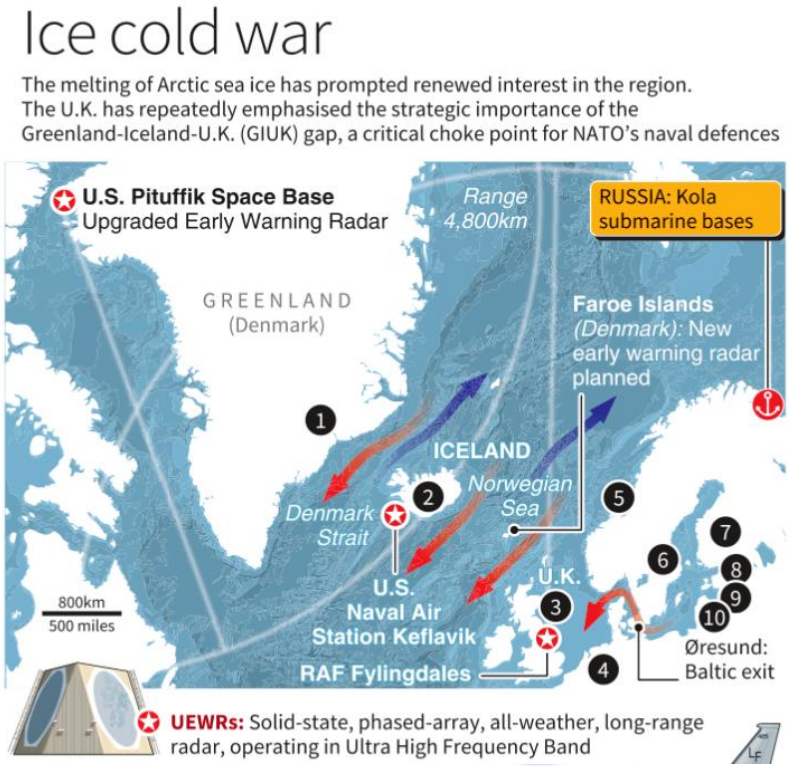
Editorial Summary

Why are tensions high in the Arctic?

Context

International observers have expressed concerns about rising tensions in the Arctic, cautioning that if not addressed, they could potentially lead to conflict in the region.

Current Scenario in the Arctic



- The Arctic is witnessing rising geopolitical tensions as climate change accelerates ice melting, unlocking new opportunities for resource extraction, trade routes, and military expansion.
- Nations such as Russia, the U.S., Canada, Denmark, and China are asserting their claims and strategic interests, leading to growing concerns over potential conflict.
- NATO and Russia are increasing military posture in the region, with Russia maintaining a strong icebreaker fleet and military bases, while NATO allies, including Sweden and Finland, are expanding their Arctic presence.

How Has Russia Made Its Presence Known in the Arctic?

- **Military Expansion**: Russia has **reopened Soviet-era Arctic military bases** and modernized its presence with **air defense systems, radar stations, and Arctic brigades**.
- **Icebreaker Fleet**: Russia has the **world's largest fleet of icebreakers**, including **nuclear-powered** ones, giving it unmatched access to Arctic waters.
- **Territorial Claims**: Russia has submitted claims to the **UN Commission on the Limits of the Continental Shelf**, arguing that large parts of the Arctic seabed belong to its continental shelf.
- **Symbolic Acts**: In **2007**, Russia planted a **titanium flag on the Arctic seabed** at the North Pole, signaling its ambitions.
- **Strategic Partnerships**: Russia has conducted **joint naval exercises with China** and controls key segments of the **Northern Sea Route**, crucial for trade between Europe and Asia.

Why is the Arctic Crucial?

- **Resource Reserves**: The Arctic is estimated to hold **13% of the world's undiscovered oil and 30% of its untapped natural gas reserves**, along with rare earth elements, phosphates, and copper, making it a key battleground for energy security.
- **New Trade Routes**: Melting ice is opening up strategic shipping routes like the **Northeast Passage** (along Russia's coast) and the **Northwest Passage** (through Canada), potentially **reducing maritime travel distances between Asia and Europe.**
- **Strategic Significance**: The Arctic has become an area of military interest, particularly for NATO and Russia. The **Greenland-Iceland-U.K. (GIUK) gap** is a key naval choke point.

How is the Arctic Controlled?

