

2) NEUTRINO AND ITS PARTNERS

- Introduction

- » Neutrinos are one of the fundamental particles which make up the Universe. It is a fermion. They are similar to electrons but without any charge.
- » Neutrinos are affected by weak subatomic force of much shorter range than electromagnetism and are therefore able to pass through great distances in matter without being affected by it.
 - Neutrinos interact very weakly with most of the things - trillions of them pass through every human body every second without anyone noticing.
- » **A neutrino spin** always points in the opposite direction of its motion, and until a few years ago, neutrinos were believed to be massless. It is now generally believed that the phenomenon of neutrino oscillations requires neutrinos to have tiny mass.
- » **Three types of neutrinos are known**, there are strong evidence that no additional neutrinos exist, unless their properties are unexpectedly very different from the known types.
- » Each type or flavor of neutrino is related to a charged particle (which gives the corresponding neutrino its name). Hence, the "electron neutrino" is associated with the electron, and two other neutrinos are associated with heavier version of electrons called muon and the tau.
- » The table below list the known types of neutrinos (and their electrically charged partners)

Neutrino	n_e	n_m	n_t
Charged Partners	Electron (e)	Muon (m)	Tau (t)

- How are neutrinos formed?

- » Neutrinos are produced copiously in nuclear reactions in the Sun, stars, and elsewhere.
- » Majority of neutrinos in the vicinity of earth are from the nuclear reactions in the Sun.
- » They are formed on earth when unstable atoms decay, which happens in the planet's core and nuclear reactors.

- Active Research Areas

- » **Large neutrino detectors**
 - Measure the neutrino masses and determine the precise values for the magnitude and rates of oscillations between neutrino flavors.

- Motivation for research

- » Neutrinos **can be used to probe environments that other radiation (such as light or radio wave) cannot penetrate**.
 - Thus, Neutrinos can be used to probe the Universe, areas beyond our Solar system and phenomenon like Supernova.
- » They can also enhance the understanding of basic physical laws as it provides a tool to study the structure of nucleons (protons and neutrons)

3) INDIAN NEUTRINO OBSERVATORY (INO) PROJECT IN THENI, TAMIL NADU

- It is a Rs 1600 Crore Science Project conceived nearly 20 years ago and can put India on the world map in the field of Neutrino Physics. It will house a massive iron detector which will be placed more than a Kilo meter below the surface of the earth. With a weight of nearly 50,000 tonnes, it will be the largest particle detector in the world.
 - » The project is led by TIFR and has more than 25 top research institutions in the country as collaborators.
- Setting up of this opportunity would mean revival of a lost opportunity for India because in 1965 pioneering Indian Scientists at the Kolar Gold Field (KGF) observatory were among the first in the world to discover the traces of atmospheric neutrinos. With the closure of KGF mines in 1990s, experimental research on neutrinos came to an end in India.
- The project will be jointly supported by the **Department of Atomic Energy** and **The Department of Science and Technology**.
- **Issue Associated with INO**
 - » In 2015, the Union government had approved the project. But later NGT stayed the project citing environmental concerns. Later in 2018, the NGT upheld the environmental clearances given to the project but asked TIFR and DAE to take approval from National Board of Wildlife before moving ahead.
 - » TN Government filed a new affidavit before SC in May 2021 saying that the project fell within the Mathikettan-Periyar Tiger Corridors. TIFR team has sought wildlife clearance but the application is pending before the state board of wildlife.
 - » The matter has now reached Supreme Court which will assess the objections raised by the TN government and environmentalists vis-a-vis the central government support and regulatory approvals to decide whether an INO will become reality.

- **Useful Video:**
 - India based Neutrino Observatory A Mega Science Project

A) **IN A FIRST SCIENTISTS SEE NEUTRINO EMITTED BY THE MILKY WAY GALAXY (JUNE 2023)**

- For the first time, scientists have seen neutrinos originating from the central disk of the Milky Way. It was achieved with the help of IceCube Experiment. They detected high-energy neutrinos in pristine ice deep below Antarctica's surface, then traced their source back to locations in the Milky Way - the first time these particles have been observed arising from our galaxy.
- **About IceCube Experiment:**
 - » For the past 10 years, an array of small light sensors drilled into Antarctic ice has been detecting neutrinos as they zip through our planet. IceCube is an actual cube of these sensors, a km long on each side, that was sunk 1.5 and 2.5 km deep in the ice. In this translucent medium, the sensors pick up tiny flashes of so-called Cherenkov radiation that forms when a vanishingly rare neutrino hits the ice and creates a shower of secondary particles.
- **Significance:**
 - » The experiment established the galaxy as a neutrino source.
 - » Milky Way neutrinos may help scientists understand the origin of high-energy particles known as cosmic rays, which kick off the formation of neutrinos.

4) HIGGS BOSON

- Why in news?
 - » Peter Higgs, who proposed existence of Higgs Boson particle, had died at 94 (April 2024)

A) ABOUT HIGGS BOSON: "GOD PARTICLE"

- » The existence of Higgs Boson, also called "**God Particle**" was first proposed by Peter Higgs in 1964. It is one of the 17 elementary particles that make up **standard model of particle physics**.
- » In 2012, the presence of the particle was confirmed at CERN.
- » It is the particle that is supposed to account for the mass of every other fundamental particles.
 - **Note:** Mass is not intrinsic to matter. Fundamental particles like electrons don't have a mass within themselves. Scientists realized this in 1950s and 1960s when the standard model was still being developed. Scientists realized that the equations didn't work if these particles had inherent mass.
 - In 1964, scientists developed the idea of all-pervasive field (later dubbed the "Higgs Field"), just like there is an electric field or a magnetic or gravitational field. It is through interaction with this field that elementary particles acquire the mass.
 - Why Peter Higgs receives pre-eminence: Because of Prediction of a new elementary Particle (which was later called Higgs Boson)
 - The day Peter Higgs submitted his original paper about the Higgs Field (at that time unnamed), on the same day, another paper by Belgian Physicists Francois Englert and Robert Brout was published describing essentially the same theory.
 - When this was brought to Higgs attention, he modified his own paper to add another prediction - that there should be a new elementary particle associated with Higgs Field. It belongs to a class of particles called bosons and would itself have an extremely high mass. This was the particle that came to be known as Higgs Boson.
 - It is the interaction of particles with the Higgs Field - the way they change the field or get changed by them - that lends them the mass. Greater is the interaction, larger is the mass. Different particles interact with the field in different ways, and that is what gives them different masses.
 - A **Photon**, which is a light particle, doesn't interact with the field at all, and is thus massless.
 - **Particles** like electrons and protons, do interact with the field and thus have masses.
 - **Higgs Boson** itself interacts with the field and thus have mass.
 - **Higgs Boson** particle is known to impart mass to every other particle. Its discovery completed what is known as Standard Model of Particle Physics, which describes all the fundamental particles and fundamental forces.

B) ABOUT PETER HIGGS

- He was a Nobel Prize winning Physicist. Higgs won the 2013 Nobel Prize in Physics for his work, alongside Francois Englert of Belgium, who independently came up with the same theory.



- He proposed the existence of the so-called "God Particle" that helped explain how matter formed after the Big Bang in 1964.
 - » He theorized that there must be sub-atomic particle of certain dimension that would explain how other particles and therefore all the stars and planets in the Universe - acquired mass. Without something like this particle, the set of equations physicists use to describe the world, known as the standard model, wouldn't hold together.
 - » Higgs' work helps scientists understand one of the most fundamental riddles of the universe: How the Big bang created something out of nothing 13.8 billion years ago. Without mass from the Higgs, particles couldn't clump together into the matter we interact with every day.
- **Details of Life:**
 - » Born on May 29, 1929, in Newcastle, Northeast England. He studied at King's College, University of London, and was awarded a PhD in 1954. He spent much of his career at Edinburgh, becoming the Personal Chair of Theoretical Physics at the Scottish University in 1980. He retired in 1996.
 - » **An important Highlight** of Higgs' career came in the 2013 presentation at CERN in Geneva where scientists presented that the boson had been confirmed. He broke into tears, wiping down his glasses in the stands of a CERN lecture hall.
 - » He was an extremely shy person, and preferred to work in isolation. He wasn't a prolific contributor and has produced just 12 papers in his entire career, only one with a co-author.

5) CERN (EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH) (CONSEIL EUROPÉEN POUR LA RECHERCHE NUCLÉAIRE)

- **Introduction**
 - » CERN is a provisional body founded in 1952 with the mandate of establishing a world class **fundamental physics research organization in Europe**. At that time, pure physics research concentrated on understanding the inside of an atom, hence the word "nuclear".
 - » European Organization for Nuclear Research officially came into being in 1954, following ratification by 12 states including France and Germany. The provisional CERN was dissolved but the acronym remained.
 - » It operates the world's largest particle physics laboratory in the world.
 - **Members: 23** (Israel is the only non-European Country which has been granted full membership)

- Associate Members: 7 (India, Pakistan, Turkey, Ukraine, Lithuania, Croatia and Latvia)

- **Main Contributions**

- » CERN's main function is to provide the particle accelerators and other infrastructure needed for high energy physics research.
- » CERN is also the birthplace of World Wide Web.

6) THE LARGE HADRON COLLIDER

- **Introduction**

- » The Large Hadron Collider (LHC) is the world's largest and most powerful particle accelerator. It first started up on 10 September 2008, and remains the latest addition to CERN's accelerator complex
- » The LHC consists of a 27-kilometre ring of superconducting magnets with a number of accelerating structures to boost the energy of the particles along the way.
- » **What is done through LHC**
 - Inside the accelerator, two high-energy particle beams travel at close to the speed of light before they are made to collide. The beams travel in opposite directions in separate beam pipes – two tubes kept at ultra high vacuum.

- **Aim:** It aims to allow physicists to test the prediction of different theories of particle physics and high energy physics like the Standard Model, and particularly prove or disprove the existence of the theorized Higgs boson and the large family of new particles predicted by supersymmetric theories. The LHC is expected to address some of the unsolved questions of physics, advancing human understanding of physical laws.

- **Two Runs**

- » **2009-2013**

- **Important Results So Far :** In 2013, the discovery of a particle matching Higgs Boson was confirmed by data from the LHC.

- » **Second Run 2015 onwards**

- » **Third Run:** The Large Hadron Collider was successfully reignited for the third time in July 2022. Since then it has discovered three exotic particles as per CERN. This will continue running for four years.

- In **10 years** since the discovery of Higgs Boson, scientists have been able to confirm that the particle is very, very close to being the Higgs Boson that is required in the so-called Standard Model of Particle Physics.

- **Future:**

- » Scientists hope to use the Higgs Boson as a tool to learn about the secrets of the universe, including Dark Matter.

7) EINSTEIN'S THEORY OF RELATIVITY

- Theory of Special Relativity**

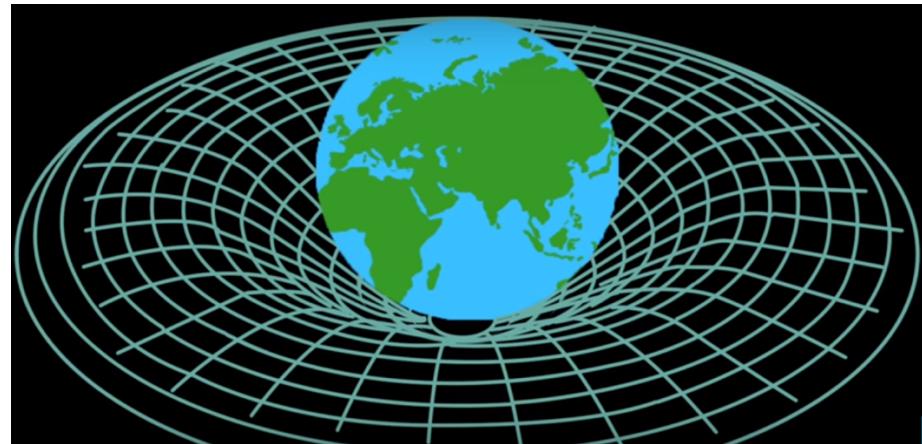
- In 1905, Albert Einstein based his theory on two principles:
 - a. the laws of physics are the same for all non-accelerating observers (inertial reference frame), and
 - b. that the speed of light in a vacuum was independent of the motion of all observers and is unchanging ($300 * 10^6$ m/s)
 - It is the time that changes (slows down for a fast moving object)
- As a result of these principles Einstein deduced that:
 - a. There is **no fixed frame of reference** in the universe.
 - b. Every-thing was moving **relative** to everything else, hence **Einstein's theory of relativity**.
- It is known as **special** relativity as it applies only to special cases; frames of reference in constant, unchanging motion.
- As a result he found that space and time are interwoven in a single continuum known as the **space-time**. Events that occur at the same time for one observer could occur at different times for another.
- **Consequence of special theory of relativity**
 - a. **Time Dilation:** Time does not pass at the same rate for everyone.
 - A fast-moving observer measures time passing more slowly than a (relatively) stationary observer would. This phenomena is called **dilation**.
 - **Useful Video:** [Special Relativity: Crash Course Physics #42](#)
 - b. **Length Contraction:** A fast moving object appears shorter along the direction of motion, relative to slow moving one. This effect is very subtle until the object travels close to the speed of light.
 - c. **Simultaneity:** something that seems simultaneous to you might not seem simultaneous to another observer.
 - d. **Mass and energy are different manifestation of the same thing.** Einstein's famous equation , $E = mc^2$.
 - As a result of this a fast moving object appears to have increased mass relative to slow moving one. This is due to the fact that increasing an object's velocity increases its kinetic energy and, therefore, its mass.

The increase in mass is the reasons that Einstein says that matter cannot travel faster than light. The mass is increased with velocity until the mass becomes infinite when it reaches light speed. An infinite mass would require infinite energy to move, so this is impossible
 - e. **Space and time** are part of one continuum, called space-time.
 - In Einstein's mathematics, space has three dimensions, and the fourth dimension is time. More recent theories presume extra dimensions that we do not perceive.

ii. General Theory of relativity

- After giving special theory of relativity, Einstein spent 10 years trying to include acceleration in the theory.
- In 1915, Einstein published the General theory of relativity, which applies to frames that are accelerating with regard to each other.
- Some consequence
 - Mass causes space time to curve which is how gravity is created
 - The rubber sheet model shows that gravity results from massive objects warping space-time. The warp is called gravity well.

- Orbiting objects follow the path that is shortest and requires the least amount of energy. The planets move in ellipses, the most energy efficient path in gravity well of the sun.

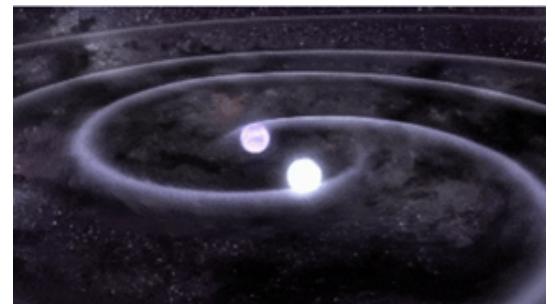


- **Gravitational lensing:** Gravity bends light. This phenomenon is called Gravitational lensing. When we observe a distant galaxy, the gravity of matter between Earth and the galaxy causes light rays to be bent into different paths. When the light reaches the telescopes, multiple images of the same galaxy appear.
- **Universe is expanding.**

8) GRAVITATIONAL WAVE

- Introduction

- » Gravitational waves are ripples in the curvature of spacetime which propagate as waves, travelling outward from the source. In other words gravitational waves are disturbance in space-time, the very fabric of universe , that travel at the speed of light.
 - The waves are emitted by any mass that is changing the speed or direction. The simplest example is the binary system, where a pair of stars or compact objects (like black holes) orbit their common center of mass.



- » **Space-time around earth:** Einstein's theory of general relativity predicted that the space time around earth would be not only warped but also twisted by the planet's rotation.



- » It was predicted in 1916 by Albert Einstein on the basis of general relativity, gravitational waves transport energy as gravitational radiation.
- » The existence of gravitational waves is a possible consequence of the Lorentz invariance of general relativity since it brings the concept of limiting speed of propagation of the physical interactions with it. By contrast gravitational wave cannot exist in the Newtonian theory of gravitation, which postulates that physical interaction propagate at infinite speed.
- » **Gravitational waves are very different from the more familiar electromagnetic waves**
- EM waves -> created by magnetic charges, rather than moving masses
- Gravitational waves with appreciable strength are so much more difficult to produce because gravitational force is much weaker than electromagnetic force.

» **Discovery of Gravitational wave (2016)**

- In 2016, after decades of search for those ripples in space-time, which Albert Einstein predicted exactly 100 years ago, scientists working with the gigantic optical instruments in the U.S. called LIGO (Laser Interferometer Gravitational-wave Observatory) have detected signals of gravitational waves emanating from two merging black holes 1.3 billion light years away arriving at their instruments on the earth.
- The advanced LIGO observatories in the US states of Washington and Louisiana have traced the warping of space from the merger of two black holes about 1.3 billion light years ago.
- **How is gravitational wave detected in Lab**
 - The basic principle for detection is **interference** - when two waves combine, they produce a pattern based on relative positions of peaks and troughs in those waves.
 - **Normal circumstance - no light detector**
 - In LIGO, a high powered laser beam is split and sent down to L-shaped vacuum tunnels, each 4 KM long. They get reflected from two high precision mirrors and reach back at the base. They come back in such a way that they completely cancel out each other. No light is detected at the photo detector.
 - **When gravity wave passes by: Some pattern detected at the photo detector**
 - But when a gravity wave passes-by, it distorts space and changes the distance that the beams have to travel. No longer are the peaks and troughs of the two reflected waves perfectly aligned. As they do not cancel out each other now, some pattern is detected at the photo-detector.



- **How will the discovery of Gravitational wave change science and our world ?**

- » We will be able to
- » **Understand Universe Better**

9) RAMAN EFFECT AND ITS APPLICATIONS

- About CV Raman

- » Born in Tiruchirappalli on Nov 7, 1888, died on Nov 21, 1970.
- » He discovered a **new phenomenon of scattering of light**, known as **Raman Effect / Raman Scattering**.
 - He received the 1930 Nobel Prize in Physics for this discovery and was the first Asian to receive a Nobel Prize.

- Other Contributions:

- » He is known to give correct explanation for why the sea water appears blue.
- » He attended the foundation ceremony of BHU and also held the position of permanent visiting professor.
- » With a student, Nagendra Nath, he provided the correct explanation of the acousto-optic effect (light scattering by sound waves) in a series of articles resulting in the celebrated Raman-Nath theory.
- » In 1933, he became the first Indian Director of the IISc.
- » He also founded Indian Academy of Science the same year (1933)
- » Later, in 1948 he established Raman Research Institute in 1948 where he worked to his last days.

- Raman Effect: Definition

- » Raman effect, change in the wavelength of light that occurs when a light beam is deflected by molecules.
- » When a beam of light traverses a dust-free, transparent samples of a chemical compound, a small fraction of the light emerges in direction other than that of the incident (incoming beam). Most of these scattered light is of unchanged wavelength. A small part, however, has wavelength different from that of the incident light. It's presence is a result of the Raman effect.
- » Chandrashekhar Venkata Raman first published the observation in 1928. (Austrian physicist Adolf Smekal theoretically described the effect in 1923).

- Applications

- » **Chemical industry**
 - a. To study catalysts
 - b. To monitor chemical purity in petro-chemical industry
 - c. Control of polymerization reaction
- » **Nanotechnology and material science**
 - a. To study nano particles
 - b. To develop microelectronics devices and novel photovoltaic cells
- » **Biomedical applications**
 - a. In vivo study of skins
 - b. Transdermal drug transfer
 - c. Cancer identification
 - d. Bone studies
- » **Detection of Narcotics and Explosives**
 - a. Hand held Raman scanners to detect narcotics
 - b. Hand held Raman scanners to detect explosives such as TNT, RDX, HMX etc.

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2. INLAND WATERWAYS

- **Inland Waterways Potential in India**
 - Inland water transport holds great untapped potential as a means for the transportation of goods and passengers. India has a large endowment of rivers, canals, and other waterways. The total navigable length of waterways in India is around 14,850 kilometres.
- **Need for improving and Inland waterways and ports.**
 - i. **Contribution in trade:** Only 3.5% of trade in India is done through the mode of Inland waterways, which is 47% in China, 40% in Europe, 44% in Japan and Korea and 35% in Bangladesh.
 - ii. **Fuel Efficient -> Cost Effective**
 - iii. **Less Polluting**
 - iv. **Economic growth and jobs**
 - v. **Reducing Pressure on Road -> less congestion**
 - vi. **Fewer accidents** - when compared to any other mode of transport.
 - vii. **Less Land Acquisition Problems and Less Deforestation:** As land capital required in case of water transport is minimal when compared to road and rail transport.

1) INLAND WATERWAYS AUTHORITY OF INDIA ACT, 1985

- Empowers the government to declare waterways with potential for development of shipping and navigation as National Waterways and develop such waterways for efficient shipping and navigation.
- For development and regulation of inland waterways in the country the Inland Waterways Authority of India (IWAI) was set up in October 1986
 - » IWAI is the nodal agency under the Ministry of Shipping to make National Waterways commercially navigable. It aims to increase the cargo transportation through IWT.
 - » Currently, it is developing the National Waterways for commercial navigation, including with assistance from the World Bank.
- It is **headquartered** in **Noida** and have regional offices at Patna (Bihar), Kolkata (WB), Guwhati (Assam) and Kochi (Kerala) and sub offices at other places throughout India.

2) NATIONAL WATERWAYS ACT, 2016

- **Commenced in 2016**
- **Provisions**
 - » The act merged five erstwhile acts which had declared 5 National Waterways. It also proposed 106 additional National Waterways.
 - » The act has thus declared 111 rivers or river stretches, creeks, estuaries as National (inland) Waterways (including the five older ones)
 - » Now, according to entry 24 of the Union list of the seventh schedule, the union government can regulate these waterways for development with regard to shipping, navigation and transport through mechanically propelled vessels.
- **Other details**

- » These 111 waterways pass through 24 states and two UTs with an approximate length of 20274 km². These will pass through nearly 139 river systems, creeks, estuaries and related canal systems of India.
- » Assam (17) and WB (16) will have the highest number of waterways.

3) OTHER STEPS TO PROMOTE NATIONAL WATERWAYS IN INDIA

- Sagarmala Project
- Declaration of 106 new waterways as National Waterways (total 111) through an act in 2016.
- Implementation of **Jal Marg Vikas Project (JMVP)** to augment capacity of NW-1 with the technical and financial support of the WB.

