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CONCISE

SCIENCE AND TECHNOLOGY

Volume - II

Current Affairs for Prelims 2026

(OCTOBER 2025- JANUARY 2026)

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PREFACE

Concise Prelims Current Affairs 2026

Current Affairs-Sine QuaNon of UPSC Preparation

Proficiency in Current affairs is sine non qua for UPSC preparation. It is the basic foundation of any aspirant 's preparation. Knowledge and skill to relate current news with UPSC syllabus is quintessential part of the preparation.

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Google AI Hub in Visakhapatnam

Space for Notes:

Why in News?

Google announced a **$15 billion investment** to build its largest AI-focused data centre outside the U.S. in **Visakhapatnam**, Andhra Pradesh, partnering with Bharti Airtel and AdaniConneX, aiming to boost AI services, connectivity, and digital infrastructure in India.

Description:

Announced by: Ministry of Electronics & Information Technology (MeitY)

Union Minister: Shri **Ashwini Vaishnaw**

Investment: USD 15 Billion (2026–2030) – Google's **largest investment in India**

Overview:

- **Google AI Hub** to be set up in **Visakhapatnam (Andhra Pradesh)**.
- Aim: To make India a **global AI and data connectivity hub**, aligned with the **Viksit Bharat Vision**.
- Hosted during **Bharat AI Shakti** event ahead of **India AI Summit 2025**.
- Marks a **transformative step** for India's **digital economy** through **AI-first infrastructure** and **clean energy**.

Key Features:

1. **Purpose-built AI Data Center Campus:**
   - Gigawatt-scale compute capacity for AI and digital services.
   - Partners: **AdaniConnex** and **Airtel**.
   - Supports global Google services (Search, Workspace, YouTube).
2. **AI Infrastructure:**
   - Integrates **Google's full AI stack** (TPUs, cloud compute, R&D).
   - Competes with Nvidia's GPU-based infrastructure.
   - Enables **AI startups and enterprises** (e.g. CoRover, Glance, Meesho, TCS).
3. **International Subsea Gateway:**
   - New **subsea cables landing at Visakhapatnam**, connecting to Google's global 2 million miles of cable network.
   - Provides **route diversity** beyond Mumbai & Chennai.
   - Enhances India's **digital backbone and internet resilience**.
4. **Clean Energy Integration:**
   - Powered by **renewable energy sources**.
   - New **transmission lines and energy storage systems** in Andhra Pradesh.
   - Expands India's **clean electricity grid capacity**.
5. **Skill Development & Employment:**
   - Expected to create **high-value jobs** and drive **AI-driven skill development**.
   - Focus on **reskilling IT professionals** under the **India AI Mission**.

Strategic Connectivity Initiatives:

- Proposal for **Vizag–Sittwe (Myanmar) Digital Link** to strengthen **North-East connectivity**.
- **RailTel Network Expansion** via Mizoram–Myanmar corridor.
- Vision to make **Andaman & Nicobar Islands** a **global internet data transfer hub** (alternative to Singapore).

Significance:

- Boosts India's position as a **global AI innovation hub**.
- Supports the **India AI Mission** and **Digital India vision**.
- Enhances **digital sovereignty** and **connectivity diversification**.
- Promotes **public–private collaboration** in advanced computing and green energy.

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H-1B Visa Fee Hike 2025

Why in News?

The U.S. government clarified that the **$100,000 H-1B visa fee will not apply** to existing visa holders, amendments, changes of status, or extensions, providing relief to Indian professionals and students in the U.S. after September 21, 2025.

Description:

- **Type:** Non-immigrant work visa.
- **Purpose:** Allows US companies to hire **foreign professionals in specialty occupations** (IT, engineering, finance, medicine, etc.).
- **Validity:** Initially 3 years, extendable to 6 years.
- **Sponsor:** US employer files petition.

Before vs After Fee Structure:

Aspect	Before 2025	After Sep 21, 2025
Fee	$2,000 – $5,000	**$100,000 (one-time)**
Applicability	All petitions	**New petitions only**
Employer Responsibility	Minimal fee	**Full $100,000 fee**
Existing Visa	Not affected	**No immediate impact**
Objective	Facilitate skilled worker entry	**Restrict misuse & protect US wages**

Non-Communicable Diseases (NCDs)

Why in News?

The Global Burden of Disease (GBD) 2023 report, launched at the World Health Summit, Berlin, reveals that India's leading causes of death have shifted from infectious diseases to non-communicable diseases (NCDs) like heart disease, COPD, and stroke.

Description:

- Non-communicable diseases (NCDs), also known as **chronic diseases**, are **not contagious** and usually develop **slowly**.
- Require **long-term or lifelong treatment**.

Main Types of NCDs:

1. **Cardiovascular diseases (CVDs)** – e.g., coronary heart disease, stroke
2. **Cancers**
3. **Chronic respiratory diseases (CRDs)** – e.g., COPD, asthma
4. **Diabetes mellitus**

These 4 account for **>80% of all premature NCD deaths** globally.

Global Scenario:

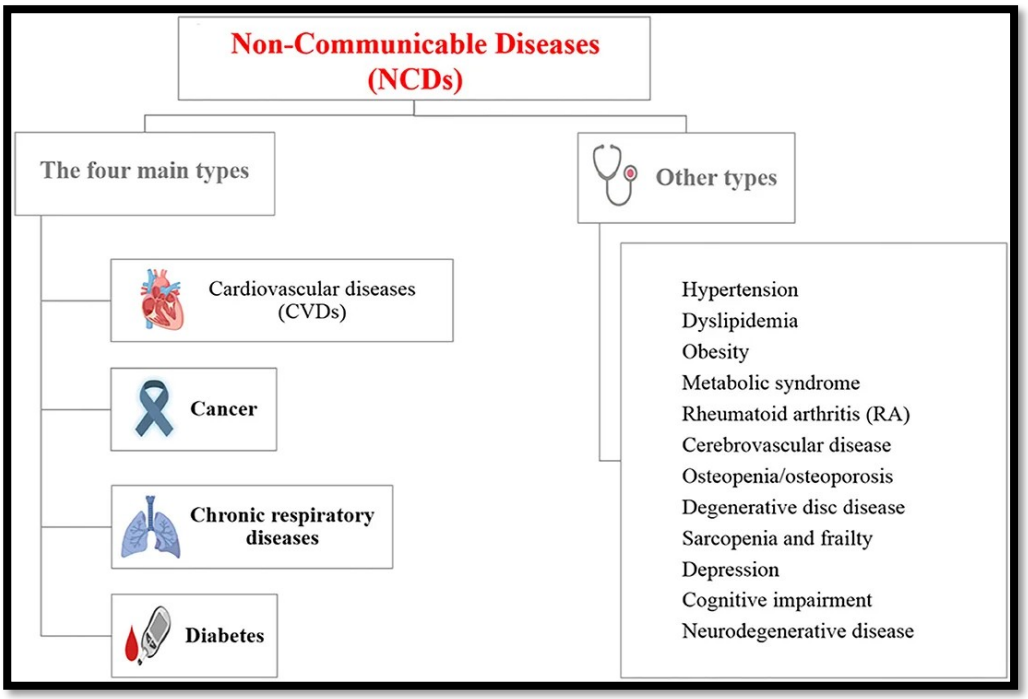
- Cause **41 million deaths** annually (**71%** of all deaths worldwide).
- **86%** of premature NCD deaths (<70 years) occur in **low- and middle-income countries**.

India and NCDs:

- Account for **66% of all deaths** in India.
- **22%** are **premature deaths** (before 70 years).
- India is likely to miss the **SDG target** of one-third reduction in premature NCD deaths by 2030; only ~15.6% reduction projected.

Major Risk Factors:

- **Behavioural:** Tobacco use, alcohol consumption, unhealthy diet, physical inactivity.
- **Metabolic/physiological:** Raised blood pressure, obesity, high blood glucose, high cholesterol.
- **Environmental:** Air pollution.
- **Genetic predisposition** also plays a role.



Comprehensive Nuclear-Test-Ban Treaty Organization (CTBT)

Context:

The U.S. decision to restart nuclear testing after 33 years breaks with decades of restraint under simulation-based deterrence and the CTBT framework, potentially destabilising global nuclear norms and escalating strategic rivalry.

Comprehensive Nuclear Test Ban Treaty (CTBT)?

- It is a multilateral treaty that bans all nuclear explosions, for both civilian and military purposes, in all environments.
- **Adopted by:** The United Nations General Assembly (UNGA) in 1996.
- **Structure:** The CTBT itself includes a Protocol in 3 parts.
  - Part I detailing the International Monitoring System (IMS)
  - Part II on On-Site Inspections (OSI)
  - Part III on Confidence-Building Measures (CBMs)
- There are also 2 Annexes to the Protocol.
  - Annex 1 detailing the location of various Treaty monitoring assets associated with the IMS
  - Annex 2 detailing the parameters for screening events

CTBTO: The Treaty establishes a CTBT Organization (CTBTO), located in Vienna, to ensure the implementation of its provisions

The CTBTO consists of 2 organs,

- Preparatory Commission (a plenary body) and
- Provisional Technical Secretariat (PTS)

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Administered by Preparatory Commission for CTBTO:

- **Condition:** For the treaty to enter into force, 44 "Annex 2" States must sign and ratify the Treaty.
  - Signed but not ratified: China, Egypt, Iran, Israel and the United States
  - Non-signatories: India, North Korea and Pakistan
  - **Withdrawal:** Each State Party has the right to withdraw from the CTBT if it decides that extraordinary events related to the subject matter of the Treaty have jeopardized the State Party's supreme national interests.

ChatGPT Atlas Browser – OpenAI's AI-Powered Web Browser

Why in News?

OpenAI launched **Atlas**, an AI-powered web browser built around ChatGPT, featuring an "agent mode" that conducts searches autonomously, challenging Google Chrome; free for macOS users, with agent mode for **paid ChatGPT Plus/Pro subscribers.**

Description:

About ChatGPT Atlas:

- A **native macOS browser** combining **AI chat + web interface**.
- Users can **interact with ChatGPT directly on webpages** without switching tabs.
- Part of OpenAI's effort to build a **"super-assistant"** that merges browsing, productivity, and automation.

Key Features:

Feature	Description
1. Contextual Assistance	Understands webpage content, summarizes articles, explains concepts, and highlights key details within the browser.
2. Agent Mode (Automation)	Allows ChatGPT to perform actions like adding items to a cart, filling forms, scheduling meetings, or navigating multiple sites — with user consent.
3. Integrated Memory	Recalls user sessions, recent websites, and ongoing tasks (e.g., summarizing last week's searches). Memory is **optional** and user-controlled.
4. Combined Search + Chat Interface	Replaces the address bar with an AI-powered **search + chat** bar offering categorized and summarized results.

Privacy & Control:

- Data stored **only within the user's ChatGPT account.**
- **Memory is opt-in**; can be viewed or deleted anytime.
- Parental controls and privacy settings inherited from ChatGPT.
- Users can choose whether browsing contributes to model training.

Availability:

- Available globally on **macOS** for **Free, Plus, Pro, and Go users.**
- Beta for **Business, Enterprise, and Education accounts.**
- Versions for **Windows, iOS, and Android** coming soon.

PUNCH Mission

Why in News?

NASA's PUNCH Mission, launched via SpaceX, is observing the Sun's corona and "young solar wind" in 3D using polarised light. It aims to improve understanding of space weather and predict solar events impacting Earth and space missions.

Space for Notes:

Description:
Full Name: Polarimetry to Unify the Corona and Heliosphere (PUNCH)
Agency: NASA (launched via SpaceX)
Mission Type: Solar observation (study of solar corona & solar wind)
Mission Life: 2 years
Orbit: Low Earth Orbit (LEO)
Payload: Constellation of 4 satellites (~64 kg each)
- 3 Wide Field Imagers (WFI)
- 1 Narrow Field Imager

Imaging Frequency:
- Polarised images every 4 minutes
- Unpolarised images every 8 minutes

Objectives:
- First mission to use **polarisation of light** to map corona & solar wind in 3D.
- Understand solar corona and solar wind as a **single system**.
- Provide data for **space weather prediction** (CMEs, solar flares) to protect Earth and space assets.

Significance:
- Enhances understanding of **solar wind formation**.
- Helps in safeguarding satellites, astronauts, and robotic missions.
- Current solar phase: **Solar Maximum** (high activity).