Arctic Council

- **Established**: 1996 by the **Ottawa declaration**
- **Objective**: To promote **cooperation, coordination and interaction** among the **Arctic States** together with the **indigenous communities** and other **Arctic inhabitants.**
    - To promote research and facilitates cooperation among Arctic countries on issues related to the environmental **protection and sustainable development of the Arctic region.**

- **Arctic Council Secretariat:** The standing **Arctic Council Secretariat** formally became operational in 2013 in **Tromsø, Norway.**
- **Members**: The Council has **members, ad hoc observer countries** and **"permanent participants"**
    - **Permanent:** Canada, Denmark, Finland, Iceland, Norway, Russia, Sweden, and the U.S..
    - **Observer status:** It is open to **non-Arctic states,** along with **inter-governmental, inter-parliamentary, global, regional** and **non-governmental organizations** that the **Council determines** can contribute to its work.
        - **India holds as the Observer status** in the Arctic Council.

- **Current Status:** It is now **struggling with geopolitical rivalries**, particularly after Russia's invasion of Ukraine.

- **Sovereign Territories**: Eight Arctic nations (Permanent members of Arctic Council) control land and resources within their Exclusive Economic Zones (EEZs).
- **UNCLOS Regulations**: Nations can extend claims beyond their 200-nautical-mile EEZ if they prove the seabed is a natural extension of their continental shelf. Overlapping claims by Russia, Canada, and Denmark remain unresolved.

What Lies Ahead?

- **Geopolitical Rivalries Intensifying**: U.S.-Canada disputes over the Northwest Passage, Russia's military buildup, and China's growing Arctic ambitions are expected to fuel tensions.
- **Increased Militarization**: Russia and NATO are conducting military drills in the Arctic, while China is developing nuclear-powered icebreakers to expand its presence.
- **Expanded Commercial Interests**: As Arctic sea routes become more viable, countries will compete for economic benefits, particularly in resource extraction and shipping.
- **Environmental and Legal Challenges**: Rising global temperatures and the absence of a comprehensive Arctic treaty (like the Antarctic Treaty) may lead to uncontrolled exploitation, further straining international relations.

Source: The Hindu: Why are tensions high in the Arctic?

Need for a Demographic Outlook in Delimitation and Financial Devolution

Context

The debate over delimitation and financial devolution has sparked controversy in Parliament and several State Assemblies, raising concerns about its impact on the federal structure of the nation.

History of the Delimitation Exercise in India

- The **delimitation** of parliamentary constituencies in India has been linked to **population growth**.
- From **1951 to 1971**, the **number of Lok Sabha seats increased** in response to population growth. The population per Lok Sabha seat rose from **7.3 lakh in 1951** to **10.1 lakh in 1971**, when the number of seats reached **543**.
- However, in **1976**, the number of seats was **frozen** based on the **1971 Census** to encourage **population control measures**.
- This freeze was extended until **2026**, and with that deadline approaching, the need for **revisiting seat allocation** has sparked concerns, especially among **southern states** that have successfully controlled population growth.

Key Concerns with Delimitation

- **Disproportionate Political Representation:** Northern states (Uttar Pradesh, Bihar, Madhya Pradesh) have experienced **higher population growth** than southern states (Tamil Nadu, Kerala, Karnataka).
    - If representation is based purely on population, **southern states may lose seats**, while **northern states may gain more**, raising concerns over **fair political representation**.
- **Financial Devolution Imbalance:** The **15th Finance Commission** shifted from using **1971 Census data** to **2011 Census data** for devolution, increasing the weightage of population from **0.15 to 0.27**.
    - Southern states, despite **better governance and lower fertility rates**, may receive **less financial allocation**, while **high-population states benefit more**.
- **Per-Capita Standardization Issue:** Using a **raw population count** to allocate resources and seats **ignores regional differences**, such as **population density, economic development, and governance quality**.
    - This could **penalize states that have controlled population growth** while rewarding those with higher fertility rates.
- **Complexities of Reservation:** Delimitation must also consider **caste-based and gender-based reservations**.
    - A simple population-based formula may not **adequately represent marginalized groups**.

What Can Be Done?

- **Expanding Lok Sabha Strength:** Given India's growing population, **capping representation at 543 seats is outdated**.
    - If past trends are followed, the **total seats should increase to 753** by 2026, ensuring **fairer representation**.
- **Balancing Representation via Population Density:** Instead of **absolute population**, using **population density** (people per sq. km) can ensure **fair distribution of seats**.
    - This method is **already used in the Northeast**, where states with smaller populations have higher representation.
- **Demographic Performance-Based Allocation:** Just like the **15th Finance Commission**, delimitation should **reward states with better population control** by ensuring they do not lose political representation.

- **Weighted Representation Formula:** A **hybrid approach** considering **population size, density, demographic progress, and governance indicators** can help balance regional disparities.
- **Reforming Financial Devolution:** Fiscal transfers should **not solely depend on population size**.
    - States that have managed their population growth well should receive **incentives** instead of being penalized.
- **Addressing the Per-Capita Hangover:** Moving beyond **per-capita measures** and incorporating **regional needs, economic performance, and demographic attributes** will ensure **equitable financial and political distribution**.