4) IMPORTANT NATIONAL WATERWAYS

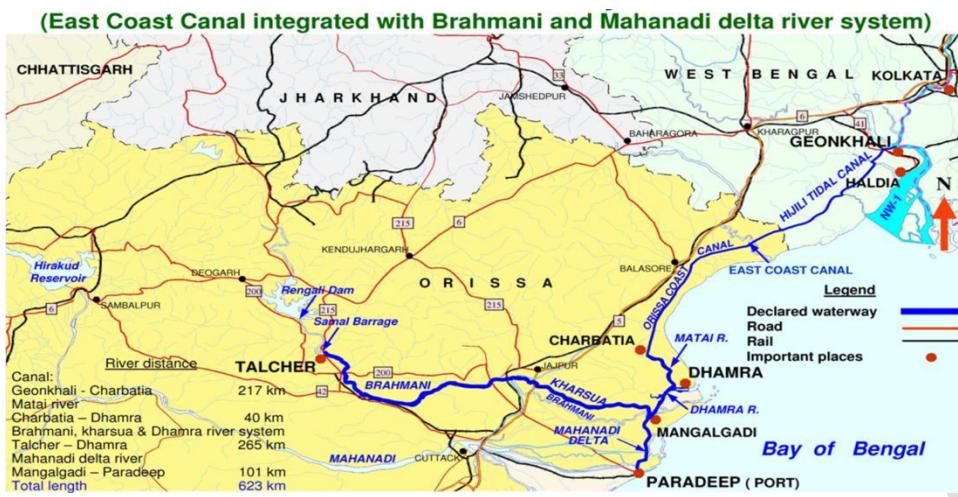
- National Waterway - 1:** (Allahabad to Haldia - 1620 KM): Ganga - Bhagirathi-Hoogly River system
 - States Served:** UP, Bihar, Jharkhand and WB.
- National Waterway - 2:** (Dhubri - Sadiya - 891 km): River Brahmaputra
 - States Served:** Arunachal Pradesh, Assam, West Bengal, Meghalaya.
- National Waterway - 3:** West Coast Canal (Kottapuram-Kollam) along with Udyogmandal and Champakara Canals (205 km)
 - States Served:** Kerala
- National Waterway-4:**

Kakinada-Puducherry canals along with Godavari and Krishna rivers (1078 km)

- States Served:** AP, TN, UT of Puducherry



- National Waterway - 5:** East Coast Canal integrated with Brahmani river and Mahanadi delta rivers (588 kms)



6. National Waterway - 16: Between Lakhipur and Bhanga (121 km) of the Barak River.

- About Barak River:** It is the 2nd largest river in the NE region. It originates from South of Kohima in Nagaland near Nagaland-Manipur border. After traversing through Nagaland, Manipur, and Assam, it splits at Bhanga into two streams called Surma and Kushiyara. These two streams rejoin at Markuli in Bangladesh and thereafter the river is called **Meghna**. Barak-Meghna River System has a total length of 900 kms (origin to upstream Chandpur in Bangladesh). Out of this, 524 kms is in India, 31 km on Indo-Bangladesh border and the rest is in Bangladesh. Out of the portion in India, only 121 kms stretch between Lakhipur and Bhanga is navigable and has been declared as **NW-16** in the year 2016.
- State Served:** Assam, Mizoram, Tripura and Manipur

7. NW-10 (river Amba, MHA), NW-68 (Mandovi river, Goa), NW-73 (river Narmada, Gujarat, and MHA), NW-83 (Rajpuri Creek, Maharashtra), NW-85 (Revadanda Creek - Kundalika River system, MHA), NW-91 (Shashtri River - Jaigad Creek system, MHA), NW-97 (Sundarban waterways, West Bengal), **NW-100** (river Tapi, Gujarat and Maharashtra), and **NW-111** (Zuari River, Goa) also are operational in parts atleast.

5) KOCHI WATER METRO

- Why in news?**
 - Kochi Water Metro completes one year after being formally inaugurated in 2023 (April 2024)
- Beginning:**
 - In April 2023, PM Modi inaugurated the first phase of the Kochi Water Metro - a first of its kind **public boat service in India integrated with a metro rail network**.
- Details:**
 - The Kochi Water Metro is a project being implemented by Kochi Metro Rail Corporation Limited (KMRL) with assistance of a German funding agency, Kreditanstalt fur Wiederaufbau.
 - It includes **boats** that are battery powered, air conditioned, and disabled friendly among other features. Thus, it operates like any traditional ferry, but with modern facilities, enhanced safety and security measures.
 - How is it linked to the metro rail?**
 - Envisaged as a feeder service of the Kochi metro rail, which has been operational since 2017.

- These boats have been designed as coaches of Kochi Metro. Its boat terminals, passenger entry and exit gates, ticket counters and safety measures mirror the features of the metro rail service.
 - All jetties feature electronic display boards about boat services. Announcements are made in English, Hindi and Malayalam.
- » **Routes and Terminals:** It will operate in backwaters of Kochi, connecting 10 nearby islands with mainland of Kochi, the commercial hub of Kerala.
- **Updates:** 20 lakh commuters travelled in Kochi Water Metro in a year (April 2024)
 - **Updates:** Kochi Water Metro considering hop on - hop off trips for tourists (April 2024)
 - » Talks to be held with local bodies for launching the project; efforts on to usher in first-and last-mile connectivity from various ferry terminals.
 - **Updates:** Even as the launch of the Kochi Metro is delayed by two years, the electric ferry of the project has won the famed Gussies Electric Boat Award - 2022 in the commercial ferry category. (Nov 2022)
 - » Gussies Electric Boat Award were instituted in memory of Gustave Trouve, a French electrical engineer who had 75 patents.

3. RAILWAYS

1) 17 ZONES OF INDIAN RAILWAYS (SOURCE: INDIA YEARBOOK)

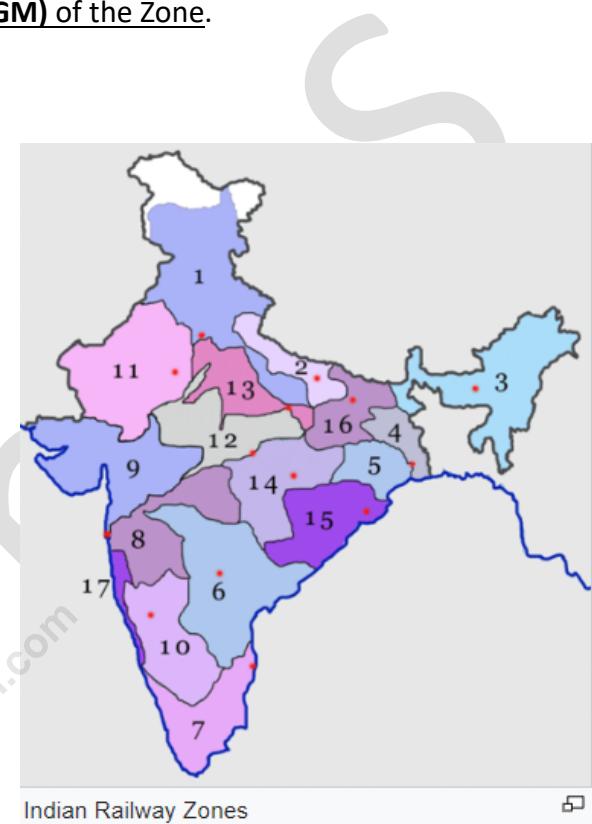
Indian Railways is divided into **17 zones** which are the basic operating Units of Railways. Each zone is further subdivided into **divisions**, each having divisional headquarters. Each of the divisions is headed by a **Divisional Railway Manager (DRM)**, who reports to the **General Manager (GM)** of the Zone.

The Zones and their headquarters are mentioned below:

SI.No.	Zonal Railways	Headquarters
1.	Central	Mumbai
2.	Eastern	Sealdah (Kolkata)
3.	East Coast	Bhubaneshwar
4.	East Central	Hajipur
5.	Northern	Delhi
6.	North-Central	Allahabad
7.	North-Eastern	Gorakhpur
8.	Northeast Frontier	Maligaon (Guwahati)
9.	North Western	Jaipur
10.	Southern	Chennai
11.	South Central	Secundrabad
12.	South Eastern	Garden Reach (Kolkata)
13.	South East Central	Bilaspur
14.	South Western	Hubli
15.	Western	Churchgate, Mumbai
16.	West Central Railway	Jabalpur
17.	Metro Railway	Kolkata

- Other Sources also mentions another zone: **Konkan Railway - Navi Mumbai**

2) REVENUE PROBLEM OF INDIAN RAILWAYS



- **Key Challenge:**
 - » **High Operating Ratio:** While the Indian Railway's capital expenditure has increased in the recent years, IR's **Operating Ratio**, which is the **ratio of ordinary working expenses to the gross traffic receipts**, has shown no improvement. A lower ratio implies better profitability and surplus for capital investment.
 - » **Trap of Rising Debt:** Lack of surplus, leads to the need of augmentation of funds from Gross Budgetary Support (GBS) and Extra Budgetary Resources (EBS). The EBS leads to the need of repayment of principal and interest.
- **But it is important to continue to invest in railways** as investment in railways boost manufacturing and services, tax revenue for government and allows for more job opportunities.
- **Where is the problem?**
 - » IR's **freight segment is profitable**, whereas the passenger segment is making huge losses.
 - For e.g. CAG report presented to Parliament in Aug 2023 states that there was a loss of Rs 68,269 crores in all the classes of passenger services during FY22, with all profit from freight traffic nullified in cross subsidizing passenger services.
 - » **Political Economy** makes it difficult to increase the passenger fares substantially. So, increasing profits from freight traffic by increasing freight volume is crucial.
- **Indian Railways Decreasing Share in Freight Traffic:**
 - » IR's modal share in India's freight traffic has steadily decreased from 80% at the time of independence to **27% currently**.
 - » **Why the decrease?**
 - **Competition from other modes:**
 - Improvement in roadways infrastructure, and successive price hikes in railways etc.
 - Pipelines and coastal shipping have also forayed into transportation of bulk items.
 - **Poor Performance in non-bulk freight transport**
 - For e.g. in parcel segment, the tariff is pretty high. After adding the first and last mile costs, the prices are higher than truck rates.
 - Other challenges are improper terminals, inconsistent weighbridges, unreliable transit times, complex booking and delivery mechanisms.
 - **Lack of Diversity:** 11 commodities in the IR's transport basket account for **90% of tonnage and revenue**, of which coal is around 45% and iron and cement 10% each.
 - **Slow average speeds** of freight trains of around **25 km/hour**.
 - **Lack of participation of private players:** It should be noted that private container train operation policy, initiated in 2006 to boost the rail share of container movement, has not made any significant dent in improving the share.
 - » **Recent Steps taken:**
 - **Dedicated Freight Corridor (DFCs)**
 - **Gati Shakti Cargo Terminals**
 - **Focus on expanding freight basket** - by targeting more commodities (e.g. Kishan Rail)
 - Policy of "**Long term Tariff Contracts**" with major customers
 - Double Stack dwarf Container train under a wire - a new delivery model

- RO-RO Services - to reduce road congestion and environmental improvement.
- » **Note: Bulk Cargo vs General Cargo**
 - General cargo includes goods typically transported in bags, boxes, crates, drums or barrels.
 - **Bulk Cargo** consists of loose materials like grain, coal, or iron ore loaded directly into a ship's hold or train carriage, while general cargo ships in smaller units.

3) KEY INITIATIVES DISCUSSED IN RAILWAY SECTOR (ESI 2022-23)

Box XII.2: Major initiatives of the Indian Railways

- ✓ Mumbai-Ahmedabad High Speed Rail (MAHSR) Project: The MAHSR project, which was sanctioned by the government in 2015, with technical and financial cooperation from Government of Japan, is under execution and survey & design aspects of it have been finalised.
- ✓ Dedicated Freight Corridor (DFC) Project: One of the most ambitious and biggest ever infrastructure project in the railways, which comprises construction of two dedicated freight corridors, i.e., Eastern and Western DFCs along the golden quadrilateral, will offer higher transport output in the country with reduced transit time and cost.
- ✓ GatiShakti Multi-Modal Cargo Terminal (GCT): GCTs are being developed by private players on non-railway land as well as fully/ partially on railway land, based on demand from industry and potential of cargo traffic. 21 GCTs have been commissioned and more than 90 more locations have been provisionally identified for development of GCTs (as of 31 October 2022). This will boost investment from industry in the development of additional terminals for handling rail cargos.
- ✓ Induction of semi-high-speed Vande Bharat Trainsets: Semi High-Speed Self-Propelled Vande Bharat Trainsets were manufactured by Integral Coach Factory, Chennai, with indigenous efforts. These trains have ultra-modern features like quick acceleration, substantial reduction in travel time, having maximum speed of 160 kmph, on-board infotainment and Global Positioning System (GPS) based passenger information system, etc.
- ✓ Electrical/Electronic Interlocking System: envisages centralized operation of points and signals to enhance safety in train operations. These systems have been provided at 6,322 stations covering 99 per cent stations of Indian Railways (as of 30 September 2022).
- ✓ Development of Hyperloop technology: Hyperloop is an emerging transportation technology that can be faster and greener than airplanes and railways. In this system, vehicles run in the levitating state (with the help of Linear Induction Motors/Electromagnets) and in vacuum environment. The technology is still in the development phase. Indian Railways intends to develop a demonstrative project on Hyperloop Technology. Indian Railways has collaborated with IIT Madras for developing Hyperloop Technology by setting up Centre of Excellence for Hyperloop Technology at IIT Madras at the cost of ₹8.34 crore.
- ✓ Kisan Rail trains were introduced in FY21 to enable speedy movement of perishables from production or surplus regions to consumption or deficient regions. Up to 31 October 2022, Indian Railways have operated 2,359 Kisan Rail services, transporting approximately 7.91 lakh tonnes of perishables including fruits and vegetables.

4) NATIONAL RAIL PLAN VISION-2030

- Indian railways have prepared a National Rail Plan (NRP) for India - 2030.
- The plans are to create **future ready** Railway system by 2030.
- The NRP is aimed to formulate strategies based on both **operational capacities and commercial policy initiatives** to increase modal share of the Railways in freight to 45% (at present it is around 27%) and to sustain it.
- **Other aspects:**
 - » **Reduce transit time of freight** substantially by increasing average speed of freight trains to 50Kmph.
 - » As part of the National Rail Plan, **Vision 2024 has been launched** for accelerated implementation of certain critical projects by 2024 such as: 100% electrification, multi-tracking of congested routes, upgradation of speed to 160 kmph on Delhi-Howrah and Delhi-Mumbai routes, upgradation of speed to 130kmph on all other Golden Quadrilateral-Golden Diagonal (GQ/GD) routes and elimination of all Level Crossings on all GQ/GD route.
 - » Identify new Dedicated Freight Corridors and new High Speed Rail Corridors.
 - » Assess rolling stock requirement for passenger traffic as well as wagon requirement for freight.
 - » Assess Locomotive requirement to meet twin objectives of 100% electrification (Green Energy) and increasing freight modal share.
 - » **Assess the total investment in capital** that would be required along with a periodical break up.
 - » Sustained involvement of the Private Sector in areas like operations and ownership of rolling stock, development of freight and passenger terminals, development/operations of track infrastructure etc.

5) RESTRUCTURING OF RAILWAYS

- **Earlier Situation:**
 - » The **Railway Board** is the Indian Railway's apex decision making body.
 - It was constituted in 1905 to assist Ministry of Railways in key administrative and executive work of Railways.
 - It consisted of a chairman and seven members from different service departments such as Finance, traffic, civil, mechanical, electrical and signal & telecom.
 - The department heads were generally secretary level officers and are a member of the Railway Board.
 - These departments were vertically separated from top to bottom and worked in Silos.
- **The Management and Administrative arm** of the organization was staffed by officers belonging to 8 Group A Services of IR that include Indian Railway Traffic Service (IRTS), Indian Railway Account Services (IRAS), Indian Railway Personal Service (IRPS), Indian Railway Service of Engineers (IRSE), Indian Railway Service of Mechanical Engineers, Indian Railway Service of Signal Engineers, and Indian Railway Service of Electrical Engineers. (3 civil and 5 engineering services)
- **Key Problems**
 - » **Over-departmentalization** has led to work taking place in Silos
 - According to **Bibek Debroy Committee**, this over departmentalization manifests itself in the form of unhealthy competition and lack of team work and cohesion.
 - » **Various committees over the years** - Prakash Tandon Committee (1994), Rakesh Mohan Committee (2001), Sam Pitroda Committee (2012) and Bibek Debroy Committee (2015) has suggested unification of services, but the railway ministry hadn't acted on it till 2019.

- » In 2019, Union Cabinet approved restructuring of Indian Railways with the following components:
 - Reorganization of the Railway Board
 - Reduction in number of **members** of the board to **5** (a chairperson, who will act as CEO and **four members** responsible for infrastructure, operations & business development, rolling stock, and finance).
 - Unification of existing **8 group A service** into single service: **The Indian Railway Management Service (IRMS)**
 - In Feb 2022, the Union government officially issued a gazette notification about the proposed merger of existing eight services of Indian Railways, which fall under the Central Civil Services.
 - Post of General Managers working at zonal level will be upgraded to secretary level.
 - **Indian Railway Medical Services (IRMS)** to be renamed to **Indian Railway Health Services (IRHS)**
- » **Advantages:** Ending Departmentalism, create coherent vision for organization, promotes faster decision making, Recruit engineers/non-engineers as per need, bring decision making as per market realities, infuse fresh thinking etc.

6) DEDICATED FREIGHT CORRIDORS (DFC)

- Why in news?
 - India Railways has operationalized 90% of its DFCs, covering a distance of 2,800 kms. Utilizing the advantages of this freight focused infrastructure, India intends to build more DFCs connecting important cities. (April 2024)
- About DFCs:
 - Dedicated Freight Corridors (DFCs) are high speed and high-capacity railway corridors that are exclusively meant for the transportation of freight or goods commodities.
 - India's Ministry of Railways has undertaken the construction of two DFCs namely:
 - i. **Eastern Dedicated Freight Corridor:**
 - » 1,840 kms (between Ludhiana (Punjab) to Sonnagar (Near Kolkata, WB)). It will also include PPP section of the Sonnagar-Dankuni route.
 - » It will run through Delhi.
 - » States covered include Punjab, Haryana, Uttar Pradesh, Jharkhand, Bihar and West Bengal.
 - ii. **Western Dedicated Freight Corridor** (between **Dadri (Uttar Pradesh)** and **Mumbai** (Jawaharlal Nehru Port Terminal (JNPT)).
 - » **1,506 kms**
 - » **States covered: UP, Haryana, RAJ, Gujarat, and MHA.**
 - The DFCs are being developed by Dedicated Freight Corridor Corporation of India Ltd (DFCCIL).
 - The Funding for DFC is through World Bank (US\$ 2.725 billion) for EDFC, and Japan International Cooperation Agency (JICA) loan (38,722) for WDFC and rest from the Gross Budgetary Support (GBS).
- Expected Impact
 - Reduce travel time on the two routes for both passengers and goods.

- DFCCIL will run freight trains at the maximum speed of 100 kmph as against the current maximum speed of 75 kmph on Indian Railway tracks whereas the average speed of freight trains will also be increased from existing speed of 26 kmph on Indian Railway lines to 70 kmph on DFC.

- Benefit industries; Reduce pollution

- Progress:

- As of April 2024, India Railways have operationalized **100% of the eastern arm** and **85% of the western one**.
- **Average speed** of the trains is around 50-60 kmph (and can be increased upto 100 km per hour)
- **Estimated cost** of operationalizing the network currently stand at Rs 1,24,000 crores.

A) 3 MORE DEDICATED FREIGHT CORRIDORS, INCLUDING COMMODITY SPECIFIC ROUTES, ARE BEING CONSIDERED AS PART OF THE INDIAN RAILWAYS' PLAN (APRIL 2024)

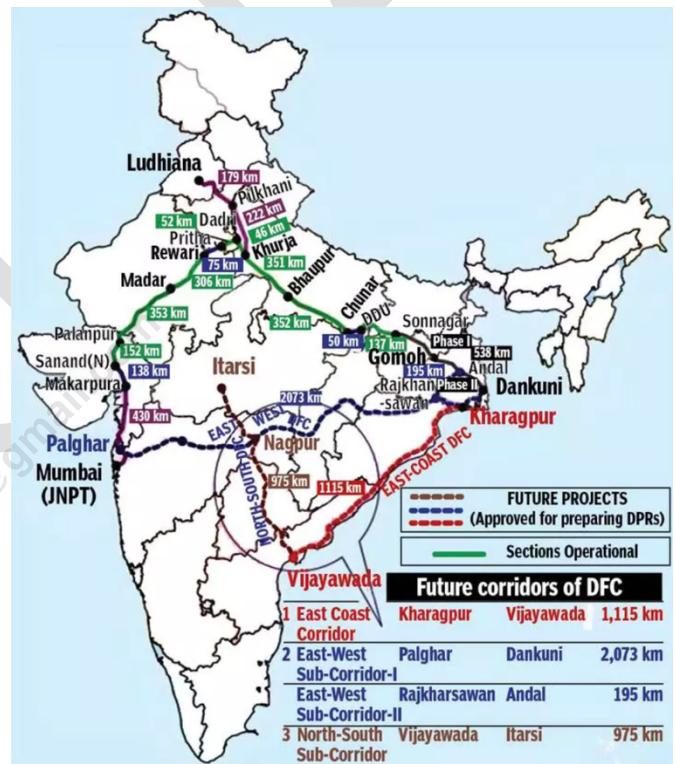
- The three corridors together will cover a length of 4,300 kms with an estimated project cost of Rs 2 lakh crores.
- Progress:

- All three network alignment reports are being prepared by the Dedicated Freight Corridor Corporation of India Ltd (DFCCIL). While two of the DPRs have been submitted, a third will be ready by the end of this month.

» **East Coast Track:** The proposed corridor is along the east coast running parallel to the existing coastal passenger rail line and covers approximately 1,200 kms starting at Kharagpur (WB) and terminating in Tenali (in Andhra Pradesh). The route passes through mineral bearing states of Bengal and Odisha, connecting the Vizag route. The target sector includes coal, fertilizers, and iron-ore movement apart from commodities like steel.

» **North South Corridor:** It covers Itarsi (in Madhya Pradesh) to Tenali (Andhra Pradesh) a distance of around 1,000-1200 kms. It will pass through Itarsi, Nagpur, Vijayawada and end at Tenali. It will pass through four states, MP, MHA, Telangana and Andhra Pradesh. Traffic would cover coal, cement, fertilizers, petroleum, lubricants etc. The long term plan would be to connect Dadri in UP with Itarshi. This will allow connecting the existing and operational DFCs with the upcoming ones.

» **The third corridor** - still under preparation- covers the East West Route connecting Andal (WB) with Palgarh (MHA). This route passes through five states which include WB, Jharkhand, Odisha, Chhattisgarh, and Maharashtra. The main line will cover close to 2,100 km and there will be spur lines with additional 300 kms.



7) GATI SHAKTI CARGO TERMINALS

- The Ministry of Railways has launched a new policy for developing Gati Shakti Cargo Terminals (GCTs), which are m multimodal logistics facilities that can handle rail cargo along with other modes such as road or water transport.
 - » It will provide seamless integration of rail transport with other modes of transport and enable customers to choose their preferred mode based on cost effectiveness and convenience.
- GCTs are being developed by private players with minimal intervention from the government.
- As of Dec 2023, 15 GCTs have been commissioned and around 96 more locations have been provisionally identified.
- It will provide seamless integration of rail transport with other modes of transport and enable customers to choose their preferred mode based on cost effectiveness and convenience.
- This will reduce congestion at railway stations and improve passenger amenities.