AMCA

Why in News?
Russia has reaffirmed its support for India's AMCA programme, offering local production of Su-57 fifth-generation fighter jets. The announcement highlights deepening defence cooperation, joint development, and potential collaboration in next-generation technologies like radars and precision strike systems.

Description:
Full Name: Advanced Medium Combat Aircraft (AMCA)
Type: Indigenous fifth-generation multirole fighter jet
Mission Life/Prototype: Prototype expected by 2028-29
Agencies Involved:
- **Aeronautical Development Agency (ADA)** under DRDO (design & development)
- **Hindustan Aeronautics Limited (HAL)** (manufacturing)

Key Features:
- Twin-engine, 25-tonne aircraft
- Advanced stealth features (low radar & electromagnetic signature)
- Internal fuel tank (6.5-tonne) and weapons bay for indigenous armaments
- Engines:
  - **AMCA Mk1:** US-built GE414 (90 kN)
  - **AMCA Mk2:** Indigenous 110 kN engine under development with foreign collaboration
- Integrated Vehicle Health Management (IVHM) system for real-time monitoring

Significance:
- Enhances India's indigenous fighter capability; joins select nations with fifth-generation aircraft
- Higher utilisation time and reduced maintenance compared to older jets
- Strategic importance against China's J-20 deployment in Tibet
- Supports IAF modernization; initial requirement: 7 squadrons

Space for Notes:

James Webb Space Telescope (JWST)

Why in News?

Astronomers detected **phosphine** on brown dwarf **Wolf 1130C**, using the **James Webb Space Telescope**. Though not proof of life, the finding refines understanding of **phosphine's natural formation**, helping assess its reliability as a potential **biosignature** in the search for **extraterrestrial life**.

Description:

- **Type:** Infrared Space Observatory
- **Launch Date:** 25 December 2021
- **Orbit / Location:** Positioned at the **Second Lagrange Point (L2)**, ~1.5 million km from Earth
- **Primary Objective:**
  - Study the **early universe**
  - Observe **formation of stars and galaxies**
  - Analyse **exoplanet atmospheres**
- **Observation Spectrum:** Primarily **Infrared (IR)**, with some **visible light capability**
- **Major Instruments:**
  - **NIRCam:** Near Infrared Camera
  - **NIRSpec:** Near Infrared Spectrograph
  - **MIRI:** Mid-Infrared Instrument
  - **FGS/NIRISS:** Fine Guidance Sensor / Near InfraRed Imager and Slitless Spectrograph
- **Key Achievements / Findings:**
  - Detection of **phosphine (PH_3)** on brown dwarf **Wolf 1130C**
  - Observation of **early galaxies billions of light-years away**
  - **Characterization of exoplanet atmospheres**
- **Recent News (2025):** Detection of phosphine on Wolf 1130C helps refine models of **abiotic vs biotic chemical processes**, important for the **search for extraterrestrial life**

Acoustic Vehicle Alerting System (AVAS)

Why in News?

The Ministry of Road Transport and Highways has proposed mandatory **Acoustic Vehicle Alerting Systems (AVAS)** for all new electric cars, buses, and trucks from October 2026 and existing models from October 2027, to enhance pedestrian safety at low speeds (0–20 kmph).

Description:

Aspect	Details
Definition	**AVAS** is a device installed in electric and hybrid vehicles that produces **artificial sound cues** to alert pedestrians and improve road safety.
Need	EVs are nearly silent at low speeds (no IC engine noise) → Risk to pedestrians → Artificial sound alerts necessary.
Applicability	All **M & N category vehicles** (cars, buses, trucks, e-rickshaws, e-carts).
Timeline	- **New Models**: Compliance from **Oct 2026** - **Existing Models**: Compliance from **Oct 2027**

Activation Range	Automatically active at **0–20 km/h** (silent zone speed range).
Sound Design	Emits steady, low-volume **artificial tone** (not disturbing, just enough for awareness).
At Higher Speeds	Above **20 km/h**, tyre + aerodynamic noise is sufficient → **no AVAS required**.

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Anusandhan National Research Foundation (ANRF)

Why in News?

ANRF launched SARAL, an AI-based tool to simplify complex scientific research into layperson-friendly summaries, videos, podcasts, and presentations, promoting accessible science and supporting deep-tech innovation and research funding.

Description:

- **Established:** Under *ANRF Act, 2023*.
- **Replaced: Science and Engineering Research Board (SERB)** → merged into ANRF.
- **Objective:** To **seed, grow & foster a culture of research & innovation** across India.
- **Funding Target:** ₹50,000 crore (2023–2028).
- Linked with **NEP 2020** vision of research-oriented education.

Importance of ANRF:

1. **Economic Growth:** R&D boosts innovation & productivity → GDP growth.
2. **Technological Advancement:** New technologies & industrial efficiency.
3. **National Challenges:** Solves issues in health, agriculture, energy, climate.
4. **Global Competitiveness:** Improves India's rank in Global Innovation Index, Nature Index.
5. **Education & Skills:** Encourages interdisciplinary research & higher education quality.

SARAL tool:

- SARAL (Simplified and Automated Research Amplification and Learning) is an AI-powered tool developed by the ANRF.
- Purpose: To make complex scientific research papers more accessible to a wider audience by generating easy-to-understand summaries. It can create summaries in various formats, including videos, podcasts, and presentations.
- Developed in collaboration with: The International Institute of Information Technology, Hyderabad (IIITH), helped in launching the tool.

Venezuela–US Naval Build-up

Why in News?

The **United States** has deployed **seven naval vessels**, including a **nuclear-powered submarine**, near **Venezuelan and Central/South American waters**, marking one of the largest US naval deployments in the region in recent years.

Description:

- **Composition of Fleet:**
  - Includes **destroyers, cruisers, amphibious assault ship, and a submarine**.
  - Many equipped with **Tomahawk missiles**, capable of **land strikes**.
- **US Justification:**
  - Official reason: **Anti-drug trafficking operation**.
  - Accuses Venezuelan President **Nicolás Maduro** of **narco-trafficking** and being an "illegal" leader.

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- **Venezuela's Response:**
  - President **Maduro denounced it as aggression.**
  - Mobilised **~4.5 million militia members** for national defense.
  - Colombia signalled possible **support to Venezuela** if attacked.
- **Strategic Motives (Underlying):**
  - To **pressure the Maduro regime** and **reassert US influence** in Latin America.
  - **Geopolitical signalling** to **Russia and China**, who back Venezuela.
  - Possible **preparation for regime-change operations** under the guise of anti-narcotics missions.

Regional Impact:

- Escalates **tensions in Latin America**, reviving **Cold War-style divides.**
- Risks **military confrontation** and **regional instability.**
- Divides countries between **pro-US** and **pro-Venezuela** blocs.

Global Context:

- Illustrates how **drug trafficking narratives** are used for **geopolitical goals.**
- Part of US's **"Monroe Doctrine 2.0"** – reinforcing dominance in the Western Hemisphere.
- Adds strain to **US–Russia–China relations**, both supporting Maduro economically and militarily.

Tomahawk Missile

Why in News?

US President Donald Trump hinted at supplying long-range Tomahawk cruise missiles to Ukraine, raising escalation concerns with Russia. Tomahawks offer precise, long-range strike capability; delivery would require training, logistics and could significantly impact the conflict's dynamics politically.

Description:

About Tomahawk Missile:

- **Type:** Long-range, all-weather **subsonic cruise missile.**
- **Origin:** United States.
- **Developer: Raytheon Missiles & Defense** (a division of RTX Corporation).
- **Primary Users:** United States Navy and Royal Navy (UK).
- **Purpose:** Designed for **precise deep land-attack missions**, striking high-value and strategic fixed targets from sea platforms.
- **First Combat Use: Operation Desert Storm (1991)**; later used in **Iraq, Afghanistan, and Syria (2017).**

Key Features:

Parameter	Specification
Length	18.3 feet
Weight	3,200 pounds (≈ 4,400 with booster)
Warhead	1,000-pound conventional explosive or cluster munition
Range	Up to **2,400 km**
Speed	Around **885 km/h (subsonic)**
Launch Platforms	Ships and submarines (via Vertical Launch System – VLS)
Guidance System	GPS, Inertial Navigation, and Terrain Contour Matching (TERCOM)
Accuracy (CEP)	Within **10 meters**
Propulsion	Solid-propellant booster (launch phase) + turbofan engine (flight phase)
Unit Cost	Approx. **USD 2 million per missile**

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Salient Points:

- Capable of **terrain-hugging flight** at low altitudes to avoid radar detection.
- The **non-linear flight path** makes it hard to intercept by enemy air defences.
- Used primarily for **pre-emptive precision strikes** on strategic enemy infrastructure such as air defence, radar, and communication systems.
- **Infrared detection** is difficult due to low heat emission from the turbofan engine.

Strategic Importance:

- Enhances **U.S. Navy's stand-off strike capability** – allowing attacks without entering hostile airspace.
- **Geopolitical angle:** Supplying Tomahawks to Ukraine could mark a major escalation in Western military support against Russia.
- Reflects **technological advancement in precision strike warfare** and **long-range deterrence**.

India–Australia Defence and Security Cooperation

Why in News?

Defence Minister **Rajnath Singh** will visit **Australia on October 9–10** to sign a **Joint Declaration on Defence and Security Cooperation**. The visit aims to strengthen **Indo-Pacific stability**, enhance **maritime security collaboration**, and mark the **fifth anniversary of the India–Australia Comprehensive Strategic Partnership**.

Description:

Aim: To sign a new **Joint Declaration on Defence and Security Cooperation** and deepen strategic partnership.

Objectives of the Visit:

- Strengthen the **defence and security pillar** of the **Comprehensive Strategic Partnership (CSP)**.
- Enhance **Indo-Pacific stability** and **strategic autonomy** for both nations.
- Observe **live air-to-air refuelling** activities aboard an **RAAF KC-30A**.
- Finalise a **Maritime Security Road Map** for collaboration on **maritime domain awareness** in the Indian Ocean.

Key Highlights:

- **Joint Declaration:** Will set parameters for **future defence engagement** and cooperation.
- **Fifth Anniversary** of the **India–Australia CSP (2020–2025)**—marked by rapid expansion in defence, trade, education, and technology ties.
- **Defence engagements tripled**: from **11 (2014)** to **33 (2024)**.
- **Air-to-Air Refuelling Implementing Arrangement** – *India's first such pact with any country*, reflecting enhanced interoperability.
- **Australia's first Defence Trade Mission to India** currently visiting **Chennai and New Delhi**, focusing on **C5ISR** (Command, Control, Communications, Computers, Cyber-Defence, Intelligence, Surveillance & Reconnaissance).

Joint Military Engagements:

- **Exercises:**
  - *Talisman Sabre* – India participated for the first time (2025).
  - *Kakadu, Milan, Cope India,* and *Tarang Shakti* – continued cooperation.
  - *International Fleet Reviews* – planned participation.
- Growing **tri-service and logistics interoperability** under QUAD framework.

Strategic Importance:

- **Enhances Indo-Pacific security architecture** amid regional tensions.
- Promotes **defence co-production and technology exchange.**
- Strengthens **maritime domain awareness** in the Indian Ocean.
- Reflects **convergence of strategic interests** between India and Australia as **like-minded democracies.**

Space for Notes:

Exercise KONKAN-25 (2025) – India–UK Naval Exercise

Why in News?

India and the UK began their first-ever joint exercise between carrier strike groups—**Konkan-25**—off the **Western coast**, featuring **INS Vikrant** and **HMS Prince of Wales**, with participation from **Japan and Norway**, to strengthen Indo-Pacific security and India-UK strategic partnership.

Description:

- **Type:** Bilateral naval exercise between **Indian Navy** and **Royal Navy (UK).**
- **Started:** 2004; **traditionally biennial.**
- **2025 Edition Location:** Western Indian Ocean.
- **Highlight:** First-ever **joint Carrier Strike Group (CSG) exercise.**
- **Indian Ship: INS Vikrant** – India's first indigenously built aircraft carrier.
- **UK Ship: HMS Prince of Wales** – UK's Carrier Strike Group flagship.
- **Other Participants:** Japan and Norway (reflecting multilateral Indo-Pacific cooperation).
- **Linked Operation: Operation Highmast** – UK's 8-month global deployment.
- **Major Objectives:**
  - Enhance **maritime and air interoperability**
  - Conduct **anti-submarine warfare (ASW)** drills
  - Conduct **air defence exercises**
  - Carry out **cross-deck flying operations**
- **Strategic Significance:**
  - Strengthens **Free & Open Indo-Pacific vision**
  - Advances **India–UK Vision 2035 on defence & security**
  - Reinforces **rules-based international order**
- **Post-Exercise Plans:** Port calls at **Mumbai and Goa**, followed by **aerial defence drills with the Indian Air Force**

WILD POLIOVIRUS

Why in News?