Source: **The Hindu: Thinking beyond population count**

Rising Jobs Deficit in India

Context

Formal jobs shrinking due to AI, automation, & rising capital intensity.

More in News

- Since 2017-18, India's **working-age population** has increased by **9 crore**, but **formal sector jobs** have only risen by **6 crore**, creating a **deficit of 50 lakh jobs annually**.
- Most new employment has been generated through **self-employment in rural areas** or **informal services**, leading to concerns over both **job quantity and quality**.

Challenges of Job Creation in the Formal Sector

- **Technological Progress & Labour Intensity**: There is a **steady decline in the labour intensity of production** due to **increasing capital intensity** in both manufacturing and services.
    - AI and automation are likely to **accelerate this shift**, further reducing demand for low-skilled labour.
- **Capital Intensity Increasing in a Labour-Abundant Economy:**
    - **Demand-side Factors**: Firms prefer **capital-intensive methods** to increase **productivity and value addition** at a lower cost.
    - **Supply-side Factors**: A lack of **skilled labour** makes firms more dependent on machinery.
- **Key Observations on Sectoral Trends**:
    - **Services Sector**: Increased value addition; higher share in **GDP and GVA**.
    - **Manufacturing Sector**: **Stagnant contribution** to GDP.
    - **Agriculture**: Declining GDP contribution.
- **Impact of Falling Capital Costs & Skill Shortages**: **Real wages** have remained stagnant, but **capital costs (machinery, technology) are declining** due to global technological advancements.
    - Less than **10% of India's workforce** has **formal technical or vocational training**.
    - Many **educated youth lack employment-ready skills**.
- **Skill-Biased Technological Change**: New technology **reduces demand for low-skilled workers** as firms opt for **automated, high-productivity** processes.
    - **Upskilling and re-skilling** of workers is essential for employment sustainability.

Government Strategies for Job Creation

Production-Linked Incentive (PLI) Scheme

- **Objective**: Expand **production capacity** and encourage **high-value manufacturing**.
- **Budget Allocation**:
    - Over **50% of PLI funds** go to **large-scale electronics, IT hardware, and drones**.
    - However, **highest job creation** has been in **food processing & pharmaceuticals**.
    - **Mismatch**: High budget allocation to **capital-intensive** sectors, while **labour-intensive** sectors receive lesser focus.
- **Constraints in PLI Implementation**:
    - The lack of **skilled workers** hinders job creation.
    - Majority of India's workforce has **low or medium-level skills**.

Employment-Linked Incentive (ELI) Scheme

- **Objective**: Encourage **formal sector hiring** by subsidizing **EPFO contributions** for new employees.
- **Key Features**:
    - Targets **labour-intensive industries**.
    - Reduces initial **hiring cost** for firms.
    - **Government bears some risk** of hiring untrained workers.

- **Challenges in ELI Implementation**:
    - Subsidy period is **short (2-3 years)**, raising concerns about **long-term employment sustainability**.
    - **Lack of data** to track **interns' career progression**.
    - **Uncertainty** over whether firms will invest in **upskilling workers** post-subsidy.

Proposed Policy Recommendations

- **Better Integration of Production & Skilling Strategies:** Align **PLI and labour skilling policies** to ensure job creation **matches sectoral needs**.
    - Address **both demand- and supply-side factors** to drive **structural transformation** towards high-value manufacturing.
- **Improving Inter-Ministerial Coordination:** Ministries of **Industry, Labour, and Skilling** should work together to map:
    - **Current** and **expected future** labour supply.
    - **Skill demand** across sectors.
- **Reforming ELI Scheme for Sustainable Job Creation:** Shift from **flat incentives** to **graded incentives**→ **Higher transfers** for each additional level of skill certification.
    - Extend ELI to **skilling institutions (e.g., ITIs)** to improve:
        - **Employment outcomes**.
        - **Skill quality** linked to **future industry demand**.
- **Addressing Labour Regulations:** Labour laws **increase hiring costs**, pushing firms towards **capital-intensive** methods.
    - **State governments must adopt flexible labour policies** to encourage hiring.

Conclusion

- India must **simultaneously invest in quantity** (job creation) and **quality** (skilling & upskilling).
- A **dynamic policy framework** is critical to align **job market trends** with **India's vision for Viksit Bharat** (developed India).
- Policymakers must ensure a **workforce ready for high-value industries** as the nation moves up the **global production value chain**.

Source: Indian Express: Labour at the Centre