8) OTHER MAJOR RAILWAY INFRA NEWS

A) AMRIT BHARAT STATION SCHEME FOR INDIAN RAILWAYS

- Ministry of Railways have formulated a new policy for modernization of stations named "Amrit Bharat Station" scheme. It envisages development of stations on a continuous basis with a long-term vision. It is based on Master Planning for long term and implementation of the elements of Master Plan as per the needs and patronage of the station.

B) CABINET APPROVES SPECTRUM FOR RAILWAYS (FEB 2024)

- The Railways had sought 5 MHz of wireless spectrum for sending real-time data from trains, which would enhance passenger safety.
 - » TRAI had floated a consultation paper on whether the transporter should be able to get - largely free of cost.
- But Union Cabinet in a surprise move approved the proposal, even though TRAI's response was pending.

C) CHENAB BRIDGE

Indian railways is constructing the iconic Arch Bridge on River Chenab as part of the Udhampur-Srinagar-Baramulla Railway Link (USBRL) project to connect the Kashmir valley to the rest of the nation.

It is located between Bakkal and Kauri in the Reasi district of Jammu Division of J&K, India.

It will be the world's highest railway bridge that soars 359 meters above the bed of the Chenab river in J&K.

- The bridge is 35 meter higher than the Eiffel Tower in Paris.

The 1.315 km long bridge is being constructed at a cost of Rs 1486 crore.



In April 2021, Indian **railways completed the arch closure of Chenab Bridge**. The Arch is the most difficult part of the bridge. It stands only with the support from the two embankments and without any intermediate pier.

- No pier could be used as the river is 359 meters below and no pier could possibly come at a height like that.
- Arch consists of steel boxes, which will be filled with concrete to improve stability.

The bridge is expected to be **open for rail traffic in 2024**.

- Other key features of the Bridge

- » The Bridge is designed to withstand high wind speed upto 266 km/hour.
 - » The bridge is also designed for blast load in consultation with DRDO for the first time in India.
 - » It can also withstand earthquake forces of highest intensity Zone-5 in India.
- **Note:** While the Chenab bridge project is being touted as the World's highest rail bridge by India, it may lose the title to neighbouring China, which is constructing the Daduhe railway bridge in Ludig along the Sichuan-Tibet Railway at a height of 380 meters.

D) PAMBAN BRIDGE – INDIA'S FIRST VERTICAL LIFT RAILWAY BRIDGE

- Why in news?

- » New Pamban Bridge may miss its Nov 2023 deadline (Sep 2023)

- Details

- » **Background:** The existing Pamban Rail Bridge, which connects Rameswaram to mainland India is more than a 100 years old. It was built in 1914 and connects Mandapam to the Rameshwaram Island. Till 1988, it was the only link connecting the two locations when a new road bridge was built parallel to the sea link.



- New Railway Bridge:

- » The state-of-the-art bridge will be country's first vertical lift railway sea bridge.
 - The bridge is stretches for 2.05 km and will have a 63 meter stretch which will lift up while remaining parallel to the deck to allow access to the ships.
- » It will help railways to operate trains at higher speed and will carry more weight and increase the volume of traffic.
- » It is being executed by Rail Vikas Nigam Limited (RVNL) at a cost of Rs 535 crores.

- Missing Deadlines (Sep 2023)

- » Its initial deadline was March 2023, which was then extended to July 2023 and then to Nov 2023. However, in Sep 2023, due to increased wind speed at the project site the work has been hampered.
- » As of Dec 2022, 84% work has been completed.

- **Video:**
 - » See video in the link: <https://www.thehindu.com/news/national/tamil-nadu/watch-pamban-bridge-indias-first-vertical-lift-railway-bridge/article65487414.ece> to get better understanding.

9) REGIONAL RAPID TRANSIT SYSTEM (RRTS) PROJECT AND NAMO BHARAT RAPIDX TRAIN

- **Why in news?**
 - » PM Modi inaugurated the priority section of Delhi-Ghaziabad-Meerut RRTS Corridor at Sahibabad RapidX station in Ghaziabad, Uttar Pradesh (Oct 2023)
- **Background:**
 - » **Need:** Increasing traffic, congestion, pollution, accidents in Delhi NCR.
 - » In 2005, the Planning Commission formed a task force under the chairmanship of Secretary, Ministry of Urban Development to develop a multi-modal regional transit system for the NCR.
 - » **The Integrated Transport Plan for NCR 2032** also includes RRTS connecting regional centres.
 - » **In July 2013**, a joint venture (JV) of GoI, and the States of Haryana, Rajasthan, Uttar Pradesh, and Delhi was formed - National Capital Region Transport Corporation (NCRTC).
- **The Delhi-Meerut RRTS** is a partially operational **82.15 km** long semi-high speed rail and regional transit corridor that will connect NCR cities of Delhi, Ghaziabad, and Meerut.
 - » It is the first of the four rapid rail corridors planned under the first phase of the RapidX project managed by the NCRTC.
 - » It allows a max speed of 180 km/h and distance between Delhi and Meerut will be covered in less than 1 hour.
 - » The foundation stone for the project was laid by PM Modi in March 2019, and construction began in June 2019.
 - » **Current Scenario:**
 - As of March 2024, corridor from Sahibabad to Modinagar Depot was operational.
 - Rest of the entire **81 km** long corridor will be opened by June 2025.
 - » **Who owns the Corridor?**
 - The owner of the corridor and its trains is the NCRTC, under who the construction is also underway.
 - The operator of the corridor is DB RRTS Operations India Pvt Ltd a subsidiary of Deutsche Bahn (DB).
 - » Upon opening, the RRTS became the first regional transit system of India, also consisting the fastest rapid transit train in India.
- **Namo Bharat RapidX Train:**
 - » Trains of the RRTS will be known as 'Namo Bharat RapidX'
 - » These trains are indigenously manufactured with a designed speed potential of 180 kmph and operational speed potential of 160 kmph. They are fully air-conditioned, safe and comfortable.
 - » Every Namo Bharat RapidX Train will have six coaches, including a premium coach. One coach in every train is reserved for women.

10) RAILWAY SAFETY

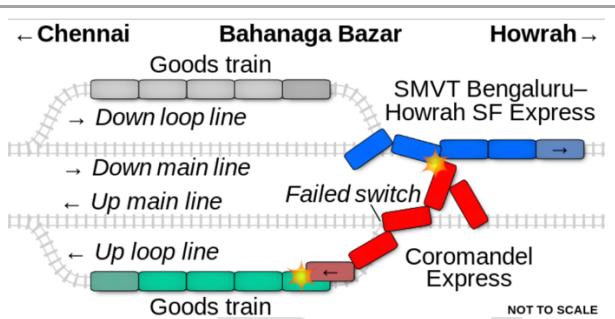
A) ODISHA ACCIDENT

On 2nd June 2023, three trains collided in Balasore district in Odisha state. The Coromandel Express entered the passing loop instead of the main line near Bahanaga Bazar Railway Station at full speed and collided with a goods train. Due to its high speed, its 21 coaches derailed and three of those collided with the oncoming **SMVT Bengaluru-Howrah Superfast Express** on the adjacent track.

A total of 296 people were killed, and more than 12,000 others were injured in the accident.

It was the deadliest railway crash since the Firozabad rail collision in 1995. It was also the deadliest rail disaster worldwide since the 2004 Sri Lanka Tsunami train wreck.

Main Reason: Signaling Failure



B) WHY COROMANDEL EXPRESS CRASHED: UNDERSTANDING THE BASICS OF RAILWAYS SIGNALING SYSTEM

- Interference with the "Configuration" of the track led to the Coromandel Express to smash into the stationary goods train.
- **Understanding the Interlocking in Railways:**
 - » Interlocking is a crucial safety mechanism that ensures train movements continue without any conflicts, thus preventing accidents. There are three main components of the inter-locking system: **point**, **track occupancy sensing devices**, and **signal**. The interlocking system coordinates the functions of these three components to control train movements.
- **What is the function of each of these three main components?**
 - » Signals (which are lights of green, red, and yellow color) are installed along the track to indicate the status of the track ahead.
 - » Track Circuits and Electrical Circuits (also known as the track-occupancy sensing devices) that detect the presence of trains.
 - There are various kinds of track-occupancy devices. Generally, sensors are installed on the tacks that detect the passage of wheels on the rails. These are called axle counters.
 - » **Points** allow trains to change tracks.
 - The Coromandel was supposed to go through Bahanagar Bazar on the 'Up' main line, but the point just before the station switched the express on the loop line that was already occupied by the stationary goods train.
 - How does the points work?

- The Points, also known as **Switch Rails**, are movable rails that are typically placed at the point of divergence of two tracks going to different directions. Once the direction of a train is determined, the **point gets locked to a particular position**, and cannot be budged until the train has passed. The driver, or loco pilot, has no say in this matter.
- **How is the whole system configured?**
 - » A **sound logic of what is 'safe' train operation is fed** into interlocking system, which is controlled remotely from the station.
 - Earlier, some of the components also worked manually.
 - » **Today**, out of the **7,000-odd stations** in the Indian Railway network, **only around 100 small stations** still have manual levers to control these points. The **rest operate electronically**, even though the basic principles of the logic are taken from the old and time-tested standard procedure for safety.
- **How safe is the system?**
 - » If **any of the three components** (signals, points, and track occupancy sensors) doesn't correspond to the overall 'safe' logic fed into the computer, the **system will work to stop the oncoming train**. This means **if the point is not locked**, or not set to the **desired direction**, and/or if the sensing device detects that the track is **not clear** the **signal will automatically turn red** - indicating to the oncoming train that **something is wrong** and that it should stop. This is called a "fail safe" system - one that errs on the side of the safety.
- **This interlocking system** is used in **railway networks worldwide**.
- **How are these systems secured against interference?**
 - » **The relay room** - which is the **place from where the entire interlocking/ signaling apparatus can be controlled or manipulated** - is locked with **double locks**. **One key** is with the **station master**; the **other is in the custody of the signaling staff**. To open the relay room, even for maintenance, **station master's permission is required**. With improved technology, **opening and closing of relay rooms were connected electronically to the data loggers**. Every event is **registered on a server**, and an SMS is also triggered to officials concerned.
- **What happened in Balasore accident?**
 - » As it now appears, a **signal maintainer or technician of the signaling department at the Bahanaga Bazar station** **did open one of the location boxes at the station to "loop" the circuit and achieve a "clear path"** (or a green signal) for the Coromandel Express.
 - **Note:** Location boxes are **the junctions of cables from various hardwares meeting circuits to work in the pre-set safety logic**.
 - » This **Safety override** is usually unauthorized.

C) COMMISSIONER OF RAILWAY SAFETY (CRS)

- Investigation into the **recent tragic train accident in Odisha**, is being conducted by the **Commissioner of Railway Safety for the south-eastern circle**.
- **Rail Safety Commissioners** are part of the **Commission of Railway Safety (CRS)**, a government body that **acts as the railway safety authority in the country**.

- CRS deals with matters related to safety of rail travel and operations, among some other statutory functions - inspectorial, investigatory, and advisory - as laid down in the Railways Act, 1989.
- Investigating Railway Accidents is one of the key responsibilities of the CRS.
- It is headquartered in Lucknow.
- It is to be noted that CRS doesn't report to Ministry of Railways. It is under the administrative control of the Ministry of Civil Aviation (MoCA).
 - **Why?**
 - » To keep CRS insulated from the country's railway establishment and prevents conflict of interest.
- It was in May 1941, that the Railway Inspectorate was separated from the Railway Board and put under the administrative control of the then Department of Post and Air. This inspectorate was redesignated as the CRS in 1961.

11) IMPORTANT STEPS IN RECENT DECADES TO ENSURE RAILWAY SAFETY

- i. **Anil Kakodkar Committee: High Level Safety Review** Committee was formed by Ministry of Railways in 2011 and it submitted its report in Feb 2012. It recommended modernization of tracks; elimination of level crossings by building rail over and under bridges; strengthening Railway Bridges; 100% mechanized track maintenance etc.
- ii. **Rashtriya Rail Sanraksha Kosh (RRSK)** was created with a corpus of Rs 1 lakh crore over a period of 5 years for giving a major boost to safety related works.
- iii. **Induction of technology for safety improvements – Smart Coach**
 - » Smart coach with diagnostic system monitor bearing vibrations provides advance information on health of bearing wheel & track. In addition, coach has been provided with wheel slip protection monitoring.
- iv. **Complete switchover to LHB:** Indian Railways have decided to completely switch over to manufacture of LHB design main line coaches from 2018-19 onwards.
 - » **Linke-Hofmann-Busch (LHB)** coach is a passenger coach of Indian Railways. It is developed by Linke-Hofmann-Busch of Germany and produced by rail coach manufacturing units at Kapurthala, Chennai and Raibareli. They have been used since 2000 on the broad gauge network of Indian railways.
- v. **Other steps include**
 - » **Elimination of level crossings**
 - » Number of **stations with the installation of CCTV based camera surveillance** have increased.
 - » **Indian Railway Institute of Disaster Management** have been opened up in Bangalore for training of officers and staff.
 - » **Commandos for Railway Security** - Launch of first Railway Commando battalion 'CORAS' on 14th Aug 2019 to tackle the menace of terrorism and Naxalism.
 - » **Empowerment of RPF** to make seizure under Narcotics, Drugs and Psychotropic Substances (NDPS) Act
 - GoI through a notification in April 2019, empowered RPF to make seizures and arrest under NDPS act.
 - Subsequently, RPF have recovered large number of such recoveries.

- vi. **Provision of Electronic Interlocking (EI):** To increase safety and flexibility EI is being adopted on large scale to derive benefits of digital technologies in train operation and enhance safety.
- vii. **KAVACH Technology (Automatic Train Protection System)**
 - » KAVACH has been developed indigenously by RDSO in association with three Indian vendors and it has been adopted as our **National Automatic Train Protection (ATP) System**.
 - It will aid Loco Pilot to avoid Signal Passing At Danger (SPAD) and over speeding but also help in train running during inclement weather such as dense fog.
 - » **Key features:**
 - Controls speed of the train by automatic application of brakes in case Loco Pilot fails to apply the brakes
 - Repeats line-side signal in cab which is very useful for higher speeds and foggy weather
 - Works on principle of continuous update of Movement authority
 - Auto Whistling at LC gates
 - Collision avoidance by direct to loco communication
 - Supports feature of SOS in case of any mishap to control train in vicinity.
 - » **Total Expenditure** incurred so far on development work of Kavach is Rs 16.88 crores.
 - » At present (March 2022) Kavach roll out is planned on New-Delhi Howrah and New Delhi - Mumbai Section which is targeted for completion by March 2024. Further rollout will be planned based on experience gained.

4. URBAN DEVELOPMENT

1) SMART CITIES MISSION (SCM)

- Government of India launched **Smart Cities Mission (SCM)** on 25 June 2015.
 - It aims to transform 100 cities by 2019-20.
 - » The mission has been given two extensions with the new deadlines being 30th June 2024.
 - The SCM has two main aspects:
 - » **Area Based Development** consisting of three components: Redevelopment (city renewal), retrofitting (city improvement), and green field projects (city extension)
 - » **Pan city Solutions based on ICT**.
 - It is based on the idea of developing the entire urban eco-system on the principles of complete and integrated planning.
 - The **main objective** of the Smart Cities Mission (SCM) is to promote cities that provide **core infrastructure, clean and sustainable environment** and give a decent quality of life to their citizens through application of 'Smart solutions'.
 - It also aims to drive economic growth and improve quality of life through comprehensive work on social, economic, physical, and institutional pillars of the city.
 - The plan is also to create a **replicable model** which will act like a light house to other aspiring cities.
- **What was the initial plan?**
 - 100 smart cities were selected through 4 rounds of competition between Jan 2016 and June 2018.
 - **Funding:**
 - Around 2 lakh crores (coming from Center, States, ULBs and PPPs) was kept aside for the mission.

- **Implementation and Monitoring Mechanisms:**
 - The implementation of the SCM at the city level is done by SPV created for the purpose.
 - » The SPV brings in a business model of governance. It was adopted by bypassing the existing models of city governance in the country.
 - » This SPV is led by a bureaucrat or a representative of an MNC, and other major stakeholders. It was created under the Companies Act.
 - » The SPV plans, appraises, approves, release funds, implement, manage, operate, monitor and evaluate the Smart City development projects.
 - » The SPV is headed by a full time CEO, and has nominees of Central Government, State governments and ULB on its Board.
 - At the state level, the mission implementation is coordinated by the State Level High Powered Steering Committee (HPSC) chaired by Chief Secretary of the State.
 - At the national level, implementation of SCM is monitored by an Apex Committee headed by Secretary, MoHUA.
 - The apex committee regularly reports on the progress of projects through the Real Time Geographical Management Information System (GMIS).
 - A Smart City Advisory Forum (SCAF) has also been established at the city level to advise and enable collaboration among various stakeholders.
 - As of May 2023, the Smart Cities have convened more than 756 meetings of SCAF.
 - Integrated Command and Control Centres (ICCC) is operational in all 100 Smart Cities.
 - These ICCC work as the brain and nervous system for the city operations, using technology for urban management.
- **Note:** The period of implementation of SCM has also been extended upto June 2024 and all remaining projects are expected to be completed by this time.
- **Progress:**
 - » The mission has around 78,00 projects worth Rs 1.8 lakh crores. As of July 2023, around 74% of the projects were completed.
 - » As of 1st May 2023, Rs 38,400 crores were released under the Smart Cities Mission, of which around 90% (Rs 35,261) crores have been utilized.
 - » Only 22 cities out of 100 cities have been able to finish all projects commissioned under the mission.

A) LABELLING STRATEGY OF SCM

- **The 100 Cities** part of SCM are marking their completed projects with logos, in a strategy aimed at displaying the accomplishment so far.
 - » In June 2023, a letter to the Smart City CEOs asked for the implementation of the "**labelling strategy**".
 - To form a "link to build trust with the community".
 - This would act as a method for creating awareness and providing information to the stakeholders of the projects.

B) SMART CITIES AWARD, 2022 (ANNOUNCED IN AUG 2023)

- The MoH&UA has named Indore as the best city, and Madhya Pradesh the best state in the Smart Cities Mission in its India Smart Cities Awards 2022.
 - » Surat and Agra were named second and third best among the cities and TN second in states, with the third prize being shared by Rajasthan and Uttar Pradesh.
- **How were the winners chosen?**
 - » Based on their ranking in terms of progress of projects, project outcomes, and presentations submitted for the awards.

2) AMRUT (ATAL MISSION FOR REJUVENATION AND URBAN TRANSFORMATION) AND AMRUT 2.0

- » Launched on 25th June 2015 to complement the Smart Cities Mission. It targeted covering 500 cities with a population of 1 lakh and more.
- » It focused on development of basic infrastructure in the sectors of water supply; sewerage and septage management; storm water drainage; non-motorized transport; and development of green spaces and parks.
- » Mission also mandated a set of 11 Reforms for all the Mission cities and Capacity building activities for the ULBs.
- » **Ministry:** Ministry of Housing and Urban Affairs
- » It is a Centrally sponsored scheme being funded through Central and State/ULB share.

A) AMRUT 2.0

- The Union Cabinet has approved the AMRUT 2.0 for the period FY2021-22 to 2025-26, as a step towards Aatma Nirbhar Bharat and with an aim of making the cities 'water secure' and 'self-sustainable' through circular economy of water.
 - » AMRUT Mission has been subsumed under AMRUT 2.0 and ongoing projects of AMRUT 1.0 will be funded till 31st March 2023.
- It targets to provide 2.68 crore tap connections and 2.64 crore sewer/septage connections to achieve the below outcomes:
 - » **Universal coverage of water supply** by providing household tap connections in all 4,378 statutory towns.
 - » **100% coverage of household sewerage/septage management** in 500 AMRUT cities.
- **Total indicative outlay** for AMRUT 2.0 is Rs 2,77,000 crore including central share of Rs 76,760 crore for five years from FY 2021-22 to FY 2025-26.
 - » Ministry of Housing and Urban Affairs has approved State Annual Action Plans (SAAPs) of all States/Uts amounting to Rs 77,640 crores of the entire mission period.
- **Monitoring Provisions:**
 - » The mission will be monitored on a robust technology portal and the projects will be geo-tagged.
- **Other features:**
 - » Endeavour to make mission paperless

- » It promotes **Circular Economy** of water through development of **City Water Balance Plan (CWBP)** for each city focusing on recycle/reuse of treated sewage, rejuvenation of water bodies and water conservation.
- **Other Components of AMRUT 2.0:**
 - » **Pey Jal Survekshan:** To ascertain equitable distribution of water, reuse of wastewater, mapping of water bodies and promote healthy competition among the cities/towns.
 - » **Technology Sub Mission for Water** to leverage latest global technologies in the field of water.
 - » **Information, Education, and Communication (IEC)** campaign to spread awareness among masses about conservation of water.
- **The total outlay for AMRUT 2.0 is Rs 2,99,000 crore including central share of Rs 76,760 crore for five years.**
 - » This outlay includes Rs 22,000 crore (Rs 10,000 crores as central assistance) for projects of AMRUT till March 2023.
 - » The **fund** for the projects is shared by Centre, State and ULBs. Central funds is released to the states in three tranches based on the allocation to the states as per the State Water Action Plan.
 - » Mission will also mobilize market finance for mandating implementation of 10% worth of projects in cities with population above 10 lakhs through Public Private Participations.
- Entrepreneurs/start-ups will be encouraged in water ecosystems.
- The mission has a **reform agenda** focused towards financial health and water security of ULBs.
 - » Meeting 20% of water demand through recycled water, reducing non-revenue water to less than 20% and rejuvenation of water bodies are major water related reforms.
 - » Reforms on property tax, user charges, and enhancing credit worthiness of ULBs are other important reforms. ULBs will be rewarded with incentive on accomplishing the reforms.