Germany has detected **wild poliovirus** in **Hamburg wastewater**, marking **Europe's first such detection since 2010**. The strain is linked to Afghanistan. No infections are reported, and the risk remains low due to high vaccination coverage, highlighting effective sewage surveillance.

Description:

- Polio is a **highly infectious viral disease** caused by poliovirus.
- The virus **multiplies in the intestine**, from where it can enter the bloodstream and invade the **nervous system.**
- Can cause **irreversible paralysis**; once paralysis occurs, **no treatment** can reverse it.
- These naturally occurring polioviruses are called **Wild Polioviruses (WPV).**

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Variants (Types of Wild Poliovirus):

- **Type 1 (WPV1):**
  - *Only type still existing*
  - Ongoing global efforts for eradication
- **Type 2 (WPV2):** *Eradicated globally* (declared in 2015)
- **Type 3 (WPV3):** *Eradicated globally* (declared in 2019)

Transmission:

- Spread occurs **person-to-person**, mainly through:
  - **Faecal–oral route** (most common)
  - Contaminated **water or food** (common vehicle)
- Virus survives in **faeces** of infected persons.
- Poor hand hygiene after defecation is a key cause of spread.

Endemism:

- WPV (Type 1) is **endemic in only two countries**:
  - **Pakistan**
  - **Afghanistan**
- Detection of WPV1 **outside these countries** shows persistent risk of **international spread** until complete global eradication.

Symptoms:

Minor Symptoms (Non-paralytic Polio)- Tiredness, Nausea, Headache, Nasal congestion, Sore throat, cough, Stiffness in neck and back, Pain in arms and legs.

Major Symptom (Paralytic Polio):

- **Permanent paralysis** due to destruction of motor neurons
- Can be **fatal** if:
  - Respiratory muscles are paralysed
  - Brain infection occurs

Cure:

- **No cure** for polio once infected.
- **Prevention through vaccination** is the only protection:
  - **Oral Polio Vaccine (OPV)**
  - **Inactivated Polio Vaccine (IPV)**

ANTIMICROBIAL RESISTANCE (AMR)

Context:

NCDC (National Centre for Disease Control) rejected a *Lancet* study's claim that **over 50% of Indian patients undergoing ERCP are colonised with MDR organisms.**

Key Terms:

- **AMR (Antimicrobial Resistance):** When microorganisms become resistant to medicines.
- **MDRO (Multi-Drug-Resistant Organisms):** Bacteria resistant to multiple antibiotics.
- **ECRP:** Endoscopic Retrograde Cholangiopancreatography

Why AMR is Rising (India + Global)?

- Overuse & misuse of antibiotics.
- Patients not completing treatment.
- Antibiotic use in **livestock, poultry, aquaculture.**
- Poor infection control in hospitals.
- Lack of hygiene and sanitation.
- Few new antibiotics being developed.

Space for Notes:

How AMR Spreads:

- Drug residues in food-producing animals → resistant bacteria in human food chain.
- Hospital-acquired infections (HAIs).
- Poor hygiene → resistant strains spread to community.
- Over-prescribing antibiotics & OTC sales.

Impact of AMR:

- **1.27 million deaths (2019)** globally due to AMR.
- Expected **$1–3.4 trillion GDP loss** by 2030.
- Risk to medical procedures like organ transplantation, chemotherapy, ICU care.
- Longer hospitalisation & higher mortality.

India's Measures to Combat AMR:

- **National AMR Programme** – surveillance & containment.
- **National Action Plan on AMR** – One Health approach.
- **Schedule H1** – regulates antibiotic sales.
- **Red Line Campaign** – discourages OTC antibiotic use.
- **ICMR AMR Network** – lab-based surveillance of drug resistance.
- **Operation AMRITH (Kerala)** – steps against unauthorised antibiotic sales.
- India is part of the **Global AMR Surveillance System (GLASS). GLASS (2015):** WHO's Global Antimicrobial Resistance Surveillance System.

Note: NCDC is under **Ministry of Health & Family Welfare**. HQ: **New Delhi**. NCDC has 8 branches across India.

Ricin

Why in News?

Ricin is in news after the Gujarat ATS arrested three men, including a doctor, for allegedly attempting to manufacture the deadly toxin for a terror plot. The case highlights ricin's ease of extraction from castor beans and its high lethality.

Description:

- Naturally found in **castor beans** (*Ricinus communis*).
- Also produced from **waste material** left after castor-oil processing.

Physical Forms:

- Appears as: **Powder,Mist,Pellet,Liquid** (dissolved in water or weak acid)

Stability:

- **Stable** under normal environmental conditions.
- **Destroyed/inactivated** at temperatures **> 80°C**.

Toxicity:

- Highly toxic when:
  - **Inhaled**
  - **Ingested**
  - **Injected**
- Lethal dose: **5–10 micrograms per kg** body weight.

Mechanism of Action:

- Enters cells → **blocks protein synthesis**.
- Causes **cell death**, organ failure → can lead to **death**.

Why Dangerous?

- Easy to obtain from a widely grown **castor plant**.
- Powerful **biological weapon agent** (non-volatile, stable).

Space for Notes:

Accidental Exposure:

- Very rare.
- Mostly due to **chewing/swallowing castor seeds**.

Treatment:

- **No antidote**.
- Only **supportive medical care** to reduce damage.

Indian National Army (INA)

Why in News?

A new book *"The Forgotten Indian Prisoners of World War II"* by Gautam Hazarika claims that Subhas Chandra Bose did not found the Indian National Army (INA); it was initially formed by Japanese intelligence and Indian nationalists, later revived and led to prominence by Bose in 1943.

Description:

- Formed during **World War II (1942)** to fight **British rule in India**.
- **Captain Mohan Singh** (14th Punjab Regiment) – first commander; recruited Indian POWs captured by Japan.
- Supported by **Japanese Army Intelligence** (Major Fujiwara Iwaichi) & **Indian nationalists** like **Giani Pritam Singh**.
- **Rash Behari Bose** formed the **Indian Independence League (Tokyo, 1942)** and handed INA leadership to **Subhas Chandra Bose** in **July 1943**.
- Netaji reorganized it and announced the **Provisional Government of Free India (Azad Hind)** on **21 Oct 1943** in **Singapore**.

Key Campaigns:

- **"Chalo Delhi"** slogan; INA hoisted flag on Indian soil at **Moirang (Manipur)**.
- Campaign ended after **Japan's defeat (1945)** → INA collapse.

INA Trials (1945–46):

- Conducted at **Red Fort**, Delhi.
- Officers tried: **Shah Nawaz Khan, Prem Kumar Sehgal, Gurbaksh Singh Dhillon**.
- Sparked **nationwide protests**, uniting all political factions.
- Triggered **RIN Mutiny (1946)** → major factor in **British withdrawal**.

Legacy:

- Direct **armed challenge to British rule**.
- Fostered **nationalist unity** across religion & politics.
- Inspired **Indian armed forces' loyalty shift**.
- The slogan **"Jai Hind"** and **patriotic spirit** remain national symbols.

Traditional vs. New Interpretation:

Aspect	Traditional View	New (2025) Interpretation
Founder	Subhas Chandra Bose	Formed jointly by Japanese intelligence (Fujiwara Iwaichi) and Indian nationalists (Giani Pritam Singh)
First Commander	Subhas Chandra Bose	Captain Mohan Singh (1942)
Political Patron	Azad Hind Government (1943)	Indian Independence League (1942)
Role of Rash Behari Bose	Lesser-known	Bridged Mohan Singh's INA and Netaji's INA
Subhas Bose's Contribution	Founder and leader	Reviver, organiser, and global symbol of the INA

Space for Notes:

ESTIC 2025

Why in News?

PM addressed the **Emerging Science, Technology and Innovation Conclave (ESTIC) 2025)** at Bharat Mandapam, New Delhi — replacing the Indian Science Congress. (Nov 2025)

What is ESTIC 2025?

- A national platform aimed at shaping India's **Science, Technology & Innovation (STI)** ecosystem.
- Aligns scientific progress with the goal of **Viksit Bharat 2047**.
- Replaces **Indian Science Congress** (last held in 2023).

Key Focus Areas:

- High-risk, high-impact research funding
- **₹1 Lakh Crore RDI Fund** + ANRF for research boost
- Deep-tech innovation ecosystem expansion
- Science-led governance approach
- Democratization of AI (India AI Mission – ₹10,000 crore)

Indicators of India's STI Growth:

- R&D expenditure **doubled** in last decade
- Patents **17x increase**
- 3rd largest startup & deep-tech ecosystem globally
- Bio-economy rose from **$10B (2014) to $140B (2025)**

Major Domains Highlighted:

- Green Hydrogen
- Quantum Computing
- Deep Sea Research
- Critical Minerals
- Clean Energy Battery Tech

India's First Private PSLV Launch

Why in News / Context?

- A **HAL + L&T consortium** is manufacturing **PSLV** (Polar Satellite Launch Vehicle) launch vehicles under India's space-sector commercialisation model.
- The **first privately built PSLV** is expected to launch in **early 2026.**

Privatisation of India's Space Sector:

- Major **Space Sector Reforms: 2020** – opened satellite building, launch vehicle manufacturing, ground segments and space services to private players.
- Key institutions created:
  - **IN-SPACe – Indian National Space Promotion and Authorisation Centre:** authorisation & regulatory body.
  - **NSIL – NewSpace India Limited:** commercial arm handling production & launch contracts.
- Under these reforms, PSLV manufacturing was offered to industry for the first time.

PSLV vs SSLV:

Feature	PSLV	SSLV
Class	Medium-lift, four-stage launch vehicle	Small-lift, low-cost, quick-turnaround rocket
Configuration	Solid → Liquid → Solid → Liquid; strap-on boosters in some variants	Three solid stages + VTM for precise orbit

Payload Capability	~1,750 kg to 600 km SSO; ~1,400+ kg to Sub-GTO	~300 kg to 500 km LEO/SSO; 10–500 kg class missions
Strengths	Highly reliable, versatile; used for Chandrayaan, Mangalyaan, Cartosat, commercial rideshare	Rapid assembly, minimal infrastructure; ideal for dedicated small-satellite launches

SSLV: Small Satellite Launch Vehicle

- **SSO (Sun-Synchronous Orbit):** A near-polar orbit where a satellite passes over the same part of Earth at the same local solar time each day.
- **GTO (Geostationary Transfer Orbit):** An elliptical transfer orbit used to move satellites from LEO to their final geostationary orbit.
- **LEO (Low Earth Orbit):** A low-altitude orbit (approx. 160–2,000 km) ideal for Earth observation, communication, and small satellites.

Space for Notes:

India's Indigenous Gene Editing Tool (CRISPR-Cas9) for Cheaper Therapies

Why in News / Context?

- The **CSIR-IGIB** has developed an **indigenous CRISPR-Cas9 gene editing system.**
- It aims to provide low-**cost gene therapy** for genetic disorders such as **sickle cell disease**, with prices far lower than existing Western therapies like **Casgevy**.

About the Indigenous Gene Editing Tool:

- Developed completely in India by **CSIR-Institute of Genomics and Integrative Biology (IGIB).**
- Uses the **CRISPR-Cas9 mechanism**, like the Nobel Prize-winning technology.
- All patents are held by Indian scientists → **self-reliance in biotechnology.**

Name of the therapy: *BIRSA-101:*

- Named after **Birsa Munda,** as sickle cell disease is prevalent in tribal populations.

How CRISPR-Cas9 Works:

- CRISPR = **Clustered Regularly Interspaced Short Palindromic Repeats**
- Cas9 = **endonuclease enzyme** acting as **molecular scissors**
- Uses:
  - A **guide RNA (gRNA)** that binds to a specific DNA sequence.
  - The **Cas9 protein** cuts the DNA at that exact point.
- Once DNA is cut, the cell's natural repair mechanisms:
  - **Delete** defective sequences,
  - **Insert** corrected ones,
  - or **modify** problematic genes.