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CAPITAL MARKET

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2. CAPITAL MARKET – FUNDAMENTALS:

- A capital market is the financial market for long term fund. It helps to generate bulk fund for government and industries.
- The most common capital markets are the stock market and the bond market.
 - The stock market allows companies to raise capital by selling shares of ownership in the company (Equity Financing).
 - The Bond Market allows companies and governments to raise capital by selling bonds (Debt Financing).
- **Securities Market** deals with shares (equity shares, preference shares, derivatives) and debt instruments.
 - **In case of Shares** (Equity financing), investors have a share in the capital and profit.
 - In case of **Debt Financing Instruments**, the investors don't have any share in the capital.
 - » Companies use Debt Financing instruments (bonds, debentures) to raise funds.
 - » It is just lending to the company and the company is liable to pay interest on the capital borrowed through bonds. Regardless of profit and loss the debt instrument holders are entitled to receive income.
 - » **Note:** Debentures are a type of bond. Any unsecured bond without any collateral is a debenture.
 - All debentures are bonds, but not all bonds are debentures. Whenever a bond is unsecured, it may be referred as debentures.
 - » **Note:** Both bonds and debentures may be convertible (meaning that they can be converted into company stocks)

1) KEY DIFFERENCES BETWEEN SHARES, DEBENTURES AND BONDS

Shares	Debentures	Bonds
<u>Shares are fractions of the company's capital.</u>	<u>Debentures are medium/long term debt instruments</u> that a company issues to borrow capital.	<u>Bonds are long term debt instruments</u> that companies issue to borrow capital.
<u>Performance of shares is highly dependent on market fluctuation.</u>	<u>Debentures are risky investments</u> as they are usually <u>not backed by collateral</u> . <u>Investor makes investment decision</u> on the basis of <u>credit rating and reputation</u> of the company.	<u>Bonds are safer investment option</u> , as it is <u>backed by collateral</u> .
<u>Shareholders are company owners who own the fraction of company equivalent to fraction of shares held by them.</u>	<u>Debenture holders are lenders</u> to the company.	<u>Bond holders</u> are lenders to the company.

The company may pay <u>dividend to the shareholders</u> in case the company makes profit.	Debenture holders receive <u>interest payments</u> periodically. It depends on <u>issuing company's performance</u> .	Bond owners receive <u>interest on accrual basis</u> . It doesn't depend on the <u>company's performance</u> .
Shares are <u>highly liquid</u> as they can be sold or purchased on stock exchanges.	Debentures has <u>lower liquidity</u> when compared to shares	Bonds have the least liquidity as these are <u>long term debt instruments</u> .
Shares <u>don't have credit rating</u> .	Debentures <u>receive credit rating</u> from CRAs.	Bonds receive credit ratings from CRAs.

2) SHARES (EQUITY, PREFERENCE, DERIVATIVES)

A) EQUITY SHARES

- Equity shares are ordinary stocks issued by a company for the purpose of raising capital to expand their business. The investor gets partial ownership of the company. The number of equities shares an investor buys is their portion of ownership in the company. Equity shares are non-redeemable, and therefore act as a long-term source of financing for companies.
- **Benefits:** Capital Appreciation; Dividends.
- However, these benefits are not fixed and are fluctuating.

B) PREFERENCE SHARE

- Preference shares carry preferential rights in terms of dividend payment and repayment of capital.
 - These shares offer shareholders fixed dividends.
 - Preferred shareholders are given their dividends before equity shareholders receive theirs.
 - In terms of priority and repayment of capital, preference shares can be ranked between debt and equity.
 - In case of bankruptcy, preferred shareholders get priority over common shareholders and receive the company's assets before them.
 - At any point of time, preference shares can be converted into equity shares.
 - Preference shares can be redeemed after a certain period or after the company successfully achieves desired goals.
- **Limitations:** Preference shareholders don't get right to vote or participate in decision-making events of the company.

C) DERIVATIVES

- Derivatives are vastly different equity stocks. They are contracts that derive their value from an underlying asset – which could be an equity stock, a currency pair or a commodity. This leads to different types of securities like equity derivatives, commodity derivatives, and currency derivatives.
- Derivatives can also be classified as futures and options based on the terms of contract.
 - **Futures:** In a future contract, two parties decide to purchase and sell the underlying asset at a specific price on a specific date in the future. This contract must be executed by both parties, and neither party has the right to let the contract expire.

- **Options:** Options contract also derives its value from an underlying asset. It gives the holder (or the buyer) of the options contract the right to purchase or sell the underlying asset at a fixed price on or before a specific date. The options buyer is not obligated to carry out the terms. Options contracts can be any one of two types – namely, call options that offer the right to buy the asset and put options that offer the right to sell the asset.

3) GOVERNMENT AND INDUSTRIAL SECURITIES

- **Based on the fund raiser**, the securities market can be classified into two types: 1) **Government Securities Market** 2) **Industrial Securities Market**

A) GOVERNMENT SECURITIES MARKET

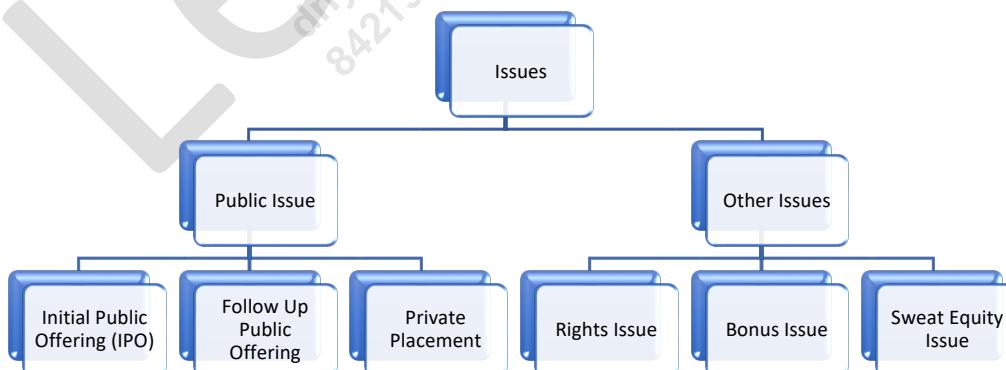
- It is a market of government and semi-government securities backed by RBI. It is also known as **Gilt Edged Market**. Gild edged means “**of the best quality**”. The government securities are more reliable and therefore they are called Gild Edged Securities.

B) INDUTRIAL SECURITIES MARKET

- It is a market for securities of industrial and commercial organizations.

4) NEW (PRIMARY) AND OLD ISSUE (SECONDARY) MARKET

- Based on the nature of issue, the securities market can be classified as **New Issue Market (Primary Market)** and **Old Issue Market (Secondary Market)**.
- **Primary Market:** Here, new securities are issued for the first time. Companies/governments raise capital by selling stocks, bonds, or other financial instruments to investors.
 - E.g.: Initial Public Offerings (IPOs) for stocks and issuance of government bonds.
 - The issue of securities in Primary Market can be classified as: 1) **Public Issue** 2) **Other Issues**



- **Public Issue** means issue of securities to public i.e. to all people, whoever wants to invest.
 - » **IPO:** If a company or financial corporation (issuer) issues shares for the first time.
 - » **FPO:** If any company or corporation has already issued shares, issues shares again, to raise additional funds it is called Follow on Public Offering.
 - » In both IPO and FPO, the issuer usually doesn't issue the security, the issuer appoints a merchant banker on behalf of it to carry out the fund raising activities.
 - » **Authorized Capital, Issued Capital, Subscribed Capital:**
 - The issuer can issue to the extent of Authorized capital. Authorized capital means the maximum amount authorized by the Memorandum of Association (MoA) of a company that can be raised by the company. A company need not issue the shares to the extent of authorized capital. It can issue less than the authorized capital. The actual amount issued by the issuer is called Issue Capital.
 - **The Subscription** may be sometimes less than the issue capital. If it is so, then it means it is unsubscribed. The actual amount of subscribed is called subscribed capital.
 - » **Private Placement** includes offering shares directly to financial institutions, mutual funds, and high worth investors.
 - **Other Issues:**
 - » **Right Issue:** Offer of security to existing shareholders in the FPO. It flows to the existing shareholders as a matter of legal rights. So, it is called the Rights issue.
 - » **Bonus Issue:** It refers to the offer of shares against distributable profit to the existing shareholders. It is also known as the scrip issue or the capitalization issue.
 - » **Sweat Equity Issue:** It denotes offer of shares to employees or Directors of the company which issues shares as recognition of their hard labour (sweat), which results in contribution to the company in the form of intellectual property rights, technical know-how etc.
- **Secondary Market (Old Issue Market):** Here, previously issued securities are traded among investors.
- E.g. Stock market where investors buy and sell shares, Bond trading platforms.
 - **Stock Exchange:** It is an institution for orderly buying and selling of listed securities.
 - **Over the counter exchange:** Platform for trading in securities that are 'not listed' on a recognized stock exchange.
- **Regulation:** In India, both New Issue and Old Issue markets are regulated by the Securities and Exchange Board of India (SEBI).

5) STOCK EXCHANGES

- In India, there are several small and big stock exchanges. The most prominent are National Stock Exchange (NSE) and Bombay Stock Exchange (BSE).
- **National Stock Exchange (NSE)** was incorporated in 1992 on the recommendation of Pherwani Committee. **IDBI** is the main promoter of the exchange. Some other leading financial institutions (SBI, LIC etc) are also promoters of its along with IDBI.

- **Bombay Stock Exchange (BSE)**: Established in 1887. It is Asia's oldest Stock exchange and was initially known as 'The Native Share and Stockbrokers Association'. It was owned by stock brokers. Now it is demutualized (i.e. made a public owned organization).

A) INDEX

- Like CPI and WPI which measure the rise/fall in the price of commodities, there are share price indices which measure the rise and fall of a bucket of shares. The most prominent indices in India are Sensex, Nifty, and Nifty Junior.
- **Sensex** stands for **Sensitive Index**. This is the index of the BSE and measures the price movement of top 30 company shares. The top 30 companies are called Blue Chip Companies.
- **NIFTY** stands for **National Index for fifty**. This and Nifty junior are the indices of National Stock Exchange. NIFTY measures the price movement of top 50 companies. Nifty junior is an index of next 50 top companies.
- **How are top companies selected**: On the basis of total value of shares that are traded in the stock exchange.
 - **Value of traded shares** = Price of one share x Number of shares traded
 - This value is called **free float market capitalization**. The value of all (both traded and non-traded (the shares that are kept for a long time)) shares is called **market capitalization**.
 - **Market Capitalization** is the value of shares that were sold to public which are called outstanding shares. Market Capitalization = Price X Total outstanding shares.

6) INDEX PROVIDERS

- **Index Providers** are companies that design, create, calculate and manage indexes. They have the responsibility to set the rules that decide what securities to include in each index, how the index will be managed, and how securities will be added or removed from that index over time.
 - » **Examples of Index Providers**: MSCI, Standard & Poors (S&P), Dow Jones, Nasdaq, FTSE Russell, Solactive, Morningstar
 - » **Note**: The first index - Dow Jones Transportation Average - was created in 1884 to measure average performance of railroad stocks in the US.
- **In India**, Index providers are subsidiaries of stock exchanges.
 - » For e.g.
 - **NSE Indices Ltd**: It is the largest index provider in India. It manages the popular Nifty indices, including the benchmark Nifty 50 Index, Nifty Bank Index etc.
 - **Asia Index Pvt Ltd (APIL)**: It is a 50-50 partnership between S&P Dow Jones Indices LLC, the world's largest provider of financial market indices and BSE Ltd, Asia's oldest stock exchange and home to iconic SENSEX Index.
- **Regulation of Index Providers**:

A) SEBI NOTIFIED THE 'SEBI INDEX PROVIDER REGULATIONS' (MARCH 2024)

- SEBI has mandated registration of index providers managing "significant indices" based on securities listed in India.
 - » The global index providers, however, may not have to register under the SEBI unless indices are used as benchmarks by domestic asset managers with large corpus.
 - » SEBI has excluded indices that are exclusively used in a foreign jurisdiction.
 - » Benchmarks regulated by RBI are also excluded from these regulations.
 - » Industry players like NSE limited, APIL etc. will have to register with SEBI
- Other than registration, the index providers covered under the regulation will also have to make the methodology documents public, follow a code of conduct, and bring more transparency on inclusion and exclusion.
- **Significance:**
 - » It is aimed at fostering transparency and accountability in governance and administration of financial benchmarks in the market.

7) DEPOSITORIES

- **Basics**
 - » Depositories are institutions that keep securities of investors in electronic format (demat format).
 - The change in ownership of shares is done electronically.
 - » Depository is an institution or a kind of organization which holds securities with it, in which trading is done among shares, debentures, mutual funds, derivatives, F&O and commodities.
 - » **Intermediaries** perform their actions in variety of securities at Depository on behalf of their clients. These intermediaries are known as **Depository Participants(DPs)**. Depository interacts with its client / investors through its agents, called DPs. For any investor/client, to avail services provided by the Depository, has to open a depository account known as Demat A/c, with any of the DPs.
 - The relationship between the DPs and the depository is governed by an agreement made between the two under the Depositories Act.
 - In a strictly legal sense, a DP is an entity who is registered as such with SEBI under the subsection 1A of Section 12 of SEBI act. As per the provisions of this act a DP can offer depository related services only after obtaining a certificate of registration from SEBI.
- **In India**, there are two depositories NSDL, Mumbai and CDSL, Mumbai
 - » National Security Depository Limited(NSDL): It is the first depository in the country. It was established by UTI, NSE and IDBI.
 - » Central Depository Service (India) Ltd (CDSL).
 - It was established by BSE, Bank of India, Bank of Baroda, SBI and HDFC Bank.

8) SEBI (SECURITIES AND EXCHANGE BOARD OF INDIA)

- SEBI is the regulator for the securities market in India. It was established in the year 1988 and given statutory powers on 12th April 1992 through the SEBI act, 1992.
- **Functions and Responsibilities**
 - **Basic Function:** The Preamble of the Securities and Exchange Board of India describes the basic functions of the SEBI as "to protect the interests of investors in securities and to promote the

development of, and to regulate the securities market and for matters connected therewith or incidental thereto.

- SEBI has to be responsive to the **needs of three groups**, which constitute the market:
 - » The issuer of security
 - » The investors
 - » The market intermediaries
 - SEBI has three functions rolled out into one body: **quasi-legislative, quasi-executive and quasi-judicial**.
 - » It drafts regulation in its legislative capacity.
 - » It conducts investigation and enforcement action in its executive function.
 - » It passes rulings and orders in its judicial capacity.
 - Though, this makes it very powerful, there is an appeal process to create accountability. There is a **Securities Appellate Tribunal** which is a three-member tribunal. A second appeal lies directly to Supreme Court.
 - SEBI has taken a very proactive role in streamlining disclosure requirements to international standards.
- **Composition:** The SEBI is managed by its members, which consist of **Chairman and 8 other members**.
- The **chairman** is nominated by the Union Government of India
 - **Two members** i.e., officers from Union Finance Ministry
 - **One member** of reserve bank of India
 - The **remaining five members** are nominated by Union government of India, out of them **at least three shall be whole-time members**.

9) RELATED TERMS

1. **P/E Ratio:** Price to Earning Ratio, is a metric used to assess a company's stock valuation. It essentially compares a company's share price to its earning.
2. **Face Value and Issue Price:**
 - Face value is the actual value of shares. It is a fixed nominal value assigned to a share by the company during its incorporation.
 - **Issue Price** is the price at which company shares are sold to the public for the first time during an IPO.
 - Premium is the extra price a share claims in the market due to high demand for it.
3. **Short Selling:** Sellers sells the securities without owning the securities. He borrows the securities and sells it.
4. **Beta:** It is a measure of stock's volatility in relation to the overall market.
 - By definition, the market has a beta of 1.0 and individual stocks are ranked according to how much they deviate from the market.
5. **Bull and Bear Trading:**
 - In bull trading, buyer buys more shares in expectation of price increase in future.
 - In Bear trading, the sellers sell the securities, with the intention to avoid loss, in the expectation that the security prices will fall.

6. **Buy Back:** Issuer buying the securities again to accumulate shares in his hands.

10) PARTICIPATORY NOTES (P-NOTES)

- **Introduction**
 - PNs (ODIs) are instruments issued by the registered foreign institutional investors (FIIs) to overseas investors, who wish to invest in the Indian stock markets without registering themselves with the market regulator, the SEBI.
 - FIIs use these instruments for facilitating the participation of their overseas clients, who are not interested in participating directly in the Indian stock market.
- **Advantages for investor**
 - **Anonymity:** PNs allow large hedge funds to carry out their operations without disclosing their identity
 - **Ease of trading** as participatory notes are like contract notes transferable by endorsements and delivery.
 - **Tax Saving** as the investor can invest through tax haven countries.
- **Advantages for India**
 - **More** Investment in the country
- **Key Controversy**
 - **Hides the identity of the investor**
 - According to a white paper on black money by government, a considerable portion of PNs are used by wealthy individuals as a mechanism to channelize black money kept in foreign countries to India.
 - SIT on black money has also called for phasing out of the participatory notes.
 - **Money Laundering**
 - P-notes have become one of the key money laundering mechanisms in the country.
- **SEBI has not banned P-Notes** because:
 - Used globally in many markets
 - SEBI believes that P-notes are legitimate instruments required for normal financial transactions and are prevalent in all the larger markets.
 - Then there are business reasons to permit these transactions through P-notes.
- **SEBI has taken a number of steps to tighten the norms**

11) GLOBAL DEPOSITORY RECEIPTS

- A GDR, also known as International Depository Receipt (IDR), is a certificate issued by a depository bank, which purchases shares of foreign companies and deposits it on the account. They are the global equivalent of the Original American Depository receipt (ADR) on which they are based.
- GDRs represent ownership of an underlying number of shares of a foreign company and are commonly used to invest in companies from developing or emerging markets by investors in developed markets. GDRs enable a company, the issuer, to access investors in capital markets outside of its home country.

3. DEBT SECURITIES

1) WHAT IS A DEBT MARKET?

- The debt market is the market where fixed income securities of various types and features are issued and traded. This includes fixed income securities from governments, municipal corporations, government bodies, and commercial entities including Financial Institutions, Banks, PSUs, Public Ltd companies etc.

What are the different types of instruments which are traded in debt market?

Market Segment	Issuer	Instruments
Government Securities	Central Government	Zero Coupon Bonds, Coupon Bearing Bonds, Treasury Bills, STRIPS
	State Governments	Coupon Bearing Bonds
Public Sector Bonds	Government Agencies / Statutory Bodies	Govt. Guaranteed Bonds, Debentures
	Public Sector Units	PSU Bonds, Debentures, Commercial Paper
Private Sector Bonds	Corporates	Debentures, Bonds, Commercial Paper, Floating Rate Bonds, Zero Coupon Bonds, Inter-Corporate Deposits
	Banks	Certificates of Deposits, Debentures, Bonds
	Financial Institutions	Certificates of Deposits, Bonds

Note-1: STRIPS – Separate Trading of Registered Interest and Principal of Securities: STRIPS are the securities created by way of separating the cash flows associated with regular G-Sec i.e. each semi-annual coupon payment and final principal payment to be received from the issuer, into separate securities. They are essentially Zero coupon bonds. However, they are created out of existing securities only and unlike other securities, are not issued through auction. Being G-Sec, STRIPS are eligible for SLR.

Note-2: The G-Secs are known as **SLR securities** in the Indian markets as they are eligible securities for the maintenance of SLR ratio by the banks.

2) WHAT IS MONEY MARKET?

- The money market is basically concerned with the issue and trading of securities with short term maturities and quasi-money instruments.

- Instruments traded in money market are: Treasury Bills, Certificate of Deposits (CDs), Commercial Papers, Bills of Exchange and other instruments of short term maturities (i.e. not those exceeding 1 year with regard to the original maturity).
- **Treasury Bills** (already studied with fiscal policy chapter)
- **Certificate of Deposits (CoD)**: A CoD is a saving product that earn interest on a lump sum for a fixed period of time. CD differs from saving account as the money has to remain untouched for the entire period or risk penalty fee or lost interest. It has higher interest rates than saving accounts as an incentive for lost liquidity. They are safer and more conservative investment than stocks and bonds, offering lower opportunity for growth, but with a non-volatile, guaranteed rate of return. Virtually every bank, credit union, and brokerage firm offers a menu of CD options. Although you lock into a term of duration when you open a CD, there are options for exiting early should you encounter an emergency or change of plans.
- **Commercial Papers**: Commercial Paper is an unsecured, short-term debt instrument issued by corporations. It's typically used to finance short term liabilities such as payroll, accounts payable, and inventories. It is usually issued at a discount from face value i.e. the commercial paper is issued at a discount and matures at its face value. It reflects prevailing market interest rates.
- **Bill of Exchange**: A bill of exchange is a written document used primarily in international trade. It's essentially an instruction from one party (the drawer) to another party (the drawee) to pay a fixed amount of money to a third party (the payee) at a specific date in the future, or on demand.
 - » **Drawer**: The person or entity who creates the bill and instructs the payment.
 - » **Drawee**: The person or entity who is instructed to make the payment (often the buyer in a trade transaction)
 - » **Payee**: The person or entity who is supposed to receive payment.

3) ADVANTAGE OF DEBT SECURITY FOR INVESTORS

- Predictable stream of payments.
- Debt securities like government bonds are also highly secure and very less volatile.
 - **Note:** The return earned on the government securities are normally taken as the benchmark rates of returns and are referred to as the risk free return in financial theory. The Risk-free rate obtained by G-Sec rates is often used to price the other non-government securities in financial market.
- It indicates wide-based efficient portfolio diversification.

4) IMPORTANCE OF DEBT MARKET TO THE ECONOMY:

- Efficient mobilization and allocation of resources
- Financing the development activities of government
- Transmitting signals to monetary policy.
- Development of heterogeneity among market participants

5) DIFFERENT TYPES OF RISKS ASSOCIATED WITH DEBT SECURITIES

- i) **Default Risk** (Credit Risk): When issuer of a bond is unable to make timely payment of interest or principal on a debt security.
- ii) **Interest Rate Risk**: This can be defined as the risk emerging from an adverse change in the interest rate prevalent in the market.
 - E.g. Upswing in the prevailing interest rate scenario leading to a situation where the investors' money is locked at lower rates.
- iii) **Reinvestment Rate Risk**: Probability of a fall in the interest rate resulting in a lack of options to invest the interest received at regular intervals at higher rates than the comparable rates in the market.

6) DEBT SECURITY MARKET STRUCTURE

- The debt markets in India and all around the world are dominated by Government securities which account for 50-75% of the trading volumes and the market capitalization in all markets.
- **In India, Government Securities (G-Sec)** account for 70-75% of the outstanding value of issued securities and 90-95% of the trading volumes in the Indian debt markets.
- **State Government securities & Treasury Bills** account for around 3-4% of the daily trading volumes.

7) WHO REGULATES FIXED INCOME MARKET (DEBT SECURITY MARKET)?

Government securities and issues by Banks and Institutions are regulated by RBI.

Non-Government securities comprising basically of Corporate Debt issues is regulated by SEBI.

8) BOND ANALYTICS

- **Bond Basics**: When a bond is issued, the issuing entity determines its duration, face value (also called its par value), and the rate of interest that it pays (coupon rate). These characteristics are fixed, remaining unaffected by changes in the bond's market.
 - E.g.: A Government bond with Rs 1 crore face value and a 7% coupon rate pays 7 lakhs in interest annually.
- **What is yield?**
 - Yield refers to the percentage rate of return paid on a stock in the form of dividend, or the effective rate of interest paid on a bond or note.
 - There are many different kinds of yields depending on the investment scenario and the characteristics of the investment.
 1. **Current Yield** of Bonds: Current yield of bond is calculated by dividing the annual coupon payment by bond's current market value.
 - » **E.g.**
 - i. Let's say Bond's face value is Rs 1 crore.
 - ii. Coupon is 10%.
 - iii. Bond's market value is Rs 1.1 crore.
 - » **Current yield in percentage = Annual Coupon Payment/ Bond Price**

$$= (10 \text{ lakh} / 1.1 \text{ crores}) = 0.0909 = 9.09\%$$

- » **Significance:** The current yield calculation helps investors drill down on bonds that generate the greatest returns on investment each year.

2. **Yield to Maturity:** It is the % rate of return paid on a bond, note, or other fixed income security, if you buy and hold the security till its maturity. It's a more complicated calculation and not relevant for our preparation.

- **How is the Price determined in the Debt Market?**

- The price of bond in the debt market is determined by the forces of demand and supply.
 - The price fluctuates according to change in:
 1. Economic Condition
 2. General Money market condition including the state of money supply.
 3. Interest rate prevalent in the market
 4. Future interest rate expectations
 5. Credit quality of the issuer
 - There is, however, a theoretical underpinning to the determination of the price of the bond in the market based on the measure of the yield of the security.

- **Bond Yield as a function of Price:**

- **Yield and Bond Prices** are inversely related. So, a rise in price will decrease the yield and a fall in the bond price will increase the yield.
 - **When the prevailing interest rate in market rise**, the prices of outstanding bonds will fall to equate the yield of older bonds with higher-interest rates of new issues. This will happen as there will be very few takers for the lower coupon bonds resulting in a fall in their prices.
 - **When the prevailing interest rate in market falls**, the price of outstanding bonds will rise, until the yield of older bonds is low enough to match the lower interest rate on the new bond issue.

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2. S&T: DEFENCE – FIGHTER JETS

1) LCA PROGRAM

- In 1983, IAF realized the need of an Indian Combat for two primary purposes - i) Replacing Mig-21 fighters which were mainstay of Indian Airforce in 1980s; ii) Serving as a vehicle for an across the board enhancement of India's domestic aerospace industry.
- **Aeronautical Development Agency (ADA)** was set up in 1984 under the DRDO to oversee the development of LCA program. It is national consortium of 100 defence laboratories, industrial organizations, and academic institutions with HAL being the principle contractor.

A) LCA TEJAS

- **News:**
 - » LCA Tejas Mark 1A fighter aircraft completes first flight in Bengaluru (March 2024)
 - » IAF flies PM Modi on a Tejas aircraft over Bengaluru for 30 mins (Nov 2023)
 - With this, PM Modi became the first prime minister to fly in a fighter aircraft.
 - » **The Defence Acquisition Council (DAC)**, chaired by Defence Minister Rajnath Singh, cleared total procurement worth Rs 2.23 lakh crores which include procurement of 97 Tejas light combat aircraft and 156 Prachand Combat Helicopters. (Nov 2023)
- **HAL Tejas** is a single seat, single-engine, multi role light fighter developed by Hindustan Aeronautics Limited for India. It came from the LCA programme and is first aircraft of India that carries **Made in India tag**.
 - **Note:** There is a twin seat variant which is used for training.
- It is also world's smallest and lightest supersonic aircraft.
- LCA was officially named "Tejas" meaning "radiance" by the then Prime Minister Atal Bihari Vajpayee.
- The Tejas is the second supersonic fighter developed by HAL after **HAL HF-24 Marut**.
- **Role of LCA in AirForce**
 - » LCA falls in the lower tier of the evolving conventional force structure of the IAF.
 - At the upper level we have aircrafts like Su-30 MKI and Dassault Rafale. **Tejas will from the lower end of the strike package** complimenting the heavy Sukhois and the medium Rafales. It will be replacing Mig-21 aircraft.
- **Capability of Air-to-Air Refueling:** In 2018, LCA Tejas became the first Indian aircraft to complete air-to-air refueling.

B) LCA TEJAS MK1A

- It is a variant of LCA Tejas MK-1A which has more than 40 improvements over the Mark-1 variant.
- **Updates:** In March 2024, HAL successfully completed the first flight of indigenous LCA Tejas Mk-1A.

C) LCA TEJAS MK2

- Cabinet committee on security (CCS) gave sanction for the development of MK-2 in Aug 2022 at a total cost of Rs 9,000 crores.
 - Prototype is expected to be rolled out by 2024-25.
- LCA Tejas MK-2 will be a larger and more capable jet and will be powered by F414 engines.
 - GE Aerospace (a US company) have delivered 8 F414 engines as part of the ongoing development program of LCA-Mk2.

D) FEATURES OF F-414 ENGINES

- India has shortlisted the F414-INS6 model for LCA MK-II for the IAF.
 - » Afterburner turbofan 154-inch long engine in the 22,000-pound (98 kilonewton) thrust class - 35% more thrust than F404 engines.
 - Note: Afterburner thrust increases the thrust of a jet engine for short periods to improve an aircraft's take-off, climb, and combat performance.
 - » A thrust to weight ratio of 9:1, which is an indicator of aircraft propulsion.
 - The higher an aircraft's thrust to weight ratio, the higher its acceleration, excess thrust, and rate of climb.
 - » Higher Payload: It will have a payload capacity of 65,00 Kg which is almost double of 3,500 kg of LCA-MK-1 and LCA MK-1A.
 - » Low maintenance cost.
 - » More reliable and greater engine durability with reduced life-cycle cost.
 - The engine was designed to maximize time on wings, which is a measure of the operational reliability of the engine.
- Warjets around the world powered by these engines:
 - » F-414-GE-400 engine power the US Navy's Boeing F/A-18E/F Super Hornet and EA18G Growler electronic attack aircraft.
 - » F-414-G is used in SAAB's Gripen E/F fighters.
 - » It could also power the upcoming Korean KF-X.
- GE's F-414 military aircraft engine powers state of art fighters like the Boeing Super Hornet and Saab Gripen.

E) MOU BETWEEN GE AEROSPACE AND HAL (JUNE 2023)

- During PM Narendra Modi's U.S. visit, Engine manufacturer General Electric Aerospace signed an MoU with HAL. This MoU contains provisions for production of fighter jet engines for the indigenous LCA. It includes:
 - » Provisions for joint production of GE Aerospace's F414 in India for LCA MK2 program.
 - The agreement will allow the manufacture under license in India of GE's F414 engine for the indigenous Light Combat Aircraft (LCA) Tejas Mk2.
 - » It also has an 80% transfer of technology clause. Such huge level of tech-transfer hasn't happened between India and USA in the past and it shows level of trust India evokes in the US.
 - Except for a small component, the F-414-INS6 engine will be entirely manufactured in India.

- **Critical technologies** that will be transferred are - Special coating for corrosion; casting, machining and coating for single crystal for turbine blades; etc.
- » **Note:** The proposal needs authorization from the US congress before an agreement could be concluded.
- » Once the contract is signed (after US Congress approval), it will take three years for the first engine to roll out.
- **Note:** **F404 engines** being used by LCA MK1 and LCA MK1A are produced by GE Aerospace.
 - » GE Aerospace started working with Aeronautical Development Agency in 1986 and in total, 75 F404 engines have been delivered and another 99 are on order for LCA Mk1A.
- **Significance of the deal:**
 - » The pact to build F-414 in India for the LCA Tejas Mk2 marks a key milestone in India-US ties, and the final burial of the 'technology denial regime'.
 - » Currently, only four countries - USA, Russia, UK and France have mastered the technology and metallurgy needed to manufacture an engine that can power combat aircraft.
 - Even China buys the engine for its fighter jets from other countries including UK.
 - Generally, the countries who have this technology have avoided sharing it. And therefore this India-US deal is very significant

2) ADVANCED MEDIUM COMBAT AIRCRAFT (MARCH 2024)

- **Why in news?**
 - » The Cabinet Committee on Security (CCS) has cleared a Rs 15,000 crore project to design and develop the Advanced Medium Combat Aircraft (AMCA), India's fifth generation fighter multirole fighter jet (March 2024)
- **Details**
 - » **AMCA** will be an Indian single seat, twin-engine, all weather fifth generation stealth, multirole combat aircraft being developed for the Indian Air Force and the Indian Navy.
 - MK-1 variant will be fifth generation.
 - MK-2 variant is expected to be sixth generation.
 - » **Nodal Agency for Implementing the Program:** The Aeronautical Development Agency (ADA) under DRDO.
 - The aircraft is designed by ADA.
 - A Special Purpose Vehicle (SPV) is being formed consisting of ADA, HAL and a private company for the development and production of AMCA.
 - » **Manufacturer:** It will be manufactured by HAL.
 - » In **March 2024**, the Cabinet Committee on Security has approved the project to design and develop AMCA, India's fifth generation fighter multirole jet. The project will be allocated Rs 15,000 crores.
- **Features:**
 - i. **STEALTH:** Advanced stealth feature to avoid detection by enemy radar.
 - This is the main difference between fifth and fourth generation aircrafts. The aircraft will have low electro-magnetic signature, which will make it difficult for enemy radar to detect it.

- It will also have powerful sensors and new weapons, so it is able to register the signature of enemy aircraft and take them out.
 - ii. **Fuel:** It will have large, concealed internal fuel tank of 6.5 tonnes capacity.
 - iii. **Weapon:** It will have internal weapon bay for a range of weapons.
 - iv. **Engine:** It will have US build GE414 engine of the 90 Kilo Newton class. It will be developed indigenously by DRDO's Gas Turbine Research Establishment (GTRE) in collaboration with a foreign defence major.
- **Timelines:** After the CCS approval, ADA hopes to have the first flight of the aircraft in four and a half to five years. The full development of aircraft is going to take 10 years from now.
- Five prototypes will be built before HAL starts manufacturing.
- **Other fifth generation fighters:**
- **USA:** F-22 Raptor and F-35A Lightning II
 - **China:** J-20 Mighty Dragon
 - **Russia:** Sukhoi Su-57.
- **IAF's Dwindling Numbers:** Sanctioned strength - 42 Squadrons; Currently -> 30 Squadrons.
- The numbers will further dwindle as squadrons of Mig-21s, Mig-29s, and Mirage 2000s are scheduled to be phased out by the middle of the decade.
- **Significance:**
- India will become one of the few countries to have indigenous fifth generation aircraft.
 - **Note:** Earlier, India was planning to jointly develop fifth generation aircraft with Russia but, India withdrew from the project in 2018.
 - **Note:** LCA Tejas is a 4.5 generation single engine multirole aircraft; Similarly, Rafale is considered 4.5 generation aircraft.

3) DASSAULT RAFAEL

- **India and France had signed an Intergovernmental agreement in Sep 2016 to provide 36 Rafale fighter worth nearly 59,000 rupees (€7.87 billion)**
 - » First procurement since Sukhoi in 1990s.
 - » India started getting the fighter jets in 2019 and by Dec 2022, India has received all 36 Rafale Aircraft.
- **Key features of the deal**
 - » **50% offset clause**
 - » The deal includes the aircraft in fly away condition, weapons, simulators, spares, maintenance, and performance-based logistics support for first five years.
 - No expenditure on maintenance for five years.
- **Features of Rafale fighter jets**
 - » It is a twin-engine fighter, multi-role fighter aircraft.
 - » The Rafale's strength lies in its advanced radar and an array of Meteor, Scalp and Mica missiles, besides 13 India-Specific enhancements.
 - » Equipped with latest missiles and weapon system besides multiple India specific modifications
 - » Rafale's '**Delta Wing**' make it exceptionally stable at supersonic speeds.

- » It is capable of carrying out all combat missions: air defense, interception, ground support, in-depth strikes, reconnaissance, anti-ship strikes and nuclear deterrence.
- **Impact**
 - » **Modernization: Generation 4.5**
 - » Rafale will also increase India's deterrence capability and with improved deterrence, chances of conflict will reduce.
 - » The IGA doesn't put any restriction on its use and hence it is likely to succeed Mirage Fighters for nuclear warhead delivery as part of India's nuclear doctrine.
- **Other significance**
 - » As per the contract, at least 75% of the Rafale fleet has to be operationally available, which would make it the most available fighter in the IAF fleet.
- **Understanding the involvement of Anil Ambani**
 - » **50% offset clause means** that Dassault has to invest around Rs 30,000 crore in Indian.
 - » **Dassault has chosen Reliance** as a partner to complete its offset obligations.
 - Bulk of the money will be invested through Dassault Reliance Aerospace, a joint venture between Reliance Aerostructure and Dassault.

4) RAFALE-M

- The Rafale-M is a fighter jet manufactured by Dassault Aviation.
 - » It is a versatile, single seat aircraft capable of performing a range of missions including Air defense, nuclear deterrence, deep strikes, and reconnaissance.
 - » Its max take-off weight is of 24.5 tonnes and can carry an external load of upto 9.5 tonnes.
 - » The aircraft can reach a speed of 750 knots (1,389 kmph) and operates efficiently at altitude upto 50,000 feet.
- **Operational Capabilities:** It can perform both air to ground and air to air missions simultaneously.
 - » It supports variety of armament including long-range Meteor missile, MICA Missile, Hammer Missile, Scalp Missile, AM39 EXOCET, and laser guided bombs.
- Government of India has approved the acquisition of Rafale Marine fighter jets from France to equip its indigenous aircraft carrier, INS Vikrant. It is being processed through inter-governmental agreement.
 - » It was chosen over the American F/A-18 Super Hornets after rigorous testing at the shore-based test facility in Goa.
 - » **Why Rafale-M was chosen:** One core reason for choosing Rafale-M is its compatibility with the Indian Air Force's existing Rafale Fleet. This commonality is expected to reduce cost related to spares and maintenance.
 - » **Main difference between Rafale-M and Rafale:** Reinforced nose and landing gears of Rafale M, designed to handle the demanding conditions of aircraft carrier operations.
- In May 2024, India and France have started negotiations for the Rs 50,000 crore deal for 26 Rafale Marine Fighter Jets this week.

3. S&T: DEFENCE: TRANSPORT AIRCRAFTS

1) C-295 TRANSPORT AIRCRAFT (SEP 2023)

- **Why in news?**
 - » IAF chief takes delivery of the first C-295 transport aircraft in Spain (Sep 2023)
- **About the Aircraft:**
 - » Note: India has ordered 56 C-295Ws for the Indian Air Force, with a plan to order an additional 6 aircrafts for the Indian Coast Guard and 9 aircraft for the Indian Navy.
- **Details**
 - » The aircraft comes in transport configuration, equipped with an Indian Electronic Warfare Suite.
 - » In Sep 2021, the Defence Ministry signed a Rs 22,000 crore deal with Airbus and Space S.A., Spain for procurement of 56 C-295s.
 - » **Total 56 Aircrafts are to be procured by Indian Airforce:**
 - 16 aircraft will come in a fly-away condition from Seville, while 40 will be manufactured by Airbus jointly with Tata Advanced System Limited (TASL).
 - Work is underway to set up the Final Assembly Line (FAL) at Vadodra in Gujarat and the first aircraft manufactured in India would be delivered in Sep 2026.
 - » **Need:** Replacing 56 Avro Transport Aircraft: IAF has 56 Avro Transport aircraft procured in the 1960s and they are in urgent need of the replacement.

2) C-130 (JAN 2024)

- **In a first**, an IAF C-130 Hercules tactical transport aircraft made a night landing at the Advanced Landing Ground (ALG) in Kargil close to LoC with Pakistan along with Garud special forces. (Jan 2024)
 - » Earlier, transport aircrafts have been landing here in the daytime and this was the first night time landing.
- **Significance:** Advanced Landing Ground (ALG) is located at an altitude of around 10,000 feet and is a restricted airstrip with unidirectional approach surrounded by rough terrain. It doesn't have night landing facilities.

4. S&T: DEFENCE: HELICOPTERS

1) HAL PRACHAND (LCH PRACHAND)

- The Prachand light combat helicopter (LCH) is designed and developed by Hindustan Aeronautics Limited (HAL). It is a twin engine LCH
- It is the first indigenous Multi-Role Combat Helicopter designed and manufactured by HAL. It has potent ground attack and aerial combat capability.
- In 2022, it was inducted in IAF in its newly raised No. 143 Helicopter unit.



- It consists of modern stealth characteristics, robust armour protection and formidable night attack capabilities.
- It was conceptualized after the 1999 Kargil war when the need for such a dedicated platform capable of operating in high altitude was felt.
 - It is the only attack helicopter in the world which can land and take off at an altitude of 5,000 meters with considerable load of weapons and fuel significantly augmenting the firepower of the IAF and the Army in high altitude areas.
- **Weapons:**
 - It is armed in 20 mm nose gun, 70 mm rockets, anti-tank guided missile 'Dhruvastra' and air-to-air missile 'Mistral-2' of MBDA which has maximum interception range of 6.5 km.
- In Oct 2023, the Army's LCH Prachand successfully carried out inaugural firing of 70 mm rocketts and 20 mm turret guns both by day and night.
 - Both the Army and Air force have inducted LCH Prachand in small numbers.
- In Dec 2023, the Defence Acquisition Council (DAC) of Defence Ministry approved acquisition of 156 LCH Prachand more (90 for Army and 66 for the Air Force)

2) APACHE ATTACK HELICOPTER (AH-64E APACHE)

- **Why in news?**
 - » Indian Army Aviation Corp raised its first unit at Jodhpur on March 15 that will operate the helicopters (March 2024)

About AH-64E APACHE

- It is considered the world's most advanced multi-role combat helicopter.
- It is an advanced multi-mission helicopter and is considered world's best attack helicopter.
- It is the only available combat helicopter with a spectrum of capabilities for virtually any mission requirement, including greater thrust and lift, joint digital operability, improved survivability, and cognitive decision making.

Role

- It is designed for all kinds of missions.
- It is equipped with laser and infrared systems for all weather, day-night operability.
- It fires the hellfire missiles, besides its arsenal of 70 mm rocketts and an automatic canon.

Other countries which use it:



India:

The **Cabinet Committee** had in the past sanctioned for the procurement of 39 AH-64 Apache attack helicopters from the USA.

- As part of this, the IAF inducted 22 Apaches under a deal signed in 2015.
- Later, government decided that subsequent Apache will go to Army and in 2020, Boeing signed an agreement with the Government of India for the acquisition of six more Apache Helicopters. As part of the deal, six pilots and 24 technicians were trained by Boeing in the US.
- In March 2024, Indian Army Aviation Corp raised its first unit at Jodhpur that will operate Apache Helicopters.

- Primarily operated by US Army, it has also become primary attack helicopter of multiple nations, including Greece, Japan, Israel, the Netherlands, Singapore, and the UAE.
 - It has been built under license in the UK as the AgustaWestland Apache.

- Army is set to receive three Apache attack helicopters in May 2024 and three more in July 2024

In Air force has become the first pure attack helicopter in India possession. **Russian Mi 35** has been operated for years and is now on the verge of retirement. But it was not pure attack helicopter and was used for troop transfer as well.

5. S&T: DEFENCE: MISSILES

1) INTEGRATED GUIDED MISSILE DEVELOPMENT PROGRAM

- It was an Indian MoD program for research and development of the comprehensive range of missiles. It was conceived by Dr. APJ Abdul Kalam, who later also became the President of India.
 - The program was managed by DRDO and Ordnance Factory Board.
- It started in 1982-83 and completed in 2008 after the strategic missiles were successfully developed.
 - The last major missile developed under the programme was the **Agni-3** intermediate range ballistic missile which was successfully test fired in July 2007.
 - In 2008, DRDO announced successful completion of the project IGMDP**

2) FIVE MISSILES DEVELOPED UNDER IGMDP

- PRITHVI** (surface to surface short range ballistic missiles)
- Agni** (surface to surface intermediate range ballistic missiles)
- Trishul** (Surface to air short range (12 kms))
- Akash** (first indigenous produced surface to air medium range; supersonic; intercept range of 30 kms.)
- Nag Missile System:** It is India's third generation "Fire and Forget" anti-tank guided missile (ATGM).

3) AGNI SERIES

About Agni Missiles: **Agni Missile System** (IGMDP = Integrated guided missile development program)

Missile	Project	Warhead	Payload	Range	Weight	Fuel/Stages	In Service
Agni-1	IGMDP	Nuclear, submunitions, FAE (Fuel Air Explosive)	1,000	700-1250	12,000	Single stage solid	2002

Agni-2	IGMDP	"	750 - 1000	2000 - 2500	16,000	Two and half stage solid	1999
Agni - 3	IGMDP	"	2000 - 2500	3000 - 3500	44,000 and 22000 (latest)	Two stage solid	2011
Agni - 4	Agni - 4	"	800 - 1000	3000 - 4000	17000	Two stage solid	2014
Agni - 5	Agni - 5	"	1500	5500 - 5800	50,000	Three stage solid	Tested
Agni - 6	Agni - 6	"	1000	6000 - 8000	55,000	Three stage solid	Under development

A) AGNI-V

- Key features
 - It is a three stage solid fuel, surface-to-surface missile, which is 17 meter tall and 2 metre wide.
 - It is capable of carrying **1.5 tonne** of nuclear warhead.
 - It is the latest and most advanced variant in terms of navigation and guidance, warhead and engine.
- Significance of Agni-V
 - Agni-V is widely regarded as a strategic missile targeted at China as it can reach almost all parts of the Chinese Mainland.
 - It provides India a strategic depth needed to contain Pakistan and China.
 - Success of India's nuclear capable Agni IV and Agni V confirmed India's nuclear deterrence capability.
 - Proven ICBM capability currently exists only with the five major powers - the US, Russia, France, the UK and China.
 - When India successfully inducts Agni-V, India will be only non P-5 countries to have an ICBM. This is expected to boost India's claim for the permanent membership of UN.
- India will soon induct Agni-V into Strategic Force Command

B) AGNI-V WITH MIRV (MARCH 2024)

- Why in news?
 - India test-fires Agni-V ballistic missile with multiple warhead technology under **Mission Divyastra** (March 2024)
- Details
 - PM Modi announced successful test firing of Agni-V ballistic Missile with Multiple Independently Targetable Re-entry vehicles (MIRV) technology by DRDO under **mission Divyastra**.
 - MIRV means a single missile may carry multiple warheads. It will ensure that a single missile can deploy multiple warheads at different locations.

- The flight test was carried from Dr A.P.J. Abdul Kalam Island in Odisha.
- **Other countries which have MIRV**
 - US was the first country to develop MIRV technology, deploying a MIRVed ICBM in 1970 and a MIRVed Submarine launched Ballistic Technology (SLBM) in 1971.
 - USSR quickly followed and by the end of 1970 developed MIRVed ICBM and SLBM.
 - China also has MIRVed tech. France, and UK have also claimed the tech;
 - Even Pakistan, has claimed to have tested an MIRV-equipped missile called Ababeel, first in 2017 and then in 2023.
- **Significance:**
 - Improves India's attack prowess;
 - It can also dodge most defence systems.