Indigenous vs Western Therapy:

- Western therapy example: **Casgevy**
  - Cost: **~USD 2.2 million** per patient
  - Targets blood stem cells to produce more fetal haemoglobin (HbF)
- Indian therapy:
  - Expected to cost **a small fraction** of the above
  - Designed using **indigenous CRISPR system (2016)** created by IGIB
- Indian system avoids expensive foreign IP licensing.

Target Disease: Sickle Cell Anaemia:

- Genetic condition causing:
  - **Crescent-shaped (sickle) RBCs**
  - Blockage in blood vessels
  - Severe pain, anaemia, organ damage, stroke
- India's large tribal population has high prevalence.

Space for Notes:

How BIRSA-101 works:

- Corrects the **defective gene** responsible for sickling.
- Aims to provide a **one-time curative therapy.**

What is "Off-targeting"?

- When CRISPR edits unintended regions of DNA besides the target sequence.
- Can cause harmful or unpredictable genetic changes.
- Minimizing off-target effects is a major challenge in gene editing.

Advantages of Indigenous CRISPR Platform:

- **Low cost**
- **Scalable manufacturing** through Serum Institute
- Reduces India's dependence on foreign biotech
- Enables gene therapy access for wider population
- Supports **Atmanirbhar Bharat** in advanced biotechnology.

NISAR Earth Observation Mission

Context:

The NASA–ISRO Synthetic Aperture Radar (NISAR) satellite, launched in July, has officially entered its **final science phase**, where it will begin regular science operations, data calibration, and global land monitoring.

What is NISAR?

- A joint **NASA–ISRO Earth observation satellite** using **dual-frequency SAR (L-band + S-band).**
- First satellite to combine these two radars **for global environmental monitoring.**
- Launched on **July 30, 2025**, aboard ISRO's **GSLV-F16** rocket from the Satish Dhawan Space Centre in **Sriharikota.**
- NISAR data will be made openly available for global scientific use.

Current Phase:

The science phase begins at the end of commissioning and continues until the end of the **5-year mission life.**

Key Features:

A. **Dual SAR Capability:**
   - **ISRO's S-band SAR**
   - **NASA's L-band SAR**

   This unique combination allows NISAR to penetrate vegetation and soil, providing high-resolution data on surface changes with centimetre-level accuracy, even under cloud cover or darkness.

B. **Satellite Specifications:**
   - 12-metre **antenna reflector** (one of the biggest radar antennas launched).
   - NISAR operates in a **Sun-synchronous orbit** at an altitude of approximately **743 km**, with a repeat cycle of **12 days**, enabling it to map the entire Earth's surface systematically.

Applications:

- Monitoring **earthquakes, volcanoes, landslides**
- Tracking **glacier and ice sheet dynamics**
- Agricultural yield estimation & soil moisture
- Measuring **forest biomass** → crucial for climate models
- Mapping **coastal changes, wetlands, flooding**
- Global carbon cycle & land-use change studies

Space for Notes:

Samudrayaan Mission

Context:

India's deep-sea manned mission **Samudrayaan** – aimed at sending a human-occupied submersible to **6,000 metres** – is facing delays due to the late arrival of **syntactic foam cladding** from France, which is essential for buoyancy and safe deep-sea operations.

Key Features of Samudrayaan:

A. Objective	B. Vehicle Specifications (MATSYA-6000)	C. Mission Architecture
Enable **manned exploration** of deep ocean for: • Mineral resources • Biodiversity studies • Geological & geophysical data • Sampling of soil and rocks	• **3-member crew capacity** • Titanium alloy sphere • Designed for **6,000 m depth** • Capable of staying submerged for **10–12 hours** • Life support for **96 hours** in emergencies	• Part of India's **Deep Ocean Mission** (MoES). • Collaboration mainly between **NIOT, ISRO materials teams**, and international partners (for critical components).

Syntactic Foam – Why It Matters?

- A composite material of **hollow glass microspheres + epoxy resin**. Essential **cladding** material for deep-sea submersibles.
- Provides **positive buoyancy** under extreme pressure at depths up to **600 bar** (pressure at ~6,000 m).
- Delay in procurement from France is postponing upcoming sea trials.

Additional Facts:

- Only a few countries operate manned submersibles at 6,000 m (USA, China, Japan, France).
- **MATSYA-6000:** Human Occupied Vehicle (HOV) designed by **NIOT, Chennai** for 6,000 m depth.

Key Terms:

- **Titanium Sphere:** Pressure-resistant crew module for human occupancy.
- **Polymetallic nodules:** Polymetallic nodules, also called manganese nodules, are mineral concretions on the sea bottom formed of concentric layers of iron and manganese hydroxides around a core.

SENTINEL-6B

Why in News?

Sentinel-6B, a joint NASA–NOAA–ESA ocean-monitoring satellite, was launched from Vandenberg to provide high-precision global sea-level data, improving weather, storm, and flood forecasting and strengthening coastal protection.

Description:

- Sentinel-6B is a **next-generation ocean-observing satellite** launched in **November 2025**.
- It is designed to provide **high-precision sea-level measurements**, continuing a 30-year global record of ocean altimetry.

Implementing Agencies:

Sentinel-6B is a **joint mission** involving:

- **NASA** (US)
- **NOAA** (US)
- **European Space Agency (ESA)**
- **EUMETSAT** (operations)
- **European Commission** (Copernicus Programme support)

This mission is part of the **Copernicus Earth Observation Programme** of the EU.

Launch Details:

- **Launch Site:** Vandenberg Space Force Base, California
- **Launch Date:** 17–18 November 2025
- **Orbit:** Low Earth Orbit (LEO), approx. 1,336 km altitude
- **Orbital Speed:** ~7.2 km/sec
- **Orbital Period:** ~112 minutes

Objectives:

Sentinel-6B's main scientific purposes:

1. **Measure global sea-level rise** with accuracy up to ~2.3 cm (1 inch).
2. **Monitor ocean temperature** and surface wind speed.
3. **Track climate change indicators** such as thermal expansion of oceans.
4. **Improve weather forecasting** and **storm/flood prediction.**
5. **Support maritime safety**, shipping routes, and protection of undersea cables.

Relation to Sentinel-6A (Michael Freilich):

- Sentinel-6B follows **Sentinel-6 Michael Freilich**, launched in **Nov 2020**.
- Together they provide **continuous sea-level records from the 1990s** (TOPEX/Poseidon → Jason-1 → Jason-2 → Jason-3 → Sentinel-6A/B).

Importance for Climate Studies:

- Oceans absorb **over 90% of excess global heat.**
- Sea-level rise is a **core climate-change indicator.**
- Sentinel-6B helps in **IPCC assessments**, long-term climate modelling, and coastal planning.

Space for Notes:

Multi-Lane Free Flow (MLFF) Tolling System

Why in News?

The government is reconsidering its **bank-centric bidding model** for the new **barrier-less Multi-Lane Free Flow (MLFF) tolling system**, after awarding eight of 25 projects. The system uses **RFID and ANPR** to collect tolls without barriers, prompting new rules to deter unpaid fees.

Description:

- A **barrier-less, stop-free tolling system** on highways.
- Uses:
  - **FASTag (RFID)**
  - **Vehicle Registration Number (VRN)**
  - **High-performance RFID readers**
  - **ANPR (Automatic Number Plate Recognition) cameras**

How It Works?

- Vehicles drive at normal speed →
- RFID + ANPR automatically identify vehicle + tag →
- Toll deducted digitally (no physical barrier or toll booth halt).

Space for Notes:

Significance:

- Removes congestion at toll plazas.
- Reduces travel time.
- Increases fuel efficiency; lowers emissions.
- Improves tolling efficiency & reduces revenue leakages.
- Helps create a **smarter highway network**.

First MLFF Project in India:

- Implemented by **ICICI Bank** at **Choryasi Fee Plaza**, Gujarat (NH-48).
- Agreement signed by **IHMCL**, promoted by **NHAI**.

About IHMCL:

- *Indian Highways Management Company Ltd.*
- Manages electronic tolling, FASTag, MLFF rollout.

About National Highways Authority of India:

- Statutory body under **Ministry of Road Transport & Highways**.
- Created under **NHAI Act, 1988**; operational since **1995**.
- Composition:
  - Chairman
  - ⩽ 5 full-time Members
  - 4 part-time Members (Secretaries of RT&H, Expenditure, Planning; DG Road Development)

Polar Satellite Launch Vehicle (PSLV)

Why in News?

ISRO Chairman announced that the **first PSLV developed entirely by a private** industry consortium led by HAL and L&T will be launched in February 2026, marking a major step in space sector privatisation, with nearly 80-85% systems sourced from Indian industry.

Description:

- ISRO's **3rd generation, expendable** launch vehicle.
- First Indian launch vehicle fitted with **liquid stages**.
- First successful operational launch – **1994**.

Orbit Capability:

- Designed mainly for **Earth Observation / Remote Sensing** satellites.
- Can launch satellites into:
  - **SSO (Sun Synchronous)** → Main (up to **1750 kg @ 600 km**)
  - LEO
  - Sub-GTO & small payloads into GTO

Major Achievements:

- Chandrayaan-1 (2008)
- Mars Orbiter Mission (2013)
- Astrosat
- Multi-satellite launch capability (record missions)

Called **"Workhorse of ISRO"** due to high reliability & successful streaks.

Stage	Type	Fuel
PS1	Solid	+ Strap-on boosters
PS2	Liquid	**Vikas Engine**
PS3	Solid	High thrust upper-atmospheric boost
PS4	Liquid	Final orbital injection (can restart multiple times)

PS4 used as POEM:

- POEM = PSLV Orbital Experimental Module
- Users spent the PS4 stage as a stabilized experiment platform.

PSLV Variants:

Variant	Strap-ons	Payload to SSPO (~600 km)
PSLV-CA (Core Alone)	None	~1019 kg
PSLV-G (Standard)	6	–
PSLV-XL	6 extra-large strap-ons	~1750 kg
PSLV-QL	4 strap-ons	~1523 kg
PSLV-DL	2 strap-ons	Used for dual satellite launches

Space for Notes:

GSAT-7R (CMS-03) Satellite – ISRO's Heaviest Communication Satellite

Why in News?

ISRO successfully launched **GSAT-7R (CMS-03)**, India's **heaviest communication satellite (≈4400 kg)**, on **2 November 2025** from the **Satish Dhawan Space Centre, Sriharikota**, aboard the **LVM3-M5** launch vehicle.

Description:

About GSAT-7R (CMS-03)

- A **military communication satellite** designed for the **Indian Navy**.
- Developed **indigenously** under the **Aatmanirbhar Bharat** initiative.
- Successor to **GSAT-7 (Rukmini)** and part of India's secure naval communication network.

Key Features:

- Multi-band communication capability supporting **voice, data, and video links**.
- Ensures **secure and robust connectivity** for **ships, submarines, aircraft, and Maritime Operations Centres**.
- Covers the **entire Indian Ocean Region (IOR)**, improving **maritime domain awareness**.
- Inserted into a **Geosynchronous Transfer Orbit (GTO)**, later circularised to a **Geostationary Orbit (GEO)** using onboard propulsion.
- **Heaviest communication satellite** ever launched from Indian soil.

Technical Highlights:

- **Launch Vehicle:** LVM3-M5 (Launch Vehicle Mark-3) – India's most powerful launcher.
- **Orbit Type:** Geosynchronous / Clarke Orbit (named after Arthur C. Clarke).
- **Function:** Provides continuous coverage over the same longitude, ideal for communication satellites.
- **Payload:** Indigenous transponders across multiple communication bands.

Strategic Importance:

- Strengthens **space-based maritime surveillance** and **real-time communication** for naval operations.
- Reduces **dependence on foreign launch vehicles** for heavy payloads.
- Demonstrates **self-reliance in satellite and launcher technology**.
- Supports **ISRO's Gaganyaan mission**, validating LVM3's heavy-lift capacity.

Significance for India:

- Boosts **defence communication capabilities**.
- Enhances **national security** through encrypted, reliable communication links.
- Reflects India's advancement in **space-based infrastructure** for military and strategic use.

BrahMos Missile Deal

Space for Notes:

Context / Why in News?

India and Indonesia made significant progress on a proposed **BrahMos supersonic cruise missile deal** during the 3rd India–Indonesia Defence Ministers' Dialogue. BrahMos continues to remain central to India's defence exports and strategic posture. Indonesia seeks the system for maritime security around **Natuna Islands**.