4) AGNI-P (ALREADY DISCUSSED IN CA UPDATES)

5) BRAHMOS

- **Why in news?**
 - India delivers first batch of BrahMos to Phillipines. (April 2024)
 - » This is the first export order for the supersonic cruise missile, a joint venture between India and Russia
 - Successful firing of Extended Range version of BRAHMOS Air launched missile against ship target from SU-30 MKI Aircrafts (Dec 2022)
- **About Brahmos**
 - BRAHMOS is a **supersonic cruise missile** that can be used against ship and land targets. The missile is uniquely configured for installing in ships, submarines, aircraft and on ground vehicles.
 - » Note: **Cruise missile** is a low flying missile which is guided to its target by an on-board computer. It is called cruise because the major portion of its flight is conducted at cruise speed (i.e. approximately at constant velocity).



- **Technical Specifications**
 - » **Speed:** At speed of Mach 2.5 to 2.8, it is **world's fastest cruise** missile, about three-and-a-half times faster than the American subsonic harpoon cruise missile.
 - A newer version under development aims at achieving the speeds of Mach 5.
 - The high speed doesn't only make it difficult to detect but also gives less time to the enemy.

- » **Range:** Up to 300 kms (extended range of 450 km tested in March 2017).
- » **Warhead:** It carries a conventional warhead weighing 200-300 Kg
- » **Two stage missile, one being solid and the second one a ramjet liquid propellant.**

- **Russian Partnership:**
 - » It has been developed by **Brahmos Aerospace**, a joint venture between DRDO of India and NPO Mashinostroeyenia (NPOM) of Russia.
 - » The missile has been named after two rivers **Brahmaputra** in India and the **Moskva** in Russia.
 - » Brahmos has emerged as accomplished joint venture under the Make in India category with countries lining up to purchase its products.
- **Significance for Indian Defense**
 - » The inclusion of the powerful weapon system in Indian Navy has given it a distinct operational advantage to hit the enemy target even in the most difficult and hidden terrain.
 - » **Army**
 - Army has inducted three Brahmos missile regiments so far and they have been deployed in the **western sector to counter threat from Pakistan** and in the second phase of military expansion along the China front, the government gave a go ahead for deployment of Brahmos cruise missile in Arunachal Pradesh.
 - » **Navy**
 - Many warships have also been equipped with the missiles, which has become the standard offensive weapon of Navy.
 - » **Air Force**
 - **Launch of Brahmos on several occasion have been tested from IAF's Sukhoi-30 MK fighter aircraft**
 - For e.g., in December 2022, Indian Air Force successfully test fired the extended range version of Brahmos Air Launched missile against a Ship Target from Su-30 MKI aircraft.
 - The extended range of Brahmos coupled with the high performance of the SU-30MKI aircraft gives the IAF a strategic reach and allows it to dominate the future battle fields.

6) NIRBHAYA MISSILE

- **Why in news?**
 - » Nirbhaya Missile to be with All Three Forces (Nov 2023: Source: ET)
- **Introduction**
 - » These are long-range sub-sonic cruise missiles being developed by DRDO indigenously.
 - » They are nuclear capable with a range of 1,000 km and payload of 300 kg.
 - » It is a terrain hugging missile. It can fly almost at the level of tree-tops to evade detection by radars.
 - It has been built to identify and strike targets in heavily populated areas with pin-point accuracy and is capable of carrying a nuclear capable warhead.
 - » It is powered by solid rocket boosters developed by Advanced Systems Laboratory (ASL).
- **Update: Nov 2023**

- In a significant boost to the firepower of the defence forces, all three defence forces will now have long-range cruise missiles of the Nirbhay class in their arsenal to strike targets at ranges of over 1,000 Km range.

7) ASTRA

- **More about ASTRA**
 - » It is India's first indigenously developed active radar homing beyond-visual-range air-to-air missile (BVRAAM) with a range of over 100 km.
 - » It is designed and developed by the Defence Research and Development Laboratory (DRDL), Research Centre Imarat (RCI) and other DRDO laboratories.
 - » It is intended to engage and destroy aerial targets with high maneuverability and supersonic speeds. The missile's advanced air combat capabilities allow it to engage multiple high-performance targets.
- **Fighter planes which are planned to carry this missile**
 - » Su-30 MKI, Mirage 2000 multi-role combat fighters, and Mig-29 and MiG-21 Bison fighter jet platforms, as well as Indian Navy's Sea Harrier jet fighter.
 - » In Aug 2023, it was successfully test-fired from the LCA Tejas off the coast of Goa during which the missile was released from the aircraft at an altitude of about 20,000 feet.
- **IAF is expected to induct ASTRA missile by end-2023 (Oct 2023)**
 - » In May 2022, the Defence Ministry signed a contract with BDL for the supply of ASTRA Mk-1 missiles and associated equipment for the IAF and the NAVY at a cost of Rs 2,971 crores.
 - » Bharat Dynamics Limited (BDL) has already received Bulk Production Clearance from the manufacturers of the Astra-Mk1 missiles from the Centre for Military Airworthiness and Certification (CEMILAC) and IAF will complete proof firing and induction this financial year.
 - » The IAF plans to arm its frontline fighters with the Astra-MK1 and officials have said that the Astra-2 would become the mainstay of the IAF's BVR missile arsenal, reducing import dependency.

8) METEOR, SCALP AND MICA MISSILES

- **The Indian Navy** is set to acquire Meteor and Scalp missiles for its Rafale-M fighter jets, which are currently being negotiated with the French Dassault group.



About Meteor Missile

- It is a beyond visual range air-to-air missile (BVRAAM) which is considered to be the best in its class and can take out enemy aircraft at a range of more than 100 km, outranging the American origin AMRAAMs being used by Pakistan.
- Meteor missiles are powered by Ramjet engines and fly at Mach 4 speed.

- These are arguably the best in the world for air combat duels, with 'a greater **no-escape zone**' for hostile fighters than any comparable BVR weapon.
- SCALP Missiles:**
 - It is a long-range air-launched cruise missile (ALCM). It has a range of 300 km and are designed to hit high-value and strongly protected targets deep inside the enemy territory. They are already deployed on Rafale fighter jets of the Indian Air Force. Rafale-M is also expected to get them.
- MICA**
 - It is a multi-mission air to air missile system for the Rafale. It has a high level of tactical flexibility in order to meet the most demanding operational requirements.
 - » **Beyond Visual Range (BVR)** multi-target / multi shoot
 - » **Enhanced Short Range (SR)** performance
 - » Maximum Flexibility for multi-role / swing role aircraft
 - It has a dual role and is able to cope with BVR and SR combat situation and exhibits very high performance in both situations.

9) ARTILLERY GUNS

- Artillery is a class of large military weapons built to fire munitions far beyond the range of power of infantry's small arms.
- Early artillery development focused on the ability to breach fortification, and led to heavy, fairly immobile siege engines.

A) DHANUSH GUNS

- Why in news?**
 - Army likely to complete inducting 114 Dhanush gun by 2026 (Sep 2023)

Dhanush is an upgraded version of Swedish Bofors gun design. It's indigenous development is aided by transfer of technology clause signed with the Swedish company.

It is developed by DRDO in collaboration with private sectors.

Dhanush is a 155 mm, 45-Calibre towed artillery gun with a range of 36 km and it has demonstrated a range of 38 km with specialized ammunitions.

It has several significant features like all electric drive; quick deploy ability; high mobility; auxiliary power mode etc.

Manufacturer: The Advanced Weapons and Equipment India Limited, carved after



corporatization of the Ordnance Factory Board, is now manufacturing the Dhanush guns.

- Introduction in Army

- Army has ordered a total of 114 Dhanush artillery gun.
 - It already has one regiment operational since 2022.
- It expects to receive all 114 guns by 2026.
- The **first regiment of 18 guns** will be in place with Army by March 2020. The entire order of 114 guns will be completed by 2022.

B) PINAKA GUNS

- Why in news?

- Defence Ministry Defence Acquisition Council has approved a Rs 2,800 crore proposal for buying around 6,400 rockets for Pinaka multi-barrel rocket launcher system. (Dec 2023)

Pinaka is a multiple rocket launcher produced in India and developed by DRDO for the Indian Army.

- The system can launch 12 rockets in 44 seconds.
 - The army generally deploys a battery that has a total of 72 rockets. All of the 72 rockets can be fired in 44 seconds, taking out an area of 1 km2.
- It is mounted on a Tatra truck for mobility.
- The launcher has been named after Lord Shiva's Bow and was first developed in the 1980s.
- During Kargil war Pinaka MBRL was effectively employed to eliminate enemy forces and their positions atop mountains.

Capabilities:

- Range:
 - Original Pinaka rockets had a range of 37 km. In Mk-1 it was enhanced to 45 km.
 - The guided Pinaka has a range of 75 km.



Private Manufacturers: Private sector companies involved in the project include Larsen & Toubro, Tata Defence and Economic Explosives Limited. They have set up production line for Pinaka system that are being supplied in bulk to the armed forces.

Export: This is one of the first weapon systems of India to have been exported to foreign countries, including Armenia.

Note: Among other MRLS, the Army has five Grad rocket regiments and three Smerch regiments both of Russian-origin. Smerch is the longest range rocket system in the Army's inventory with a range of 90 kms. Pinaka will eventually become mainstay of multi-rocket systems.

- Next, Pinaka with a range of 120 km is also under the development phase.

Current Situation:

- The army has four Pinaka regiment and six more on order. They are expected to be inducted in the next few years.

Future:

- The Indian Army has approved the development of two longer-range Pinaka Multi-Barrel Rocket Launcher (MBRL).
- The DRDO subsidiary - Armament Research and Development Establishment will develop the rockets with ranges of 120 kms and 300 kms.
- Once developed, state owned rocket manufacturer Munitions India Limited will produce the rockets under a transfer of technology agreement with the DRDO.

10) CYBER SECURITY IN DEFENCE SECTOR

A) MAYA OPERATING SYSTEM

- **Background/Concerns:** Increasing cyber and malware attacks on defence as well as critical infrastructure across the country.
- **Decision:** Defence Ministry has decided to replace the Microsoft Operating System (OS) in all computers connected to the Internet with a new OS, Maya, based on open-source Ubuntu developed locally.
 - » As of Aug 2023, Maya OS has reportedly been installed in Defence Ministry systems.
 - » After the Ministry, it will also be installed on the system of the three services.
 - The three services have vetted the system. Navy has already cleared the new OS and the Army, and the Air Force were currently evaluating it.
- **About MAYA:**
 - » **MAYA** is based on Ubuntu and has been developed by a team of experts from various government agencies like DRDO, C-DAC and National Informatics Centre (NIC) in a time period of reportedly six months.
 - **Note:** Maya OS is not the first OS developed by GoI. In 2007, the Centre for Development of Advanced Computing (C-DAC) released the Bharat Operating System Solution (BOSS GNU/Linux), a distribution of GNU/Linux aimed to promote adoption of Swatantra software and was also being used by the Indian Army.

- » It has interface and all functionality like Windows and users will not feel much difference as they transition into it.
- **Chakravyuh:** It is 'an end point detection and protection system' which is shipped with Maya OS.

6. NAVY

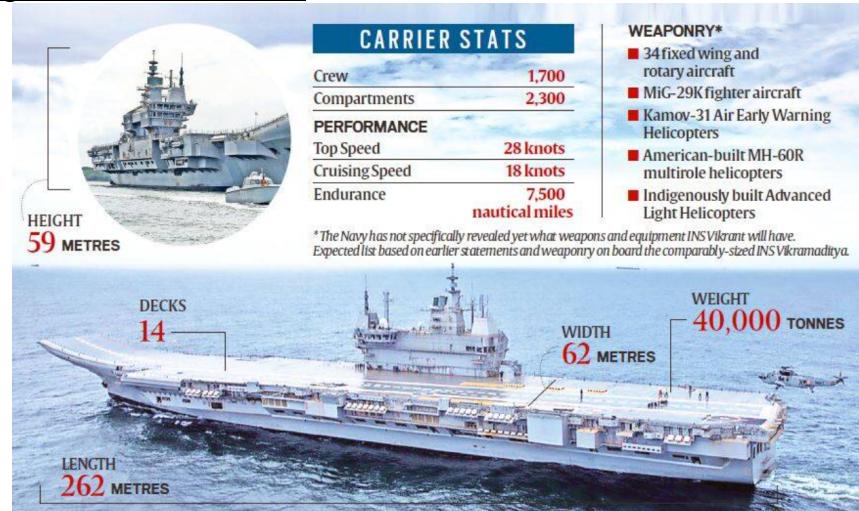
1) AIRCRAFT CARRIERS

- **Basics: What is an aircraft carrier?**
 - An aircraft carrier is a warship that serves as seagoing airbase, equipped with full length flight deck and facilities for carrying, arming, deploying, and recovering aircraft.
 - It is one of the most potent marine assets for a nation.
 - Many experts consider having an aircraft carrier as essential to be considered a blue water navy - one that has the capacity to project a nation's strength and power across high seas.
 - India presently has two functioning aircraft carriers: INS Vikramaditya which is a Kiev class vessel of Russian origin; and INS Vikrant (IAC) (Vikrant class - Indigenously developed)
 - **In Sep 2022**, India made a historical milestone as it commissioned its first-ever indigenous aircraft carrier (IAC) - Vikrant

A) INS-VIKRANT

- It is India's maiden Indigenous Aircraft Carrier (IAC-1), built by the public sector Cochin Shipyard Ltd (CSL).
 - » IAC-1 has been designed by the Indian Navy's Directorate of Naval Design (DND), and built by Cochin Shipyard Limited (CSL), a public sector shipyard under the Ministry of Ports, Shipping and Waterways. It is the largest ship ever built in the maritime history of India.
 - » The carrier is named after her illustrious predecessor, India's first Aircraft Carrier which played a vital role in the 1971 war.
 - » **Help from Italy and Russia:**
 - Design was done with the help from the Italian Firm Fincantieri, the Russians collaborated in designing and developing the aviation complex.
 - » **Technical Details:**
 - Length: 262 meters
 - Full Displacement: 45,000 tonnes
 - Power: Gas Turbines totaling **88 MW** power which has a maximum speed of 28 Knots.
 - » **Other details:**
 - The ship will be capable of operating air wing consisting of 30 aircrafts comprising of Mig-29K fighter jets, Kamov-31, MH-60R multi-role helicopters, in addition to indigenously manufactured Advanced Light Helicopters (ALH) and Light Combat Aircraft (LCA) (Navy).
 - It uses STOBAR (Short Take-off but arrest landing) and is equipped with a ski-jump for launching aircraft, and a set of "arrester wires" for their recovery onboard.
 - » **Overall cost:** Rs 20,000 crores.

- » With an overall indigenous content of 76%, IAC is a perfect example of nation's quest for "Aatma Nirbhar Bharat" and provides thrust to Government's 'Make in India' initiative.
- » India has now joined the league of USA, Russia, China, France and the UK that can indigenously design, build and integrate an aircraft carrier.



B) DEFENCE PROCUREMENT BOARD CLEARS INDIAN NAVY'S PROPOSAL ON SECOND INDIGENOUS AIRCRAFT CARRIER (NOV 2023)

- Defence Procurement Board (DPB), a key body of defence ministry, has accorded an in-principle approval to the ambitious proposal signaling the government's readiness to go for the second indigenous aircraft carrier, to be known as IAC II.
- The proposal will now be put before Defence Acquisition Council (DAC), the defence ministry's top body on procurement.
- If approved the 2nd aircraft carrier is expected to cost **Rs 40,000 crores**.

2) CORVETTES

A) INS KIRPAN

- **Why in news?**
 - India gifts missile Corvette INS Kirpan to Vietnam (June 2023)
- **Details:**
 - INS Kirpan is a Khukri class missile corvette displacing 1,350 tonnes and was commissioned into the navy on Jan 12, 1991.
 - The ship is fitted with a medium range gun, 30 mm close range guns, chaff launchers, and surface to surface missiles, enabling it to perform a wide variety of roles, including coastal and offshore patrol, coastal security, anti-piracy, HADR operations etc.
- **Gift to Vietnam**
 - India gifted indigenously built in service missile corvette INS Kirpan to Vietnam to enhance that country's Naval capabilities.

3) FRIGATES

Frigates, are naval vessels intermediate between corvettes and destroyers

Class	Type	Ships	Origin	Displacement	Note
Shivalik	Stealth guided missile frigate	INS - Shivalik, INS Satpura, INS Sahyadri	India	6,200	To be succeeded from 2017 by the Project 17A class frigate
Talwar (Krivak)	Stealth guided missile frigate	INS Talwar, Trishul, Tabar, Teg, Tarkash, Trikand	Russia	4,035	Four additional vessels to be built in joint partnership between Russia and India
Brahmaputra	Guided Missile Frigate	INS Brahmaputra, Betwa , Beas	India	3,850	
Godavari Class	Guided Missile Frigate	INS Ganga, INS Gomati	India	3,850	<ul style="list-style-type: none"> Lead vessel INS Godavari decommissioned Remaining two vessels in class scheduled to be decommissioned in the near future

A) PROJECT 17A (ALPHA) FRIGATES (NILGIRI CLASS)

- Project 17A Frigates are follow-on class of the Project 17 (Shivalik Class) Frigates, with improved stealth features, advanced weapons and sensors and platform management systems.
 - Seven Project 17A Frigates are under various stages of construction at MDL and GRSE.
 - INS Nilgiri, Udaygiri, Taragiri, Mahendragiri by MDL
 - INS Himgiri, Dunagiri, Vindhyaagiri by GRSE
- INS Vindhyaagiri**
 - Why in news?**
 - President Murmu launches stealth frigate **INS Vindhyaagiri** (Aug 2023)
- Background:**
 - The first and second ships of the series are INS Himgiri and INS Dunagiri. The three Nilgiri-class frigates were ordered at a cost of approximately 19,200 crore and was the largest ever contract executed by Kolkata based **Garden Reach Shipbuilders and Engineers (GRSE)**.

- **INS VindhyaGiri** is the last in the series of three 17A (Alpha) frigates built by the Indian Navy.
 - It reflects country's commitment to self-reliance and technological advancement as well as indigenous innovation for developing state of art technology.
- **Features:**
 - These ships have length of 149 meters and displacement of over 6,670 tonnes. Their cutting edge propulsion system allows for speeds of over 28 knots.

4) DESTROYERS

- In naval terminology, a destroyer is a fast, maneuverable, long distance warship intended to escort larger vessels in a fleet, convoy or battle group and defend them against smaller short ranged attackers.
- They are also known as Carrier Strike Group.

Class	Type	Ships	Origin	Displacement	Note
Vishakhapatnam Class	Stealth guided missile destroyer	INS Vishakhapatnam; INS Mormugao INS Imphal INS Surat (Not commissioned Yet)	India	74,00 tonnes	Designed by the Indian Navy's in-house warship design entity Warship Design Bureau, and built by MSDL in Mumbai. The arsenal of Vishakhapatnam class has <u>BrahMos</u> surface-to-surface cruise missile and vertically launched Barak-8 surface to air missile for long range engagement.
Kolkata Class	Stealth guided missile destroyer	INS Kolkata INS Kochi INS Chennai	India	7,500 tonnes	Commissioned between 2014 - 2016 under <u>Project 15A</u> . They were a step ahead of <u>Delhi Class</u> of destroyers. To be succeeded by <u>Project 15B</u> <u>Vishakhapatnam - class destroyer</u>

					<u>Built at MDSL.</u>
Delhi Class	Guided Missile destroyer	INS Delhi, INS Mysore INS Mumbai	India	6,700 tonnes	Built under <u>Project 15</u> and commissioned between 1997 and 2001. Built at <u>Mazagon Dock Shipbuilders Limited (MDSL)</u> .
Rajput Class (Kashin Class)	Guided Missile destroyer	INS Rajput, Rana, Ranjit, Ranvir, Ranvijay	Soviet Union	4,974 tonnes	<u>INS Rajput</u> decommissioned in May 2021, after 41 years of service. It was the <u>first destroyer of Indian Navy</u> . It was commissioned on <u>May 4, 1980</u> .

A) PROJECT 15B (VISHAKHAPATNAM CLASS)

- The Vishakhapatnam class (Project 15B) is a class of stealth guided missile destroyers currently under the construction of the Indian Navy.
 - » The class comprises of four ships - Vishakhapatnam, Mormugao, Imphal and Porbandar all of which will be built by Mazagon Dock Limited (MDL) in India, and will be the largest destroyers to be operated by the Indian Navy.
- The project is an improved version of the Kolkata-class (Project 15A) and will feature enhanced stealth characteristics.
- **INS Vishakhapatnam** was the lead ship of Project 15B and was commissioned in Indian Navy in Nov 2021 and the second ship INS Mormugao (D67) was commissioned in Dec 2022.
- **INS Imphal** (D68), the third of the four warships under Project 15B got commissioned in Dec 2023.
- The fourth ship, D69, which when commissioned will be christened INS Surat, was launched in May 2022.

5) SUB-MARINES

- A submarine is a watercraft capable of independent operation underwater. They were first widely used during World War 1, and now figure in all important naval forces.
- **Key functions of Submarines** - Military uses; Civilian Uses
- **Indian Navy's submarine arm** completed 50 years on 8th December 2017.

- The Submarine Day is celebrated every year to commemorate the birth of the submarine arm with induction of the first submarine, erstwhile INS Kalvari, into the Indian Navy on 8 Dec, 1967.
- In 1992, India joined exclusive group of submarines constructing nations, with the commissioning of the first Indian-built submarine, INS Shalki.
- Why Submarines are important? (Stealth; assured second strike capability)**
- How submarines operate?**
 - They operate under water and rely on sonar or sound waves for communication and detection.
 - They operate over specific frequencies, their signature, and is highly guarded

A) VARIOUS SUBMARINES OF INDIA

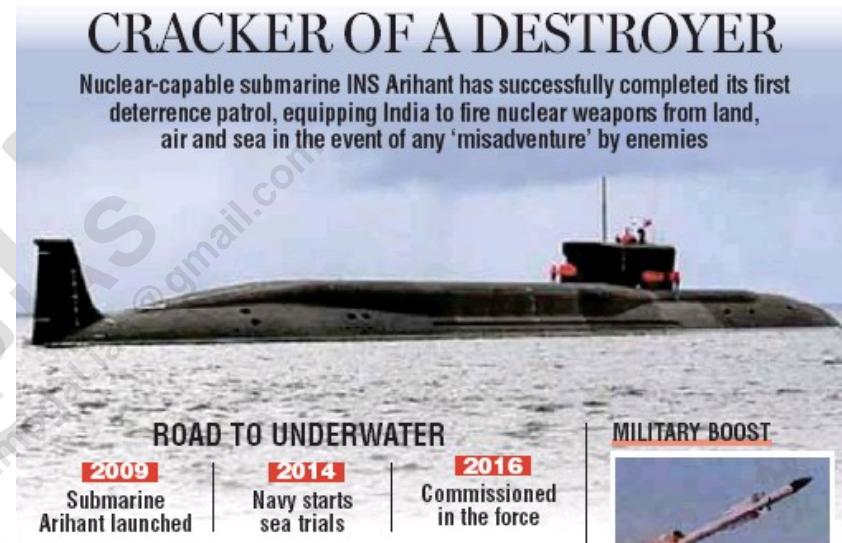
Class	Type	Power	Boats	Origin	Displacement	Notes
Arihant	SSBN (ship submersible ballistic nuclear)	Nuclear Powered	INS Arihant (S73) INS Arighat (launched in Nov-2017)	India	6,000 tonnes	Arihant was commissioned in Aug 2016. Second SSBN Arighat, now in advanced stage of sea trials, was expected to be commissioned in 2021.
Chakra (Akula II) Class	SSN	Nuclear Powered	INS Chakra (S71)	Russia	12,770 tonnes	Under 10 years lease from Russia since 2012. Returned now. In 2019, India leased an Akula Class Nuclear Attack submarine for <u>10 years from Russia</u> for a sum of <u>\$3 billion</u> . It is being called (Chakra-III) and is being fitted in Russia. Its delivery was expected by 2025 or 2026, but has been delayed due to ongoing war situation between Russia and Ukraine.
Scorpene Class/ Kalvari class	Attack submarine	Diesel Electric	INS Kalvari, INS Khanderi, INS Karanj, INS Vela,	French (DCNS)		<ul style="list-style-type: none"> 5 commissioned The last one Vagsheer has began sea trial.