About BrahMos:

1. **Origin & Development:**
   - **Named after:** Brahmaputra (India) + Moskva (Russia).
   - **Joint Venture:** BrahMos Aerospace (DRDO 50.5%, NPOM 49.5%) established in 1998.
   - **First Test:** 12 June 2001 at Chandipur, Odisha.
   - Fully inducted in **Army, Navy & Air Force**.
   - **NPOM:** (NPO Mashinostroyeniya) **DRDO:** Defence Research and Development Organisation
2. **Nature of Missile:**
   - **Type:** Long-range nuclear-capable **supersonic cruise missile**.
   - **Speed:** Up to **Mach 3** (one of the world's fastest cruise missiles).
   - **Range:**
     - Original: ~290 km
     - Upgraded: **500 km (land attack), 400 km (ship attack).**
   - **Warhead:** 200–300 kg (conventional).
   - **Platforms:** Land, air, ship, and submarine launch capability.

NOTE: The range of BrahMos was originally capped at 290 km, in line with the limitations of the Missile Technology Control Regime (MTCR). However, since India joined the grouping in June 2016, the range was extended to 450 km, and work to extend it to 800 km is underway.

Variants: Land-Based, Ship-Based, Submarine-Launched, Air-Launched.

Next-Generation Systems:

BrahMos-NG: • **Speed:** Mach 3.5 • **Range:** 290 km • Lightweight; smaller RCS; multi-platform (including submarine torpedo tubes). • Designed for high manoeuvrability & stealth.
BrahMos-II (Hypersonic): • Hypersonic cruise missile (up to **Mach 7**). • Based partly on Russia's Tsirkon scramjet technology. • Intended for **Indian Navy** to counter Indo-Pacific threats.

Major **export potential**:

- First country: Philippines (2022 deal, $375 million).
- Talks with **12+ countries** including Indonesia, UAE, Egypt, Saudi Arabia.

Space for Notes:

INS Mahe

Context:

- **India's First Mahe-class Anti-Submarine Warfare (ASW) Shallow Watercraft** has been commissioned into the Indian Navy at the Naval Dockyard, Mumbai.
- Launched by **General Upendra Dwivedi**, Chief of the Army Staff – first time an **Army Chief** commissioned a naval warship.
- Marks growing **tri-service synergy** and India's indigenous defence capability.

Key Features of INS Mahe:

A. Classification & Role:
   - **Class:** Mahe-class ASW Shallow Watercraft.
   - **Primary role:**
     - Anti-submarine operations in **littoral (shallow coastal) waters.**
     - Coastal defence & surveillance.
     - Protection of India's maritime borders.
   - First vessel of a planned **8-vessel Mahe-class series.**

B. Indigenisation:
   - **Over 80% indigenous content.**
   - Designed and built by **Cochin Shipyard Limited (CSL).**

Capabilities & Systems:

- **Stealth features** → Motto: **"Silent Hunters".**
- Equipped with:
  - Advanced **sonar systems**
  - Modern **communication systems**
  - Sensors for detecting & tracking sub-surface threats
  - ASW weapons to **neutralise submarines**
- Built for **prolonged operations** in shallow waters.
- Integrates with coastal defence network, larger naval ships, submarines, and maritime aircraft.

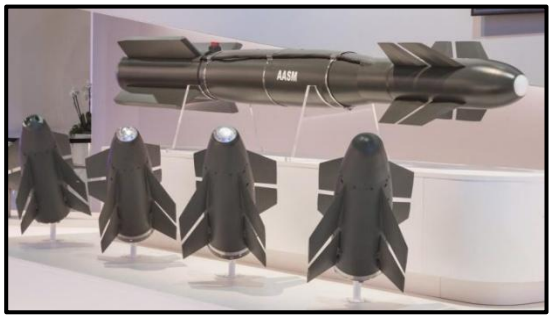
HAMMER air-to-surface missile

Context:

Bharat Electronics Limited (BEL) and France's Safran Electronics & Defence (SED) have signed a **Joint Venture Cooperation Agreement (JVCA)** to manufacture **HAMMER.**

What is HAMMER?

Highly Agile Modular Munition Extended Range (HAMMER):



- A **precision-guided, air-to-ground weapon system** developed by Safran (France).
- Categorised as a **smart glide bomb** with modular design, offering high accuracy.
- Already in service with **Rafale** aircraft; to be integrated with India's **LCA Tejas** as well. **High modularity:** Suitable for integration on multiple aircraft platforms.

Space for Notes:

Key Technical Features:

- **Range:** Up to **70 km.**
- **Payload Compatibility:** Can be fitted to **standard bombs** of **250 kg, 500 kg, 1000 kg.**
- **All-weather capability**
- **Low-altitude launch**
- **Jamming-resistant**
- **Penetration ability**

China's "Fujian" Aircraft Carrier

Why in News?

China has commissioned its third and most advanced aircraft carrier 'Fujian', equipped with electromagnetic catapults, making China the world's second-largest aircraft carrier fleet operator after the US.

Description:

Feature	Fujian
Commissioned	5 Nov 2025
Type	Conventionally powered
Special Feature	**Electromagnetic Catapult Launch System (EMALS)**
Status	1st fully designed & built in China
Displacement	~80,000+ tonnes
Aircraft Capacity	50+ aircraft

- Fujian is China's **first carrier** equipped with **EM catapults** (previous two used "ski-jump" ramps).
- With Fujian's induction, China becomes the 2nd **largest aircraft carrier fleet** operator after the USA.
- 1st carrier: **Liaoning** (refitted Soviet Kuznetsov-class)
- 2nd carrier: **Shandong** (China's 1st indigenously built but not fully indigenous designed)

Strategic Importance:

- Boosts China's **power projection** in the Indo-Pacific **/ Taiwan theatre.**
- Allows launch of heavier aircraft → more fuel + more missiles → higher strike radius.
- China is now developing a 4th **carrier** → likely **nuclear powered** (110,000 tonnes class, 100 aircraft).

Carrier	Type	Tech	Origin
Liaoning	Conventional	Ski-Jump	Soviet origin (refit)
Shandong	Conventional	Ski-Jump	China built (1st)
Fujian	Conventional	**EM Catapult**	Fully designed + built in China

Exercise Trishul (2025)

Why in News?

The tri-services exercise **Trishul 2025** began in Rajasthan, Gujarat, and the northern Arabian Sea, led by the **Indian Navy**, to enhance joint combat preparedness, interoperability, and network integration among the Army, Navy, and Air Force, focusing on cyber and electronic warfare.

Description:

- Exercise Trishul is a **tri-services military drill** conducted jointly by the **Indian Army, Navy, and Air Force** to test coordination across **land, sea, air, cyber, and space** domains.
- The exercise reflects India's strategic posture of **"JAI" — Jointness, Atmanirbharta, and Innovation.**

Codename:

Also referred to internally as **"Mahagurjar"**, the exercise focuses on enhancing **jointness**, validating **theatre logistics**, and reinforcing **multi-domain combat readiness**.

Schedule:

- **Date:** 30 October – 10 November 2025
- **Conducted by:** Ministry of Defence under the **Southern Command**
- **Nature:** Large-scale operational readiness and deterrence drill near India's western border.

Location:

Exercise Trishul spans diverse terrains —

- **Sir Creek sector (Gujarat)**
- **Rann of Kutch**
- **Desert zones of Rajasthan**
- **Saurashtra coast** for amphibious operations

It integrates **land manoeuvres**, **naval drills**, and **air operations** to simulate multi-domain warfare.

Participation:

- **Army:** Over 20,000 troops with T-90S and Arjun tanks, artillery, and howitzers.
- **Air Force:** Rafale and Su-30MKI fighters, IL-78 refuellers, transport aircraft, and UAVs.
- **Navy:** Frigates, destroyers, and amphibious assets deployed along Gujarat and Saurashtra coast.

Key Sub-Exercises:

1. **Agni Drishti:** Network-centric warfare and "sensor-to-shooter" integration.
2. **Trinetra:** Electromagnetic spectrum dominance, counter-drone warfare, and multi-domain sensing.
3. **Amphibious Landings:** Conducted off the Saurashtra coast to test maritime flexibility.

Purpose and Objectives:

- Test **tri-service synergy** under theatre command structures.
- Validate **theatre logistics and mobility** across large operational zones.
- Integrate **multi-domain warfare** (land, sea, air, cyber, and space).
- Demonstrate **Atmanirbharta** via indigenous systems and platforms.
- Strengthen **strategic deterrence** near sensitive borders (Sir Creek sector).

Space for Notes:

Indian Ocean Naval Symposium (IONS)

Why in News?

Over 55 countries, including the US and Russia, will participate in the Indian Navy's biennial maritime exercise **Milan** in February 2026 at Visakhapatnam, alongside the **International Fleet Review (IFR) 2026** and **Indian Ocean Naval Symposium (IONS)**, where India assumes chairmanship (2025–27).

Space for Notes:

About IONS:

- **Initiative:** Voluntary maritime cooperation forum among navies of Indian Ocean littoral states.
- **Objective:** Promote regional maritime security, cooperation, and dialogue on common maritime issues.
- **Conceived by:** Indian Navy in **2008**.
- **Inaugural Edition: New Delhi, February 2008**, with India as the first Chair (2008–2010).
- **Nature:** Open, inclusive, and non-binding forum for exchange of views on maritime challenges.

Member Composition:

- **Total Littoral States:** 36
- **Grouped into Four Sub-Regions:**
  1. **South Asian Littorals:** Bangladesh, India, Maldives, Pakistan, Seychelles, Sri Lanka, United Kingdom (BIOT)
  2. **West Asian Littorals:** Iran, Oman, Saudi Arabia, UAE
  3. **East African Littorals:** France (Réunion), Kenya, Mauritius, Mozambique, South Africa, Tanzania
  4. **Southeast Asian & Australian Littorals:** Australia, Indonesia, Malaysia, Myanmar, Singapore, Thailand, Timor-Leste
- **Observers:** China, Germany, Italy, Japan, Madagascar, Netherlands, Russia, Spain

Significance:

- Enhances **naval diplomacy** and **regional maritime cooperation**.
- Strengthens **freedom of navigation** and **collective maritime security** in the Indian Ocean Region (IOR).
- India to assume **Chairmanship (2025–27)** during the **IONS Conclave of Chiefs** at **Visakhapatnam**, alongside **Exercise MILAN 2026** and **IFR 2026**.

Milan Exercise:

It is a **biennial multilateral naval exercise** hosted by the **Indian Navy** since **1995**, aimed at enhancing **interoperability, maritime cooperation, and mutual understanding** among navies of the **Indian Ocean and Indo-Pacific regions**.

India's Malaria Elimination Goal (2030)

Context:

India's progress towards **eliminating malaria by 2030** faces a renewed challenge due to the spread of the **invasive urban mosquito *Anopheles stephensi***, as highlighted in the **"Malaria Elimination: Technical Report, 2025"** released by the **Health Ministry**.

About *Anopheles stephensi:*

- **Type**: Malaria vector mosquito (invasive in India)
- **Special adaptation**: Thrives in **urban environments**
- **Breeding sites**: Artificial water containers (overhead tanks, tyres, construction sites)
- **Disease transmission**: *Plasmodium falciparum, Plasmodium vivax* (protozoan parasites that cause malaria)
- **Public health concern**: Anopheles stephensi is unique because it urbanises malaria, unlike other vectors that are predominantly rural or forest based.

Space for Notes:

Malaria Vectors in India:

- Primary malaria vectors in India: Anopheles culicifacies, Anopheles fluviatilis, Anopheles stephensi, Anopheles minimus, Anopheles baimaii, Anopheles sundaicus.
- Anopheles culicifacies is the most dominant vector, causing 60–70% of malaria cases and 75–80% of total burden, mainly in rural and peri-urban areas.
- Anopheles fluviatilis is significant in hilly and forested regions (~15% cases), while Anopheles stephensi is the primary urban vector (~12% cases).

India's Malaria Elimination Targets:

- Zero indigenous malaria cases by: **2027**
- Complete elimination by: **2030**

Key initiatives of India:

- **Strategic Roadmap:** Implementation of the **National Strategic Plan (2023–2027)** to achieve zero indigenous cases by 2027 and total elimination by 2030.
- **Surveillance:** Scaling the **"Test, Treat, Track"** model using Rapid Diagnostic Tests (RDTs) and real-time digital monitoring via the **Integrated Health Information Platform (IHIP)**.
- **Vector Control:** Mass distribution of **Long-Lasting Insecticidal Nets (LLINs)** and targeted **Indoor Residual Spraying (IRS)** in high-burden tribal and forested areas.
- **Grassroots Integration:** Utilizing **Ayushman Arogya Mandirs** and ASHA workers to provide diagnosis and treatment within the **Ayushman Bharat** ecosystem.

Vaccines:

- **Malaria Vaccines: RTS, S/AS01 vaccine** (WHO approved first vaccine in 2021), **R21/Matrix-M** (WHO approved second vaccine in 2023).

Operation Sagar Bandhu

Context:

In December 2025, India announced a **$450 million relief and reconstruction package** for Sri Lanka following the devastation caused by **Cyclone Ditwah**, reaffirming India's **Neighbourhood First Policy** and **First Responder role** in the Indian Ocean Region (IOR).

Operation Sagar Bandhu:

- Launched to address the devastation caused by **Cyclone Ditwah.**
- **Impact of Cyclone Ditwah:** Claimed over 640 lives, destroyed hundreds of buildings, and displaced approximately 200,000 people.
- **India's Financial Pledge:** A $450 million reconstruction package.
- **Infrastructure:** Restoration of road, railway, and bridge connectivity; reconstruction of fully and partially damaged houses.
- **Sectors:** Support for health, education, and agriculture (addressing potential food shortages).

Strategic & Diplomatic Significance:

- Reinforces India's **Neighbourhood First** and **SAGAR doctrine** (Security and Growth for All in the Region).
- **"First Responder":** India's role in the region under its **"Neighbourhood First"** policy.

Cyclone Ditwah:

- Cyclone Ditwah, located off Tamil Nadu and Puducherry, weakened into a deep depression.
- The name "Ditwah" means "lagoon" and was suggested by Yemen. It specifically refers to the Detwah Lagoon on Socotra Island, Yemen.

Space for Notes:

IN-SPACe & Antariksh Prayogshala (Space Labs)

Why in News?

IN-SPACe has invited proposals to establish **Antariksh Prayogshala (Space Labs)** across select academic institutions in India to strengthen the space technology ecosystem.

About IN-SPACe:

- Indian National Space Promotion and Authorization Center (IN-SPACe) is **a single-window, independent, nodal agency that functions as an autonomous agency** in the **Department of Space (DOS).**
- It is formed following the Space sector reforms to enable and facilitate the participation of private players.

Mandate & Functions:

- Promote, enable, authorize and supervise space activities of **Non-Governmental Entities (NGEs)**
- **Key responsibilities:**
  - Authorization of launch vehicles & satellites
  - Facilitation of space-based services
  - Sharing of space infrastructure under **DoS/ISRO**
  - Establishment of new space infrastructure and facilities
- The agency acts as an interface between ISRO and NGEs and assesses how to utilize India's space resources better and increase space-based activities.
- It also assesses the needs and demands of private players, including educational and research institutions, and explores ways to accommodate these requirements in consultation with ISRO.
- **Three Directorates viz.,** Promotion Directorate (PD), Technical Directorate (TD) and Program Management and Authorization Directorate (PMAD) are carrying out the functions of IN-SPACe.

Thalassemia

Why in News?

Children suffering from **thalassemia** in Madhya Pradesh were reported **HIV-positive** after repeated blood transfusions, raising concerns about **blood safety**.

What is Thalassemia?

- **Thalassemia** is a **genetic blood disease**. It affects the body's ability to make **normal haemoglobin**
- Due to this, the blood cannot carry enough oxygen which results in **long-term anaemia**

How does it occur?

- Passed **from parents to children**
- It is **not contagious**
- A child gets the disease **only if both parents are carriers**

Types of Thalassemia:

- **Alpha Thalassemia** – problem in alpha globin chains
- **Beta Thalassemia** – problem in beta globin chains
  - **Thalassemia Minor**: mild, usually no symptoms
  - **Thalassemia Major**: severe, needs regular blood transfusions

Space for Notes:

Common Symptoms:

- Severe anaemia
- Tiredness and weakness
- Poor growth in children
- Pale skin
- Enlarged spleen
- Bone changes (in severe cases)

Diagnosis:

- Blood tests (low haemoglobin)
- **Haemoglobin electrophoresis**
- Genetic tests (confirmatory)

Treatment:

- **Regular blood transfusions** (especially in thalassemia major)
- **Iron chelation therapy** to remove excess iron
- **Bone marrow / stem cell transplant** – only permanent cure (limited cases)

Prevention:

- **Carrier testing before marriage**
- **Testing during pregnancy**
- **Genetic counselling**

Why Blood Safety is Important:

- Repeated transfusions can lead to infections like: **HIV**, Hepatitis B and C (From Donor)
- Blood screening and donor tracking are guided by **National AIDS Control Organization (NACO)**

Project Suncatcher (Google)

Context:

Google CEO **Sundar Pichai** announced **Project Suncatcher**, a long-term moonshot initiative to explore the feasibility of **solar-powered data centres in space**, with prototype satellites planned by **2027**.

Project Suncatcher: Google's Space-Based AI Initiative:

Aspect	Details
Associated With	**Google LLC** (Initiative announced by CEO Sundar Pichai)
Primary Aim	**Sustainability & Scalability:** To process massive AI workloads in space by using **continuous solar power** and avoiding the energy, water, and land constraints of terrestrial data centers.
Nature of Project	**Research Moonshot:** A long-term, high-risk, high-reward initiative to explore building scalable **AI compute systems in space** (Space-Based Data Centers).
Core Components	1. **Solar-Powered Satellites:** Planned constellation, likely in a **dawn-dusk Sun-Synchronous Low Earth Orbit (LEO)** for near-continuous solar exposure. 2. **AI Hardware:** Satellites equipped with Google's custom-designed AI accelerators, the **Tensor Processing Units (TPUs)** (specifically the Trillium v6e generation). 3. **Communication:** Satellites linked using **Free-Space Optical (FSO) Links** (laser beams) for high-speed, low-latency inter-satellite and space-to-Earth data transfer (aiming for tens of Terabits per second).

Environmental Advantage	Solar panels in LEO can be up to **8 times more productive** than on Earth due to less atmospheric attenuation and near-constant sunlight.
Development Status	Planning to launch **two prototype satellites** by **early 2027** in partnership with **Planet Labs** to test hardware durability and communications in space.

Space for Notes:

MahaCrimeOS AI

Context:

Maharashtra Police has rolled out *MahaCrimeOS AI*, an AI-powered investigation platform developed with Microsoft under the *MARVEL* initiative, to enhance crime detection and investigation efficiency across the state.

About MahaCrimeOS AI:

- AI-powered **investigation support system** developed jointly by **Government of Maharashtra + Microsoft**.
- Built using **Microsoft Foundry** and adapted to Maharashtra Police protocols.
- Configured in **Marathi** for ease of adoption by police personnel.
- Deployed across **all police stations in Maharashtra (~11,100)**.

Genesis & Institutional Framework:

- Part of the **MARVEL initiative (2024)** aimed at integrating advanced technologies into policing. (*Maharashtra Research and Vigilance for Enhanced Law Enforcement)*
- Supported by **three AI Centres of Excellence** in the state.

Aditya-L1 Mission

Context:

Aditya-L1, India's first solar observatory mission, played a **major global role** in explaining why the **May 2024 solar storm (Gannon's storm)** behaved unusually.

About Aditya-L1:

1. **Mission Type & Objective:**
   - India's **first dedicated solar mission**.
   - Developed by **ISRO**.
   - Main objective: Continuous observation of the **Sun's corona**, **solar wind**, **solar flares**, **Coronal Mass Ejections (CMEs)**, and **space weather**.
   - Helps predict geomagnetic storms that impact satellites, communication networks, navigation, and power grids.

   NOTE: A **Coronal Mass Ejection (CME)** is a massive burst of solar wind, magnetic fields, and solar plasma that is violently expelled from the Sun's outermost atmosphere (the corona) into space.
2. **Orbit & Placement – Lagrange Point L1:**
   - Positioned at **Sun–Earth L1 point**, **~1.5 million km** from Earth.
   - **Why L1?**
     - An uninterrupted view of the Sun (no eclipses).
     - Ability to detect solar activity **60–90 minutes before it affects Earth**.
     - Stable environment requiring minimal fuel as it balances the gravitational pull of the Sun and Earth against the centrifugal force of the satellite's motion.

3. Scientific Payloads (Seven Instruments):

To observe the Sun:	To study space environment around L1:
1. **VELC** – Visible Emission Line Coronagraph (studies corona; key instrument). 2. **SUIT** – Solar Ultraviolet Imaging Telescope (UV images of photosphere and chromosphere). 3. **SoLEXS** – Solar Low Energy X-ray Spectrometer (solar soft X-rays). 4. **HEL1OS** – High Energy L1 Orbiting X-ray Spectrometer.	1. **ASPEX** – Aditya Solar wind Particle Experiment (solar wind ions/electrons). 2. **PAPA** – Plasma Analyser Package for Aditya. 3. **MAG** – Magnetometer (precise magnetic field measurements; critical in 2024 storm analysis). 4. In the news: **MAG data** helped detect the unprecedented magnetic reconnection region in the 2024 solar storm.

Space for Notes:

KAVACH – Railway Safety System

Why in News?

Union Railway Minister **Ashwini Vaishnaw** informed Parliament that **Kavach**, the indigenous anti-collision system, has been commissioned on **over 2,000 km** of the **Indian Railways** network.

What is Kavach?

- **Kavach** is an **indigenous Automatic Train Protection (ATP) system**
- Designed to **prevent accidents caused by human error**
- Automatically **applies brakes** when unsafe conditions arise

What Kavach Prevents:

- Train-to-train **collisions**
- **Overspeeding**
- **Signal Passing at Danger (SPAD)**

How Kavach Works:

- Continuous communication between:
  - **Locomotive (onboard system)**
  - **Track-side equipment**
  - **Signalling system**
- Uses **radio communication and GPS assistance**
- If the driver fails to act, **system intervenes automatically**

Key Facts:

- Works in **all weather conditions** (fog, rain, night)
- Requires **Optical Fibre Cable (OFC)** along tracks
- Installed on **both locomotives and track-side infrastructure**
- **Does NOT replace** drivers or signalling system
- Prevents **consequential accidents**, not derailments due to track failure

Impact:

- Railway accidents reduced by **~90%**
- Rollout is **phased** due to cost and infrastructure needs
- Focus on **high-density and high-risk routes**

Space for Notes:

Stubble Burning

Context:

iForest's analysis shows that using **fire counts alone** significantly underestimates the extent of stubble burning. Government-reported sharp declines in Punjab and Haryana contrast with satellite-measured **burnt area**, which shows only a modest reduction.

Key terms:

- **Polar-orbiting satellite** – passes over a location intermittently (e.g., every few days); examples: Sentinel (MSI), Suomi-NPP (VIIRS), Terra/Aqua (MODIS).
- **Geostationary satellite (SEVIRI)** - Spinning Enhanced Visible and Infrared Imager -stays fixed over one longitude and provides high-frequency observations (minutes), useful for diurnal timing.
- **VIIRS & MODIS** – sensors widely used for active-fire and burnt-area products; differ in spatial resolution and detection capabilities. VIIRS (Visible Infrared Imaging Radiometer Suite). MODIS (Moderate Resolution Imaging Spectroradiometer)

CREAMS (Consortium for Research on Agroecosystem Monitoring and Modelling from Space):

- **Type:** An **Indian research consortium** providing satellite-derived agroecosystem and fire-related data.
- **Institutions Involved:** Primarily **Indian Agricultural Research Institute (IARI)** and partner institutions.
- **Role:**
  - Supplies India's **official fire-count datasets** used by the Environment Ministry.
  - Uses NASA's **MODIS** and **VIIRS** data for monitoring crop-residue burning and agroecosystem changes.
- **Importance:** Forms the backbone of India's **official stubble-burning statistics**, though limited by active-fire detection constraints.

Sanchar Saathi App

Context:

- The **Department of Telecommunications (DoT)** has directed smartphone manufacturers to pre-install the Sanchar Saathi app on all devices sold from March 2026.
- The app must be non-deletable, raising privacy and market-freedom concerns among companies.

Key Terms:

- **Sanchar Saathi:** DoT's citizen-centric telecom security platform (launched 2023).
- **CEIR (Central Equipment Identity Register):** Database for blocking stolen/lost phones.
- **SIM Binding:** Linking a SIM to a verified device/IMEI to prevent misuse.

Features of the Directive:

1. All new smartphones must come with the Sanchar Saathi app pre-installed.
2. For existing models in the market, app installation must come via OS updates.
3. App functionalities cannot be disabled or restricted by OEMs.
4. OEMs are given 3 months to comply with.