			INS Vagir			
Sindhughosh Class	Attack Submarine	Diesel Electric Submarine	INS Sindhu* (7 in service)	Soviet Union	3,076	A total of <u>10</u> were commissioned but now only 3 in service.
Shishumar class	Attack submarine	Diesel Electric	INS Shshumar INS Shankush INS Shalki INS SHankul	Germany	1,850 tonnes	They carry <u>anti-sub and anti-ship capabilities</u> . To be upgraded for prolonged service

B) ARIHANT CLASS SUBMARINES (INS ARIHANT; INS ARIGHAT; S4)

- Introduction

- » The Arihant class submarines is a class of nuclear-powered ballistic missile submarines being used by Indian Navy. They are designed and developed under the US\$ 2.9 billion **Advanced Technology Vessel (ATV)** project.
- » The lead vessel of this class is **INS Arihant** which was launched in 2009 (code named **S2**), and after extensive sea trials have been commissioned in Indian Navy. In Nov 2018, it completed its first deterrent patrol.



- More About INS Arihant

- » It is the first ballistic missile submarine to have been built by a country other than one of the P-5 of UNSC.
 - It is capable of carrying nuclear-tipped ballistic missiles, the class referred to as **Ship Submersible Ballistic Nuclear (SSBN)**.
 - It is India's first nuclear powered ballistic missile submarine and is propelled by an 83 MW pressurized light-water reactor at its core.
 - These are designed to cruise the waters carrying nuclear weapons and provides a nation, with an assured second strike capability, which, put simply, is the ability to retaliate after taking a nuclear hit.
 - The vessel is currently armed with K-15 missile which has a range of 750 km.

- It will also be armed with K-4 missile which will have a range of 3,500 km and is being developed by DRDO.
 - Arihant has four vertical launch tubes. It can either carry 12 K-15 missiles or four larger K-4 missiles.
 - The design of Arihant is based on Russian Akula-1 class submarines/ Charlie class (NATO Name), of which the best known example is the INS Chakra.
 - It weighs around 6,000 tonnes.
- Nuclear Triad and its significance (Class discussion)

C) FUTURE ARIHANT CLASS VESSELS

- » INS Arighat (code named S3) has been launched in 2017. It may have been secretly commissioned in 2021.
- » Third Arihant Class Submarine code named S4 has been quietly launched in Nov 2022 in Vishakhapatnam.
 - It is still a long way from sea trials, weapon trials, and commissioning.

K-4 MISSILE

- The solid fuelled K-4 missile is being developed by DRDO to arm the country's nuclear powered submarines in the shape of INS Arihant and its under-development sister vessels.
- India tested its nuclear capable K-4 submarine launched ballistic missile (SLBM), designed to have a strike range of 3,500 km, for the second time in six days in Dec 2023.
- **After K-4:**
 - » The K-4 missiles are to be followed by the K-5 missiles and K-6 missiles in the 5,000 - 6,000 km range class.

D) SCORPENE CLASS SUBMARINES

- **About Scorpene Class Submarine**
 - » Scorpene class submarine is being built at (Mazagon Dock Limited), Mumbai in collaboration with Direction des Constructions Navales Services (DCNS) of France, as part of Project 75 acquisition program of Indian Navy.
 - » DCNS, in 2005, was awarded a \$4.16 billion contract by Indian government to build six SSks for the Indian Navy in cooperation with India's major shipbuilder, Mumbai based Mazagon Dock Limited.
 - » The first five submarines, INS Kalvari (2017), INS Khanderi (2019), INS Karanj, INS Vela and INS Vagir (2023) have been commissioned.
 - » The last one Vagsheer has began sea trial.
- **Engine:** The submarine is powered by diesel electric engine.
 - » It alternates between using Diesel (for functioning on the surface) and electric (for functioning underwater).
 - » However, these electric batteries need to be recharged using diesel engine after prolonged submersion, meaning that the submarine has to periodically come to surface.

- **Key Features of Kalvari class submarines**
 - » Superior stealth features like advanced acoustic silencing techniques, low radiated noise levels, hydro-dynamically optimized shape.
 - » The 66 meter submarine can dive upto 300 meter of water depth to avoid detection.
 - » Ability to launch crippling attack on the enemy using precision guided weapons.
 - » These will be armed with torpedoes as well as tube-launched anti-ship missiles.
 - » Endurance of 50 days (when compared to unlimited endurance of nuclear powered submarines)
- **Key Functions of Kalvari class submarine**
 - » It will be able to conduct different functions including anti-surface warfare, anti-submarine warfare, intelligence gathering, mine laying, area surveillance etc.
- **Why do we need a conventional submarine (like Kalavari) when we have a SSBN like Arihant?**
 - » A diesel electric sub's biggest advantages is that it has a smaller hull i.e. easier to maneuver in shallow waters and harder to detect.
 - » Fractional cost
 - » It is easy to operate
 - » No danger of nuclear leak.
 - » Further Air Independent Propulsion (AIP) system and fuel cells have made it possible for conventional submarines to remain underwater much longer than previously.
 - » Simply put, developing maritime states like India can't afford to overlook the practical utility and effectiveness of an SSK in South Asia's littoral spaces.
 - » It also contributes to modernization of our submarine fleet and increased under water capabilities.

E) 3 MORE SCORPENE CLASS SUBMARINES TO BE BOUGHT

- In July 2023, the Defence Acquisition Council (DAC), the apex decision making body for the acquisition of military equipment for India's armed forces has cleared proposals worth thousands of crores to buy three additional Scorpene submarines and 26 Rafale-M fighter jets.
- An MoU has been signed between Mazagon Dockyard Ltd and Naval Group for the construction of three submarines after the success of the first Scorpene submarine construction program (P75-Kalvari).
- It will be bought under Buy (Indian) category and will be built by the Mazagon Dock Shipbuilders Limited (MDL).
- Why?
 - » Indian Navy needs at least 18 submarines to carry out its full spectrum operations.
 - » Currently, it has 16 conventional submarines - 7 of Sindhughosh class (Russian Kilo Class), four of the Shishumar class (modified German Type 209) and five of the Kalavari class (French Scorpene class)
 - Further, at any time, around 30% of the submarines are under refit thus further bringing down the strength of operational submarines.

6) DEEP SUBMERGENCE RESCUE VESSELS (DSRVS)

- **Why in news?**
 - » At Milan-24, Navy offers its submarine rescue capability (Feb 2024)
 - Indian Navy is offering its submarine rescue capabilities to friendly countries, a key highlight of the ongoing **Multilateral naval exercise Milan-24 in Vishakhapatnam** that will further India's defence diplomacy.
 - Navy showcased its DSRV to delegates of 50 countries at the mega naval exercise.
- **What is Deep Submergence Rescue Vehicle**
 - » It is used to rescue officers stranded on a malfunctioning submarine. The DSRV will be used for rescue operations in the Indian Ocean Region and beyond.
 - » **The Indian Navy** has acquired two advanced DSRVs - one each for India's west coast and east coast in Mumbai and Vishakhapatnam, respectively - in 2018 and 2019 from JFD, UK.
 - These are third generation products of **Scotland-based James Fisher Defence**, a part of James Fischer and Sons Plc -- and has the latest technology and capability.
 - JFD had **won contract** for supply of two DSRVs and 25 year maintenance of them.
 - The Navy has given contract to the Hindustan Shipyard for the building of two motherships for DSRVs. Navy is still waiting for its deliveries.
 - DSRVs are permanently deployed on motherships and can be flown away in case of emergencies.
- **Capabilities:** During the trial DSRV dived to 666 m which is a record for deepest submergence by a manned vessel in Indian waters.
 - » It has an operational depth of 650 meters and a capacity to accommodate 15 people.
- **Significance**
 - » Indian navy joins select group of countries having integral submarine rescue capabilities (only 12 countries have this capability out of 40 countries which have submarine services).
 - » It will enhance safety of our ever increasing submarines.

7. PROMOTING DEFENCE INDIGENIZATION

A) 2ND INDUS-X SUMMIT (FEB 2024)

8. INTERNATIONAL PROJECTS IN DEFENCE

1) IRON DOME

- **Why in news?**
 - » The Iron Dome Air Defence Missile System shot down many rockets fired by Hamas on 7th Oct 2023, but some of them landed on populated areas (Oct 2023)

Iron dome is a multi-mission system capable of intercepting rockets, artillery, mortars, and Precision Guided Munitions like very short range air defence (V-SHORAD) systems as well as aircraft, helicopters and UAVs over short range of upto 70 kms.

It is an all-weather system and can engage multiple targets simultaneously and be deployed over land and sea.

It is an effective truck towed mobile air defence system developed by Rafael Advanced Defence Systems Limited. The system was deployed in 2011 and has been in service since then.

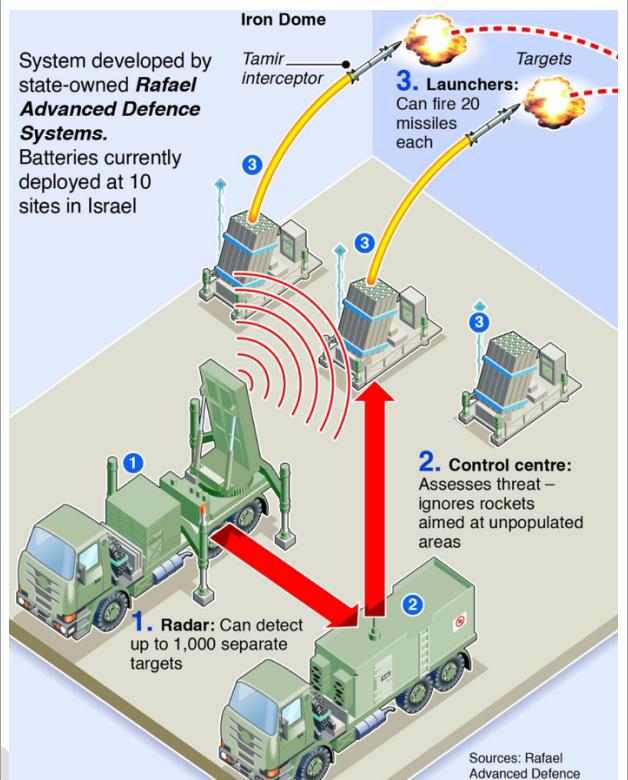
Israel has at least 10 Iron Dome batteries deployed throughout the country, each designed to defend a 60-square-mile populated area and can be moved as threats change.

Components: It consist of Radar, Control Center and launchers

How does it work?

The targeting system and radar first track the trajectory of incoming projectiles. It is designed to fire its Tamir interceptors only at those which are likely to land in populated areas or important areas/targets.

In the past, Israel has put Iron Dome's interception rate at as high as 97%.



A) USA-ISRAEL COLLABORATION ON IRON-DOME

- To date (Oct 2023), USA has provided \$3 billion to Israel for Iron Dome batteries, interceptors, co-production costs, and general maintenance.
- A co-production agreement signed between Israel and US in March 2014 enables manufacture of various components of Iron Dome in USA under a joint venture 'Raytheon Rafael Area Protection Systems', set up in 2020 between Rafael and Raytheon of the USA.
- Tamir interceptor (the U.S. version is called Sky Hunter) are manufactured at Raytheon's facility in Tucson, Arizona, and elsewhere, and then assembled in Israel.
- The US Army has procured two Iron Dome batteries from Rafael at a cost of \$373 million.

B) ISRAEL'S LAYERED AIR DEFENCE

- Israel has a four-layered air defence network to tackle a range of projectile, short ranged mortars, rockets, and long-range ballistic missiles. It comprises of:
 - i. **Iron Dome** (short range)

- ii. **David's Sling** (low to medium range)
- iii. **Arrow II** (Upper atmospheric)
- iv. **Arrow III** (exo-atmospheric)
- In addition to these, US Missile Defence Agency and various private defence contractors are working on next generation defence systems, such as Arrow IV90 and various ground and air-based laser systems, including Iron Beam.

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TARGET PRELIMS 2024

BOOKLET-55

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2. S&T:

1) SPACE:

A) 55 CANCRI E (OR JANSEN)

- It is an exoplanet discovered recently. It is the first rocky planet outside our solar system which has an atmosphere.
- It is located in our **Milky Way Galaxy** about 41 light years from Earth, in the constellation Cancer.
- It is a 'super earth' – significantly larger than earth – and it orbits perilously close (1/25th of AU) to a star dimmer and slightly less massive than Sun, rapidly completing an orbit in about 18 hours.
- It is inhospitable with surface temperature of about 1725 degree Celsius. This is one of the hottest known exoplanets.
- **Why atmosphere is crucial?**
 - » It is essential for any possibility for harboring life.

2) HEALTH: FLIRT – THE NEW COVID-19 VARIANT (MAY 2024)

- **FLiRT** is the nickname of the new coronavirus variant called KP.2
 - » **Understanding the connection of KP.2 with Omicron:**
 - **Omicron** was a variant of SARS-COV-2 that took hold in the US in 2021. It spawned many subvariant including JN.1, which was identified in Sep 2023. JN.1 has many descendants, one of them being JN.1.11.1. **FLiRT/KP.2** is a variant/Spinoff of JN.1.11.1.
- **Why this nickname?**
 - » **FLiRT** is based on the letters representing two immune escape mutations that allows virus to evade antibodies.
 - These two mutations on the spike protein disrupt the major sites on the spike protein where antibodies bind and neutralize the SARS-CoV-2 virus. These mutations allow the virus to escape antibodies.
 - The mutations in the Spike Protein of KP.2 are at R346T, F456L, and V1104L.
- It has been linked to rising cases of COVID-19 in the US, UK, and South Korea.
 - » In India, KP.2 sequence made up 29% of Covid-19 sequences uploaded by India to the Global Initiative on Sharing All Influenza Data (GISAID), the world's largest repository of these sequences, over the last 60 days.
- FLiRT is characterized by its ability to evade immunity from vaccines and previous infections.
 - » **Symptoms** are similar to earlier variants.
 - The US Centers for Disease Control and Prevention (CDC) notes that there are currently no indicators suggesting that KP.2 would cause more severe illness than other strains.
 - » **However, KP.2 can drive-up infection:** It has heightened transmission rate, and, like its parent JN.1, it is likely to drive a wave of infections.
- **Can booster shots of Covid-19 vaccines help here?**

- » Most Covid-19 vaccines available in India are aimed at the original variant of virus, so additional shots are unlikely to help.
- » **How vaccine should be modified?**
 - In late April, the WHO's Covid vaccine advisory group advised the use of JN.1 lineage as the antigen for upcoming vaccine formulation, as the FLiRT variants are within JN.1 family. However, vaccines in India are not updated yet.

3) COMPUTER AND IT: ARTIFICIAL GENERAL INTELLIGENCE (AGI)

- **Artificial General Intelligence** is a theoretical AI system with capabilities that rival those of a human. It will be able to perform any intellectual task that a human can and perhaps even surpass human abilities in the area.
 - When AI's abilities are indistinguishable from those of a human, it will have passed what is known as Turing Test first proposed by 20th century computer scientists Alan Turing. So far, no AI tool has passed Turing Test.
 - **Alan Turing**, widely considered the father of theoretical computer science and artificial intelligence, introduced what is known as Turing Test – a benchmark for machine intelligence. In simple words, if a Machine can engage in a conversation with a human without being detected as a machine, according to the Turing Test, it has demonstrated human intelligence.
- **How is it different from Current AI System?**
 - **Current AI systems** (also known as **narrow AI**) are designed for specific task like image recognition, natural language processing, translation, playing games like chess etc. But this AI remain limited to set parameters.
 - **AGI** envisions a more general and broader form of intelligence, not confined to only limited tasks. They will be able to solve problems, adapt to new situations, and learn new skills in a way that is similar to how humans learn. This would require AGI to possess self-awareness and consciousness, as well as ability to reason, plan, and make decisions.
- **How close are we in achieving AGI?**
 - Scientists believe that we are decades away, if not centuries.
- **How will AGI benefit humans?**
 - By solving some unsolvable problems in the field of:
 - **Health:** By integrating and analyzing vast data it can redefine diagnostics, treatment planning etc. far beyond the capability of humans.
 - **Finance and Business:** AGI could automate various processes and enhance the overall decision making.
 - **Education:** AGI could transform adaptive learning systems that work towards the unique needs of students. This could potentially democratize access to personalized education worldwide.
- **AGI** will also be associated with potential risk:
 - **Environmental Risks** associated with humongous amount of computation power required to develop AGI.
 - **Job displacement** and economic disruption -> increase inequality
 - **Weaponization of AI tech**
 - **Loss of control over AI system**
 - **Existential risk for humans** -> Situation where AGI becomes too independent, so much so that humans simply lose control.

4) HEALTH/BIOTECHNOLOGY: XENOTRANSPLANTATION

- **Why in news?**
 - In Jan 2022, doctors replaced the heart of a 57-year-old patient with the heart of a genetically modified altered pig. However, the patient died two months after the transplant. This was an experimental procedure that was done after US FDA granted emergency authorization for it on 31st Dec 2021.
- **Xenotransplantation** is "any procedure that involves the transplantation, implantation, or infusion into a human recipient of either (a) live cells, tissues or organs from a nonhuman animal source, or (b) human body fluids, cells, tissues or organs that have had ex vivo contact with live nonhuman animal cells, tissues or organs.
 - It is seen as an alternative to the clinical transplantation of human organs which is in shortage due to demand-supply issues.
 - It was first tried in 1980s in USA. A well known case is of Baby Fae, who was born with a congenital condition defect and who received a baboon heart in 1984. This baby died in few months after the body's immune system rejected the baboons heart.
 - First kidney transplant from pig to human happened in March 2024 and the patient died in May 2024.
- **Why Xenotransplantation is being explored?**
 - Can provide an alternative supply of organs.
- **Why Pig Heart is being used in several cases of Xenotransplantation?**
 - Pig Heart Valves have been used for replacing damaged valves in humans for over 50 years.
 - There are several advantages of using domesticated or farmed pig as the donor for xenotransplantation.
 - **The Pig's anatomical and physiological parameters** are similar to that of humans.
 - **Breeding** of pigs of different varieties is widespread and cost effective. It provides an opportunity for the size of harvested organ to be matched with the specific needs of human recipient.
 - **Pigs have shorter lifespan** allowing for quick production of new organs when needed.
- **Why are Pigs genetically engineered to use their organ (heart, kidney etc)?**
 - The molecular incompatibility between pigs and humans can trigger several immune complications after the transplant. Therefore, genetic engineering is used to tweak the genome of the pig so as to 'disguise it', so that immune system of the human recipient fails to recognize it, and the reactions that lead to xenograft rejection are not triggered.
 - **For e.g:** Pigs have a gene for Alpha-gal (**a sugar molecule**) which can elicit a devastating immune response in humans. So, the gene which codes for Alpha-gal is removed to make 'GalSafe' pig. These GalSafe pigs are well studied and are approved by USFDA for use in pharmacology.

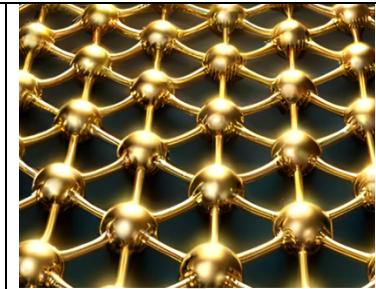
5) NANOTECHNOLOGY: GOLDENE – A SHEET OF GOLD WHICH IS ONLY ONE ATOM THICK

For the first time scientists have created a free standing sheet of gold that is only one atom thick. (May 2024)

These sheets of goldene are roughly 100 nanometers thick, approximately 400 times thinner than the thinnest commercially available gold leaf.

It has been developed by scientists from Sweden's Linkoping University.

- » Since the development of Graphene in 2004, scientists have created hundreds of 2D material. But, coming up with atom-thin metallic sheets has been a challenge, due to metal's tendency to cluster together to make nanoparticles instead.
- » **Goldene is the first free-standing 2-D metal.**



- **How was Goldene formed?**

- » Researchers first sandwiched an atomic monolayer of silicon between layers of titanium carbide.
- » Then they deposited gold on top of this sandwich structure, the gold atoms diffuse into the material and replace the silicon atoms, forming a trapped monolayer of gold atoms.
- » Subsequently, scientists etched away the titanium carbide layers to create a free standing, one atom thick layer of gold. This was done with the help of an age-old Japanese technique used to forge Katanas and high-quality knives, using a chemical popularly known as Murakami's reagent.

- **Applications/Advantages:**

- » It can revolutionize electronics industry – Electronics which use gold due to electrical conductivity, can potentially use lesser amounts for the same purpose.
- » **Great Catalyst:** Goldene holds promise of a great catalyst because its much more economically viable than thicker, three-dimensional gold.
- » Method used to make goldene can be used to (theoretically) make other 2-D metal sheets.
- » Other special properties – Like other 2-D materials, goldene will have some other special properties. This is because each gold atom, in this case, has only six neighbouring atoms, compared to 12 in a three-dimensional crystal.
- » These special properties and applications are being explored.

6) PHYSICS: MAGNETIC RESONANCE IMAGING (MRI): KEY COMONENTS AND FUNCTIONS

- **What is Magnetic Resonance Imaging?**

- » It is a medical imaging technique that is used to obtain detailed picture of soft tissues within the body. It is a non-invasive diagnostic procedure widely used to image the brain, the cardiovascular system, the spinal cord and joints, various muscles, the liver, arteries, etc. It is particularly important in the observation and treatment of certain cancers including Prostate and rectal cancer, and to track neurological conditions like Alzheimer's, dementia, epilepsy, and stroke.
- » It is also used to observe changes in the blood flow to infer the way the activity of neurons is changing in the brain. In this form the technique is called **functional MRI**.