Space for Notes:

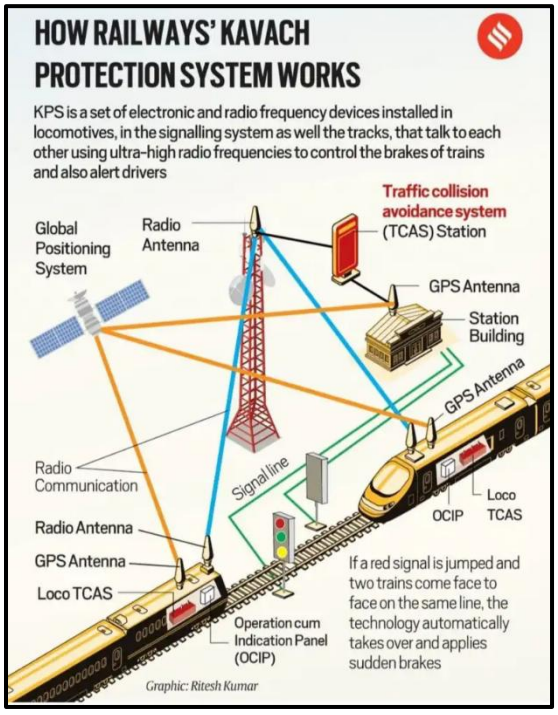
Functions of Sanchar Saathi:

1. Report lost/stolen mobiles, block IMEI, track recovery.
2. Verify authenticity of IMEI used in devices → curb counterfeit/illegal handsets.
3. Identify connections obtained using spoofed/tampered IDs.
4. Receive alerts on fraudulent telecom activity, scam calls.
5. CEIR integration → Govt says 50,000 lost/stolen phones recovered per month.

MH-60R Seahawk Helicopter – Indian Navy

Why in News?

- **Indian Navy commissioned its 2nd MH-60R Seahawk helicopter squadron (INAS 335) at INS Hansa, Goa, to strengthen anti-submarine warfare and blue-water naval capabilities.**
- **Squadron: INAS 335** (nickname: *Ospreys*)
- **Location: INS Hansa**, Goa
- **Aircraft: MH-60R Seahawk**
  - US-origin, multi-role naval helicopter
  - Developed by **Sikorsky / Lockheed Martin**
  - Indian variant of the US Navy's Seahawk
- **Primary Role: Anti-Submarine Warfare (ASW)**
- **Other Roles:**
  - Anti-surface warfare
  - Maritime surveillance & reconnaissance
  - Search and Rescue (SAR)
  - Medical evacuation
  - Naval logistics & vertical replenishment
- **Key Capabilities:**
  - Advanced mission system integrating multiple sensors
  - Uses **sonar, sonobuoys and torpedoes** to detect submarines
  - Can be armed with **torpedoes, anti-ship missiles, rockets and guns**
  - Operates from **aircraft carriers, warships and shore bases**
- **Strategic Significance:**
  - Enhances **blue-water naval operations**
  - Improves **undersea domain awareness**
  - Can counter **conventional and asymmetric maritime threats**
- **Procurement Facts:**
  - **24 MH-60R helicopters** acquired from the US
  - Cost: **~₹15,000 crore**
  - Replacing ageing **Sea King helicopters**
  - Includes **five-year sustainment package** (spares, repairs, technical support)



Space for Notes:

INS Vagsheer

Context:

In **December 2025**, the President of India undertook a **submarine sortie onboard INS Vagsheer**, highlighting India's **indigenous submarine capability** and the strategic importance of the **submarine arm** in India's maritime security architecture.

About INS Vagsheer:

- **Identity:** It is the **sixth and final** submarine of the **P75 Scorpene project**.
- **Origin:** It is an **indigenously built** frontline submarine.
- **Commissioning:** It was commissioned into the Indian Navy in **January 2025**.
- **Class:** It belongs to the **Kalvari class** of submarines.

Background: Project-75 (P75):

Feature	Details
Description	Construction of six Scorpene-class attack submarines.
Technology Transfer	Built by **Mazagon Dock Shipbuilders Limited (MDL)** in collaboration with **Naval Group (France)**.
Type	Diesel-electric attack submarines (SSK).
The Six Submarines	1. INS Kalvari, 2. INS Khanderi, 3. INS Karanj, 4. INS Vela, 5. INS Vagir, **6. INS Vagsheer**.
Capabilities	Anti-surface warfare, anti-submarine warfare, intelligence gathering, mine laying, and area surveillance.

Strategic Importance:

- **Atmanirbhar Bharat:** The submarine is cited as a "shining example of the Indian Navy's professional excellence" and indigenous manufacturing capabilities.
- **Maritime Strategy:** The submarine arm is pivotal to India's maritime strategy and safeguarding national interests on the Western Seaboard and beyond.

ANJADIP

Context:

The **Indian Navy** has inducted **Anjadip**, the **third of eight Anti-Submarine Warfare Shallow Water Craft (ASW-SWC)**, strengthening near-shore anti-submarine and coastal security capabilities under *Aatmanirbhar Bharat*.

About Anjadip:

- **Type**: Anti-Submarine Warfare – Shallow Water Craft
- **Builder**: Garden Reach Shipbuilders and Engineers (GRSE), Kolkata
- **Naming**: After **Anjadip Island** (off Karwar, Karnataka); also recalls the decommissioned **INS Anjadip** (Petya-class corvette)

Operational Capabilities:

Designed for coastal anti-submarine operations, **Low-Intensity Maritime Operations (LIMO)**, and **mine-laying** in littoral waters.

Key Technical Features:

- **Propulsion:** They are the largest Indian naval warships propelled by **waterjets**.
- **Indigenization:** Features over **80% indigenous content**, supporting *Aatmanirbhar Bharat*.
- **Armament:** Equipped with lightweight torpedoes, indigenous anti-submarine rockets, and **shallow water sonar**.

Space for Notes:

Project & Implementation:

- Execution Model: **Public–Private Partnership (PPP).** GRSE + **L&T Shipyard, Kattupalli**

Strategic Significance:

- Enhances **near-shore ASW**—a critical gap area versus conventional blue-water ASW platforms

Advanced Chemistry Cell (ACC)

Context:

India's ACC Production Linked Incentive (PLI) Scheme, aimed at building **next-generation battery manufacturing capacity**, is facing implementation hurdles, threatening the target of achieving **50 GWh domestic capacity by 2026**.

Objective: To **reduce India's dependence on imported batteries**, create a domestic battery manufacturing ecosystem, and accelerate EV and energy storage adoption.

Ministry: Ministry of Heavy Industries (MHI)

Launch Year: October 2021

Scheme Type: Central Sector Scheme. Production Linked Incentive (PLI) based on output and localisation

Target Beneficiaries:

- Battery cell manufacturers
- EV and energy storage ecosystem (indirect beneficiaries)

Key Features:

- **Technology focus:** Advanced Chemistry Cells (non-lead-acid; e.g., lithium-ion)
- **Total outlay:** ₹18,100 crore
- **Target capacity:** 50 GWh of ACC manufacturing
- **Minimum investment requirement:** ₹1,100 crore per selected firm
- **Incentive ceiling:** ₹2,000 per kWh
- **Localisation mandate:**
  - 25% domestic value addition within **2 years**
  - 60% domestic value addition within **5 years**
- **Selection mechanism:** Competitive global auction

Coconut Root Wilt Disease

Context:

Coconut root wilt disease has severely affected coconut-growing regions of **Kerala, Tamil Nadu, and Karnataka**, which together contribute **~82–83% of India's coconut production**. The disease is linked to **phytoplasma infection** and is spreading under climate stress and vector pressure.

About Coconut Root Wilt Disease:

- **Non-fatal but debilitating disease** (Causing a loss of energy or strength). Caused by **Phytoplasma** a wall-less, obligate **parasitic bacteria-like** organisms that infect plant phloem
- Causes **gradual decline in productivity**
- Coconut palm becomes unproductive, weak, deformed in appearance
- First reported in **Erattupetta (Kerala)** over a century ago

Space for Notes:

Mode of Spread:

- **Insect vectors** (sap-sucking insects, e.g., leafhoppers/planthoppers)
- Assisted by wind movement, continuous coconut plantations

Symptoms:

- Wilting and flaccidity of leaves, yellowing, reduced nut yield, distorted Crown
- Symptoms appear **after long incubation period**

Aggravating Factors:

- **Climate change-induced stress** erratic rainfall & temperature extremes
- Increased **vector population**
- Replacement of coconut with **intercropping systems** (cocoa, nutmeg) increasing stress
- Fragmented and inadequate field-level interventions

Institutional Efforts:

- **CPCRI (Central Plantation Crops Research Institute)** – Kasaragod
- Released **1 resistant & 3 tolerant coconut varieties**
- Other institutions involved are Tamil Nadu Agricultural University, Coconut Development Board (CDB) - Kochi

Coconut:

Coconut thrives in **humid tropical climates**, mainly coastal areas, requiring **20–32°C temperature**, **~1000 mm rainfall**, **ample sunlight**, and grows best in **red sandy loam, laterite, and alluvial soils**; **India is the world's 3rd largest coconut producer (2021–22)** with major producers being **Kerala, Karnataka, and Tamil Nadu**.

Guillain-Barré Syndrome (GBS)

Context:

Recent reports from **Madhya Pradesh (Neemuch district)** indicate multiple cases and deaths linked to **Guillain-Barré Syndrome (GBS)**, prompting public health response and outbreak investigation.

Key Terms:

- **Autoimmune Disorder:** Immune system attacks the body's own tissues
- **Peripheral Nervous System (PNS):** Nerves outside the brain and spinal cord
- **Ascending Paralysis:** Weakness starting in legs and moving upward

About Guillain-Barré Syndrome:

- **Rare neurological disorder**
- Immune system **attacks peripheral nerves**
- Often **triggered after an infection**, not caused by infection itself
- Considered a **medical emergency**

Cause & Trigger	Pathophysiology
• Exact cause **unknown** • Often preceded by infections • **Viral:** Influenza, COVID-19 • **Bacterial:** *Campylobacter jejuni* • Rarely after surgery or vaccination • Not contagious • Not water-borne	• Autoimmune immune response • Damage to **peripheral nerves** • Affects: – Myelin sheath (demyelinating type) **or** – Axons of peripheral nerves • Results in **impaired nerve signal transmission**

Key Clinical Features	Diagnosis
• Progressive muscle weakness • Tingling / numbness in limbs • **Ascending paralysis** • Loss of reflexes • **Severe cases:** – Breathing difficulty – Autonomic dysfunction – Can be fatal without treatment	• Clinical presentation • Nerve conduction studies • Cerebrospinal Fluid (CSF) findings: – **Albuminocytologic dissociation** – High protein with normal cell count

Treatment:

- No definitive cure
- Supportive and immunomodulatory therapy: **Intravenous Immunoglobulin (IVIG), Plasmapheresis**
- Early treatment improves outcomes

BIOMATERIALS

Context:

As countries aim to reduce dependence on fossil-fuel–based imports and meet climate goals, biomaterials are emerging as a key pillar of sustainable manufacturing and the bioeconomy.

What are Biomaterials?

These are materials produced from **renewable biological feedstocks** such as crops, agricultural residues, or microorganisms, designed to substitute conventional fossil-derived materials in industrial applications.

Classification:

1. **Based on Compatibility with Existing Systems:**
   - **Drop-in biomaterials** such as **Bio-PET (bio-based Polyethylene Terephthalate)** and **Bio-PE (bio-based Polyethylene)** are chemically similar to conventional plastics and can be used within existing manufacturing and recycling systems.
   - **Non-drop-in biomaterials** like **PLA (Polylactic Acid)** and **PHA (Polyhydroxyalkanoates)** have different chemical properties and therefore require separate processing and dedicated composting or disposal infrastructure.
2. **Based on Use:** Packaging, Textiles and fibres, Construction materials, Agricultural inputs, Industrial chemicals

Why Biomaterials Matter?

- **Import substitution**: Reduces fossil-fuel and petrochemical imports.
- **Climate mitigation**: Lower lifecycle greenhouse-gas emissions.
- **Waste utilisation**: Converts agricultural and biomass residues into value-added products.
- **Rural income diversification**: New markets for farmers and bio-feedstock suppliers.
- **Industrial competitiveness**: Supports sustainable manufacturing.

India's Biomaterials Sector is still dependent on **foreign technology** for large-scale conversion of feedstocks into market-ready products.

Significance:

Biomaterials can simultaneously address **energy security, environmental sustainability, industrial growth, and rural livelihoods**, positioning them as a strategic pillar of India's green transition.

Space for Notes:

Space for Notes:

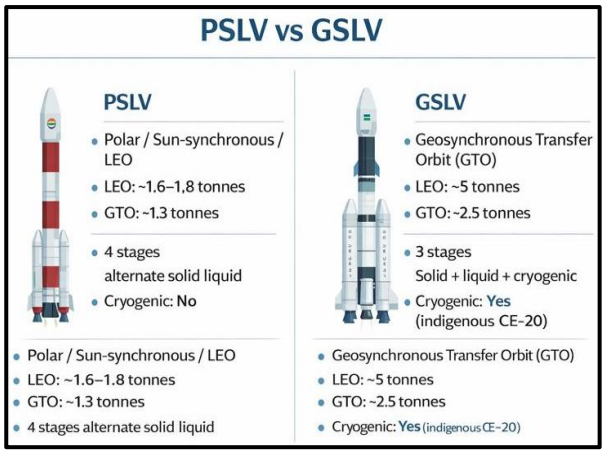
PSLV-C62 / EOS-N1 Mission

Context:

ISRO is scheduled to launch the **PSLV-C62 mission carrying the Earth Observation Satellite (EOS-N1)** in January 2026, marking the agency's **first launch of the year** and an important return to flight after a previous PSLV mission glitch.

About the Mission:

- **Mission name**: PSLV-C62 / EOS-N1
- **Launch vehicle**: PSLV
- **Satellite type**: Earth observation / Earth imaging satellite
- **Orbit**: Low Earth Orbit (LEO)



Satellite Details – EOS-N1:

- Classified as an **Earth Observation Satellite.**
- Designed for **strategic imaging purposes.**
- ISRO has **not disclosed detailed technical specifications**, indicating sensitivity.

Additional Payloads:

- Along with EOS-N1, the mission will also carry:
  - Payloads developed by **Indian and foreign startups**
  - Payloads from **academic institutions**

ADITYA-L1

Context:

On the second anniversary of Aditya-L1 reaching the Sun–Earth L1 point, ISRO highlighted the growing scientific utilisation of its solar data, with large volumes released in the public domain.

Key Terms:

- **Aditya-L1**: India's first dedicated space-based solar observatory.
- **Sun–Earth L1 (Lagrange Point-1)**: A gravitationally stable point located ~1.5 million km from Earth towards the Sun.
- **Heliophysics**: Study of the Sun and its influence on the solar system, especially space weather.

About Aditya-L1:

- **Launch date**: 2 September 2023
- **L1 insertion**: 6 January 2024 (after ~127 days)
- **Orbit**: Halo orbit around Sun–Earth L1
- **Nature**: Observation mission (not a landing mission)

Why L1 Point is Chosen?

- Enables **continuous, uninterrupted observation of the Sun.**
- Free from **Earth's eclipses and occultation.**
- Ideal for monitoring solar phenomena affecting **space weather.**

Space for Notes:

Scientific Objectives:

- Study the **solar photosphere, chromosphere, and corona.**
- Understand **solar flares, coronal mass ejections (CMEs),** and solar wind.
- Improve prediction of **space weather events** impacting satellites, communication, and power grids.

Payload Overview:

- **Total payloads**: 7
- **VELC** (*Visible Emission Line Coronagraph*): Studies solar corona and CMEs
- **SUIT** (*Solar Ultraviolet Imaging Telescope*): Images photosphere and chromosphere
- **SoLEXS** (*Solar Low Energy X-ray Spectrometer*): Observes solar flares (X-rays)
- **HEL1OS** (*High Energy L1 Orbiting X-ray Spectrometer*): Studies high-energy solar flares
- **ASPEX** (*Aditya Solar wind Particle Experiment*): Measures solar wind particles
- **PAPA** (*Plasma Analyser Package for Aditya*): Analyses solar wind plasma properties
- **MAG** (*Magnetometer*): Measures interplanetary magnetic field

Gaganyaan Mission

Context:

India's human spaceflight programme **Gaganyaan** has seen repeated timeline revisions, with the **first uncrewed mission now expected by March 2026**, while the **first crewed mission is likely by late 2027 or early 2028**.

Key Mission Facts:

- **Target Orbit:** Low Earth Orbit (LEO) at an altitude of approximately **400 km**.
- **Mission Duration:** 3 days (planned for the first crewed flight).
- **Crew Capacity:** Up to 3 astronauts (officially called **Gaganyaatris** or Vyomanauts).
- **Launch Vehicle: LVM3** (Launch Vehicle Mark-3), formerly known as GSLV Mk III. It has been "human-rated" to meet safety standards.
- **Nodal Agency:** Indian Space Research Organisation (ISRO).
- **Launch Site:** Satish Dhawan Space Centre (SDSC), Sriharikota.

Spacecraft Components:

The Gaganyaan spacecraft, known as the **Orbital Module (OM)**, consists of two main parts:

1. **Crew Module (CM):** The habitable space for astronauts. It features a double-walled construction with a **Thermal Protection System (TPS)** to withstand extreme heat during re-entry.
2. **Service Module (SM):** An unpressurized structure containing the propulsion system, solar panels, and batteries to provide power and thermal control during the mission.
3. **Crew Escape System (CES):** A critical safety mechanism designed to pull the Crew Module away from the launch vehicle in case of a mid-flight emergency.

The Astronauts (Gaganyaatris):

The four designated crew members are all experienced Indian Air Force (IAF) fighter pilots:

1. **Group Captain Prashanth Nair**
2. **Group Captain Ajit Krishnan**
3. **Group Captain Angad Pratap**
4. **Group Captain Shubhanshu Shukla**

Note: Group Captain Shubhanshu Shukla is also slated to join a joint **ISRO-NASA mission** to the International Space Station (ISS) in 2026, which will serve as a precursor to the Gaganyaan mission.

Space for Notes:

Notable Technologies:

- **Vyommitra:** A female-looking humanoid robot designed to simulate human functions, operate switches, and communicate with ground control to test the environment before humans go.
- **ECLSS:** The **Environmental Control and Life Support System** is being developed indigenously to manage oxygen, carbon dioxide, temperature, and waste.
- **Splashdown:** The mission will conclude with the Crew Module landing in the **Indian Ocean**, where the Indian Navy will lead recovery operations.

Long Range Anti-Ship Hypersonic Missile (LRAShM)

Context:

The LRAShM made its highly anticipated public debut at the **77th Republic Day Parade** on January 26, 2026, showcased by the Defence Research and Development Organisation (DRDO) at Kartavya Path.

About LRAShM:

- **Developer & Role:** Developed by DRDO primarily for the **Indian Navy** to counter high-value naval assets like warships and carrier strike groups.
- **Technology:** It is a **Hypersonic Glide Vehicle (HGV)** that uses a two-stage solid-fuel rocket booster to reach the upper atmosphere before releasing a maneuverable glide vehicle.
- **Maneuverability:** Unlike ballistic missiles, it follows a **quasi-ballistic trajectory** with "skips" and unpowered glide maneuvers, making it difficult for traditional air defense systems to intercept.

Key Specifications:

- **Range:** Verified at approximately **1,500 km**. Future variants are reportedly being planned with ranges up to 3,000–3,500 km.
- **Speed:** Reported peak speeds of **Mach 10**, with an average glide speed around Mach 5. It can reportedly strike a target at its full range within **15 minutes**.
- **Targeting:** Equipped with an **advanced RF seeker** (X-band synthetic-aperture radar) designed to function at hypersonic speeds for hitting moving naval targets.
- **Platforms:** Configured for **land-based truck-mounted launchers** (Transporter Erector Launchers). A ship-launched version is also in development.
- **Payload:** Designed to carry various payloads, including conventional warheads; some reports suggest compatibility for strategic (nuclear) payloads, though this is not officially detailed.
- **Materials:** Uses specialized **heat-resistant composite materials** and thermal shielding to withstand temperatures exceeding 2,000°C during flight.

Operational Significance:

- **Sea Denial:** Enhances India's maritime deterrence in the **Indian Ocean Region (IOR)** by providing a "carrier killer" capability.
- **Technological Leap:** Its debut positions India among a select group of nations (including the US, Russia, and China) with operational hypersonic glide technology.
- **Strategic Deterrence:** Acts as a viable counter to advanced regional missile systems and area-denial (A2/AD) capabilities.

Space for Notes:

Bhairav Battalions (Indian Army)

Context:

The Indian Army's newly raised **Bhairav Battalions**, designed as **high-speed, offensive, modern warfare units**, will make their **first public debut at the Army Day Parade in Jaipur on January 15**, reflecting the Army's shift towards **hybrid and technology-intensive warfare**.

About Bhairav Battalions:

- **Type:** High-speed, offensive combat units
- **Role:** Execute **Special Forces–like tasks,** operate **inside enemy territory,** Conduct **deep raids, target acquisition, and precision strikes**
- **Operational Flexibility:** Capable of **multi-level operations** (tactical to operational depth)

Genesis & Rationale:

Raised by Army HQ by integrating lessons from global conflicts and Indian operational experience (including Operation Sindoor) to meet the demands of rapidly evolving modern warfare.

Deployment & Structure:

Fifteen Bhairav Battalions have been raised so far, with plans to expand to about 25, deployed across border formations including two under Southern Command (e.g., "Desert Falcons") and four under South Western Command.

Key Capabilities:

Combat & Technology:

- High mobility and rapid insertion
- Advanced weapons and night-fighting capability
- Strong focus on **unmanned systems (drones)**
- Personnel trained for **drone handling and employment in real operations**

Force Integration:

- Designed to **bridge the gap between Para Special Forces and regular infantry**
- Enable **special operations at operational depth** without exclusive SF deployment

ICGS Samudra Pratap

Context:

India commissioned *Samudra Pratap* **(Majesty of the Seas)**, the **first indigenously designed and built Pollution Control Vessel (PCV)** for the **Indian Coast Guard**, strengthening marine environmental protection, maritime safety, and coastal surveillance amid rising pollution and climate risks.

About *Samudra Pratap:*

- **Type:** Pollution Control Vessel (PCV)
- **Service: Indian Coast Guard**
- **Built by: Goa Shipyard Limited**
- **Indigenous Content: >60%** (target of **90%** indigenous content in warships)
- **Status: Largest ship in the Indian Coast Guard fleet** to date
- **Category:** First of **two** indigenously built PCVs

Space for Notes:

Key Features / Capabilities:

- **Pollution Response:** Advanced oil-spill detection and containment systems. Specialised pollution response boats and recovery equipment
- **Firefighting:** Modern firefighting systems for maritime emergencies
- **Surveillance & Safety:** Extended maritime surveillance. Coastal patrol and maritime law enforcement support
- **Multi-Role Platform:** Integrates pollution control, coastal security, and maritime safety on a single platform
- **Aviation Support:** Helicopter hangar for enhanced operational reach, including rough sea conditions
- **Gender Inclusion:** First PCV with **two women officers onboard**, reflecting a gender-neutral and inclusive Coast Guard

INSV *Kaundinya*

Context:

The Indian Navy's indigenously built **stitched sailing vessel INSV *Kaundinya*** embarked on its **maiden overseas voyage from Porbandar (Gujarat) to Muscat (Oman)**, retracing ancient maritime routes and highlighting India's maritime heritage and India–Oman civilisational ties.

Technical & Design Features of INSV Kaundinya:

- **Type:** Two-masted traditional sailboat
- **Construction technique:** Stitched shipbuilding **(ancient Indian technique)**
- **Materials:** It uses **no metal nails**; wooden planks are **stitched together** using natural fibres, reflecting historical seafaring practices.
- **Crew:** Naval officers and sailors with special training
- **Inspired by:** Ancient Indian ship depictions, Ajanta cave paintings and Historical maritime records of Indian Ocean trade
- **Collaborating institutions:** Ministry of Culture, Naval heritage and maritime experts

Significance:

- Revives India's **ancient Indian Ocean stitched-ship trade tradition**, linking the western coast with the **Arabian region**.
- Voyage **Porbandar–Muscat** reinforces **India–Oman historical and maritime ties**, especially Gujarat–Oman links.
- Enhances **maritime diplomacy and cultural soft power** in the **Indian Ocean Region**, aligning with India's **SAGAR** vision.