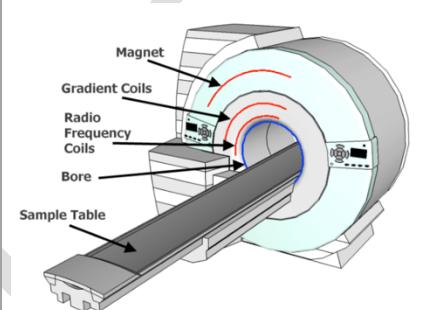
- **2003 Medicine Nobel Prize:**

- » The underlying techniques of MRI was worked in 1970s; In the same decade, Paul Lauterbur and Peter Mansfield refined the techniques to pave the way for their commercial use. For these efforts, they were awarded the Medicine Nobel Prize in 2003.

- **How does MRI work?**

- » MRI scan reveals an image of a body part using the Hydrogen atoms in that part. In normal times, these atoms are all spinning, with axes pointing in random direction.
- » **Four components of MRI Machine:**

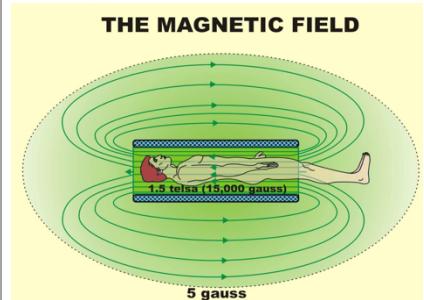
The Machine looks like a giant donut which has a hole in the center called the **bore**. It is where the person whose body is to be scanned is inserted.



A Powerful Superconducting Magnet: Its job is to produce powerful and stable magnetic field around the body.

Each hydrogen atom has a powerful magnetic moment, which means in the presence of a magnetic field, the atom's spin axis will point along the field's direction.

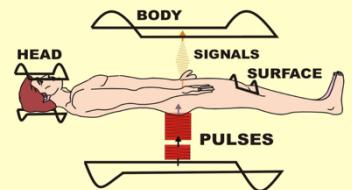
Other than big powerful magnetic field, the MRI machine activates three magnets that produce smaller magnetic field that are weaker than the main field by about 80 times. These fields also have gradient i.e. they are not uniform. These fields interfere with the main field at the part to be scanned such that resulting field highlights very specific portions, which can be the focus of the scan.



Device that emits Radio Frequency Pulse at the part under the scanner. These radio waves nudge the protons out of alignment.

When the radio pulse go 'off' these hydrogen atoms (protons) realign themselves with the magnetic field, releasing energy in the process. This released energy is detected by the MRI machine detector.

THE RF COILS



Detector: The detector receives the emissions and converts them to signals, which are sent to a computer that uses them to recreate two- or three-dimensional images of the part of the body.

- **Advantages of MRI:**
 - » **MRI scan** can practically image the body from all useful direction and, if required, in very small increments.
 - » They don't pose any threats; Unlike X-Rays and CT scans, MRI's don't use ionizing radiation.
 - » However, a scan's effect on pregnant ladies are not well studied and therefore many scanning facilities simply refuse such appointments.
- **Limitations:**
 - » **Expensive:** Depending on features, they may cost from a few tens of lakhs to crores of rupees. This leads to high cost of MRI for patients.
 - » **Claustrophobic** people may find it difficult to remain inside (though some 'open bore' MRI machine designs can alleviate this issue)
 - » **High Energy Consumption:** heavy currents are passed through the coil
 - » **A strong magnetic field** prevents individuals with embedded metallic objects, shrapnel, metallic implants, including pacemakers from going for MRI Scan. This magnetic field can wipe the magnetic strip of a credit card.
- **MRIs vs X-Rays:**
 - » **MRIs** are better suited for soft tissues, and they don't show up on X-rays. **X-rays** are better suited for bone fracture detection.
 - » **MRIs** may detect bone fracture, but they are not as clear as X-Rays. Further, X-rays are cheaper, making them ideal for initial fracture diagnosis.
 - » **MRIs are more expensive and time consuming** than X-Rays.
 - » **MRIs** can however be used for detecting hidden fractures which X-rays can't detect. This is especially true for hairline fracture, stress fracture etc.

7) DEFENCE: INDIGENOUS TECHNOLOGY CRUISE MISSILE (ITCM)

- In April 2024, **DRDO** conducted a successful **flight test** of Indigenous Technology Cruise Missile (ITCM) from the Integrated Test Range (ITR), Chandipur off the coast of Odisha.
 - » It is a long-range subsonic cruise missile powered by indigenous propulsion.
 - » Missile has been developed by Bengaluru based DRDO laboratory Aeronautical Development Establishment (ADE) along with contribution from other laboratories and Indian industries.
 - » The missile used Indigenous propulsion system developed by Gas Turbine Research Establishment (GTRE), Bengaluru.

8) DEFENCE: SUPERSONIC MISSILE ASSISTED RELEASE OF TORPEDO (SMART)

- It is a canister based, long range supersonic anti-submarine missile developed by DRDO for Indian Navy.
 - » It consist of a long range missile carrier (640 km) which can travel at supersonic speed and a lightweight torpedo (50 kg, 20 km) as payload for anti-submarine warfare (ASW) role.
- It can be launched from surface ship or a truck based coastal battery.
- It was launched jointly by Defence Research Development Laboratory (DRDL) and Research Centre Imarat (RCI).
- On 1st May 2024, it was successfully tested from Dr APJ Abdul Kalam Island off the coast of Odisha.

3. EB&CC

1) PLANT BIODIVERSITY

A) SEMAL TREE (BOMBAX CEIBA L.)

- Why in news?

- » Semal trees are disappearing from South Rajasthan because of it being burned during Holi Festival (Holika Dahan) (March/May 2024)

- Details

Semal (local name in Rajasthan), **cotton tree** (more specifically **Malabar Silk-Cotton Tree**; Red Silk Cotton; Red Cotton Tree;) is an Asian tropical tree.

IUCN: LC

Significance of the tree:

- It's roots, fruits, seeds, stem, stem bark, and gum are all medicinally significant.
- It also plays a crucial role in forest ecosystem:
 - The rock bees nestle on its branches because the tree's spikes keep its predator, the sloth bears, away.
 - Members of tribal communities consume the tree's reddish root for food during the monsoons.
 - Larvae of the moth *Bucculatrix crateracma* feed on its leaves.
 - The golden-crowned sparrow weaves the lining of its nests with white cotton from its seeds.
 - The Dysdercus bugs, the Indian crested porcupine, Hanuman langurs, and some other species feast on the nectar in its flowers

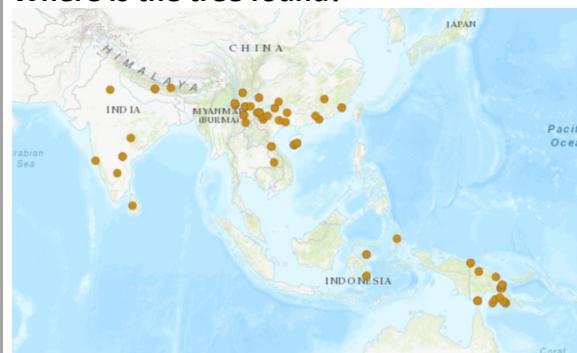
In some parts of Rajasthan, it has been traditionally used for **Holika Dahan** festival.

Traditionally the debarked stem or branch of a semal tree is used as the bonfire's main pillar.

Is this cutting not illegal?

The cutting violates a panoply of laws, from Rajasthan Forest Act 1953 to the Forest (Conservation) Act, 1980.

Where is the tree found?



Flower



Seeds

4. SOCIAL JUSTICE: HEALTH:

1) OPERATION AMRITH – TO TACKLE ANTI-MICROBIAL RESISTANCE

- By Kerala Government
- **AMRITH** – (Antimicrobial Resistance Intervention for Total Health)
- Implements the original H1 rule which requires a doctor's prescription for purchase of any class of anti-biotics.
 - **Original H1 Rule of 2011:** It prohibited OTC sales of antibiotics without prescription
 - **Modified H1 Rule of 2013:** It restricts OTC sale of 2nd and 3rd line of anti-biotics. This modification aims to ensure accessibility to life saving anti-biotics, particularly in remote areas where access to doctors may be limited.
- Under it, surprise raids are being conducted in retail medical shops for detected OTC sale of anti-biotics.
 - Pharmacies must keep an accurate records of anti-biotic sales as per this initiative.
 - A poster mentioning 'anti-biotics not sold without doctor's prescription' should be displayed.
 - **Public can also participate in this initiative by reporting** any pharmacies selling anti-biotics without a prescription to the Drugs Department.
- **Note:** Kerala government, in 2018 became the first state to come up with the state action plan on AMR – Kerala Anti-Microbial Resistance Strategic Action Plan (KARSAP)

2) SWATCH BHARAT MISSION (SBM)

- Aligning with the ideals of Mahatma Gandhi, the Swachh Bharat Mission (SBM) was initiated in 2014 to achieve universal sanitation coverage by 2 October 2019.
- It was launched with a **multi-pronged approach** where focus was not only on construction of toilets but also on behavioural change in the communities.
- The mission has **two components** SBM-Gramin (MoDW&S (now Ministry of Jal Shakti)) and SBM-Urban (Ministry of Urban Development (now MoH&UA)) as the requirement of rural and urban areas were different.
 - **The objective of Swatch Bharat Mission (SBM-Gramin)** is to improve the general quality of life in rural areas, accelerate sanitation coverage, adopt sustainable sanitation practices and facilities, encourage use of cost effective and appropriate technologies and development of community managed sanitation systems focusing on solid and liquid waste management for overall cleanliness in rural areas.
 - The **Swatch Bharat Mission-Urban** (SBM-Urban) aimed to eliminate open defecation, eradicate manual scavenging, promote modern and scientific Municipal Solid Waste Management, Effect Behaviour change regarding sanitation practices, generate awareness, augment capacity for ULBs and to create enabling environment for private sector participation in Capital Expenditure, Operation and Maintenance.

3) SWATCH BHARAT MISSION (GRAMIN) (UNDER MINISTRY OF JAL SHAKTI)

- Swachh Bharat Mission (Grameen) (SBM(G)) was launched on 2nd Oct 2014 to ensure cleanliness in India and make Indian Open Defecation Free (ODF).
- Having achieved the ODF status in all villages in the country as of 2nd Oct 2019, phase-II of SBM (G) is now being implemented during FY21 and FY25, with the focus to sustain the ODF status of villages and covering all the villages with Solid and Liquid Waste management i.e. to convert the villages from ODF to ODF Plus.
- **Progress:**
 - » More than 1.2 lakh villages have been declared ODF plus till 10th Nov 2022.
 - » Andaman & Nicobar Islands has declared all its villages as ODF Plus, thus becoming the first Swachh, Sujal Pradesh.

4) SWATCHTA SURVEKSHAN, 2023

- Swatchta Survekshan was started in 2016 as a competitive monitoring framework of the progress of SBM in urban areas. It is an annual survey of cleanliness, hygiene, and sanitation in cities and towns across India as part of SBA-U.
 - » It started with evaluation of 73 cities in 2016, but in 2023 it covered 4477 cities.
- It was launched by MoHUA with Quality Council of India its implementation partner:
- **The design** of Swachh Survekshan is based on **three key pillars**:
 - » **Service Level Progress** - Evaluating progress of cities in ODF status, segregated waste collection, processing, disposal of solid waste and sustainable sanitation. Progress claim is validated through citizens and on-field visits.
 - » **Citizens' Voice** - Assessment through direct feedback, engagement with citizens and innovations helmed by citizens.
 - » **Certifications** - Assessing progress of cities in their performance under Ministry's certification protocols such as Star Rating for Garbage Free Cities and ODF/ODF+/ODF++/ Water+.

A) SWACHH SURVEKSHAN AWARDS 2023

- The President of India, Smt. Droupadi Murmu conferred Swachh Survekshan Awards 2023 at Bharat Mandapam, New Delhi, hosted by MoH&UA.
- 13 awardees received felicitations under categories of Clean Cities, Cleanest Cantonment, SafaiMitra Suraksha, Ganga Towns, and Best Performing States.
- **All India Clean City Rank-1** (Indore and Surat)
- Cleanest city with population less than 1 lakh – **Sasvad**, MHA
- **Cleanest cantonment board**: Mhow
- **Cleanest Ganga town**: Varanasi and Pryagraj
- **Best performing states**: Mha, MP, Chhattisgarh
- **Best Safaimitra Surakshit Sheher**: Chandigarh

5. SOCIAL JUSTICE: EDUCATION

1) ANNUAL STATUS OF EDUCATION REPORT, 2023 – ‘BEYOND BASICS’ (ASER, 2023 – BEYOND BASICS)

- Released in Jan 2024
- It is a nationwide citizen-led household survey that provides a snapshot of the status of Children's schooling and learning in rural India.
- **History:**
 - » ASER reports are being published since 2005.
 - » The 'basic' ASER survey was conducted annually until 2014 and switched to alternate-year cycle in 2016.
 - It collects information about enrolment in preschool and school for children in the age group of 3-16 years.
 - It assesses children in the age group of 5 to 16 year one-on-one to understand their foundational reading and arithmetic abilities.
 - » In the intervening year, ASER dives deeper into different aspects of children's schooling and learning in rural India. The 2023 report is one such report.
- **Who releases the report:**
 - » ASER 2023 was released by ASER Centre, an organization focused on providing reliable data on the status of children's schooling and basic learning in India.
 - » **Note:**
 - **ASER Centre** is an independent research unit, which is responsible for conducting and releasing the ASER reports.
 - **PRATHAM** is an NGO focused on education. It played a key role in establishment of the ASER Centre and continues to collaborate with them. It's a crucial partner which contributes to data collection and dissemination efforts.
 - » **Key Highlights** of 2023 report.
 - The report puts the spotlight on youth aged 14 to 18 years in rural India.
 - **Overall, 86.8% of 14-18 years old** are enrolled in an educational institution.
 - » Small gender gap exists
 - » Notable difference on the basis of age - 3.9% of 14-year-old youth are not enrolled, when compared to 32.6% of 18 years old.
 - **Stream:**
 - » Arts & Humanities (55.7%).
 - » STEM (31.7%)
 - **More Male (36.3%) than Female (28.1%)**
 - » Commerce (9.4%)
 - **Vocational Training** -> Only 5.6% of the surveyed youth
 - **Learning outcome:** The youth were surveyed on four points: Basic Reading, Math and English Abilities; Application of Basic Skills to everyday calculations; Reading and understanding written instructions; and financial calculations that need to be done in real life.
 - » **Basic Reading; Maths and English Abilities:**
 - About 25% cannot read a std II level text fluently in their regional language.
 - Females (76%) do better than males (70.9%).

- 56.7% struggle with division (3 digit by 1 digit) problems.
 - More than 40% couldn't read sentences in English.
- » **Application of Basic Skills to everyday calculations:**
- 15% of the youth are not able to measure length using scale when the starting point is 0 cm.
 - 61% of the youth are not able to measure length using scale if the starting point was not 0 cm.

2) ALL INDIA SURVEY ON HIGHER EDUCATION (AISHE)

- **Why in news?**
 - » **Ministry of Education** releases All India Survey on Higher Education 2021-22 (Jan 2024)
- **In Jan 2024**, Ministry of Education, GoI, has released All India Survey on Higher Education (AISHE) 2021-22 covering all HEIs in the country registered with AISHE collecting detailed information on different parameters such as student enrollment, teachers, infrastructure information etc.
- **Key Highlights:**
 - » **Student enrolment** (4.33 crores) is 26% higher than 2014-15.
 - » **Female Enrolment** (2.07 crores) has increased by 32% compared to 2014-15.
 - » There has been substantial increase in the enrolment of SC students, SC female students, ST students, ST female students etc.
 - » **Caste wise breakdown:** SC (15.3%); ST (6.3%); OBC (37.8%); Other communities (40.6%).
 - » **Gross Enrolment Ratio (GER)** has increased to 28.4% in 2021-22 when compared to 23.7% in 2014-15 (for population between 18-23 years of age).
 - **GER caste wise** (SC - 25.9%; ST - 21.2%;
 - » **Gender Parity Index** - the ratio of female GER to Male GER is 1.01 in 2021-22. (Note: GER has continued to remain over 1 since 2017-18). Thus female GER continues to be higher than male GER for fifth consecutive year.
 - » **Distribution of enrolment:**
 - **Government University** (73.7% enrolment) and Private Universities (26.3%) of total enrolment
 - **Graduation** (78.9%), **Post Graduation** (12.1%),
 - **PhD enrolment** in 2021-22 (2.12 lakh) has increased by 81.2%;
 - **Discipline at undergraduate levels:** Arts (34.2%); Science (14.8%); Commerce (13.3%) and Engineering Technology (11.8%)

3) SCHEMES UNDER MINISTRY OF EDUCATION

B) PRADHAN MANTRI SCHOOLS FOR RISING INDIA (PM-SHRI SCHEME)

- It is a Centrally Sponsored Scheme (CSS) launched on 7 September 2022.
- The objective of the scheme is to set up more than 14,500 PM SHRI Schools over a period of FY23 to FY27 by strengthening the existing schools from those managed by central government/ state governments/ Ut government and local bodies.
 - » **Total project cost:** Rs 27,360 crores (central share of 18128 crores)
 - » These schools will showcase the implementation of the NEP and emerge as exemplary schools over a period, while offering leadership to other schools in the neighbourhood.

- » These schools will be equipped with modern infrastructure including labs, smart classrooms, libraries, sports equipment, art room etc. which is inclusive and accessible.
- » They shall also be **developed as green schools** with **water conservation, waste recycling, energy-efficient infrastructure and integration of organic lifestyle in curriculum**.
- » **Pedagogy** of the school will be more **experimental, holistic, inquiry-driven, discovery oriented** etc.
- » More than **20 lakh students** are expected to be direct beneficiaries of the scheme
- » **Quality evaluation** of these schools will be conducted at **regular intervals** to ensure **desired standards**.

C) VIDYANJALI PROGRAM (A SCHOOL VOLUNTEER INITIATIVE)

- With the aim of **strengthening schools and improving the quality of school education through community, Corporate Social Responsibility (CSR) and private sector involvement** across the country, the Government has initiated Vidyanjali (a school volunteer management program).
- The Vidyanjali portal (<https://vidyanjali.education.gov.in/en>) enables community and volunteers/organisations to interact and **connect directly with the Government and Government aided schools of their choice and share their knowledge and skills** and/or contribute in the form of assets/material/equipment to meet the requirement of the schools.
- As of **20 January 2023**, 3,95,177 schools have been onboarded and **1,14,674 volunteers have registered on the Vidyanjali portal**.

D) EDCIL VIDYANJALI SCHOLARSHIP PROGRAM

- **Launched in Feb 2024** by Ministry of Education
- **The EdCIL Vidyanjali Scholarship Program**, in alignment with the **National Education Policy, 2020** is a powerful force aimed at **revolutionizing opportunities for quality education and access to higher education institutions**.
 - i. It provides **financial support to meritorious students** from **Navodaya Vidyalayas** who lack means, thereby promoting educational equity and inclusion.
 - ii. It also **encourages involvement of private sector through CSR** initiative, thereby **making way of joining forces between the Government and corporates towards an educated India**.
- It thus represents a **whole of society approach** to empowerment.

E) PARAKH (PERFORMANCE ASSESSMENT, REVIEW, AND ANALYSIS OF KNOWLEDGE FOR HOLISTIC DEVELOPMENT)

- It was launched **as part of NEP, 2020**.
- It has been set up as an **organization under NCERT**.
- It is envisaged as a **standard setting body** to advise school boards regarding new assessment patterns. It will thus work on **bringing school boards** across the states and UTs on a common platform
- It will also be holding **periodic learning outcome tests** like the **National Achievement Survey, and State Achievement Surveys**.

- It will work on three major assessment areas:
 - i. Large Scale Assessment
 - ii. School Based Assessment
 - iii. Examination Reforms
- **Objectives:**
 - Uniform norms and guidelines
 - Enhanced Assessment patterns - It will help schools boards to shift their assessment patterns towards meeting the skill requirements of 21st century.
 - Reduce disparity in Evaluation - across the states and boards which currently follow different standards of evaluation.
 - Benchmark Assessment

F) BAL VATIKA PROGRAM

- It is designed as a preparatory class for children before Grade-1. It focuses on developing cognitive, affective, and psychomotor abilities and also early literacy and numeracy for students in the age groups of 3+, 4+, and 5+ years.
- It was launched in Oct 2022 as a pilot project in 49 Kendriya Vidyalayas.

G) PRASHAST: SCREENING TOOL (MOBILE APPS) FOR SPECIFIC LEARNING DISABILITIES

- **Pre-Assessment Holistic Screening Tool (PRASHAST):**
 - » It is a disability screen mobile app developed by the Central Institute of Educational Technology (CIET), a constituent of NCERT.
 - » It covers all 21 disabilities recognized by Persons with Disabilities Act, 2016.
 - » It is available in 23 languages, including all 22 languages included in the VIII schedule of Indian Constitution.
 - » The app will generate school wise report, for further sharing with authorities for initiating the certification process, as per the guidelines of Samagra Shiksha.
- **Why is it needed?**
 - » **Early identification** of Children with disability
 - » **Facilitation** of timely intervention and support
 - » **Enhancement of inclusivity** in school
 - » Promoting Equitable education for all.

H) PRADHAN MANTRI-UCHCHATAR SHIKSHA ABHIYAN (PM-USHA)

- **Background:**
 - » **Rashtriya Uchchatar Shiksha Abhiyan (RUSA)** was a centrally sponsored scheme to fund states/UTs institutions, with the vision to attain higher levels of access, equity, and excellence in the State Higher Education system with greater efficiency, transparency, accountability, and responsiveness.
 - » The first phase of the scheme ran from 2013-2018 and the 2nd phase was launched in 2018.

- » Now, in the light of NEP, 2020, RUSA Scheme has been launched as Pradhan Mantri Uchchatar Shiksha Abhiyan (PM-USHA).
- **Details about PM-USHA:**
 - » **Centrally sponsored scheme.**
 - » It covers government, and government aided institutions from the States and Uts.
 - » **Objective:** To enhance the quality of state higher education institutions by ensuring they meet established standards and using accreditation for quality assurance.
 - » **It focuses on the following:**
 1. **Equity, Access and Inclusion**
 2. **Developing Quality Teaching & Learning Processes:**
 - PM-USHA would provide facilities to the institutions for upgrading the physical and digital infrastructure and also for the conversion of single-stream HEIs into multiple stream institutions.
 - Faculty training will be supported specially with the help of Digital infrastructure.
 3. **Accreditation of Non-Accredited Institutions & Improving Accreditation:**
 - Currently, there are limited number of HEIs with NAAC accreditation. These institutions will get handholding under the scheme for getting accreditation as well as enhancing accreditation from NAAC.
 4. **ICT based digital infrastructure:**
 - HEIs should be encouraged to design, develop and roll out MOOCs for learners & teachers as well as institutions and faculties.
 - Under PM-USHA, institutions would be encouraged to provide Wi-Fi facilities, smart classes, and virtual labs on the institute campus.
 5. **Enhancing Employability through Multidisciplinary:**
 - PM-USHA will encourage HEIs to get linked with the industry and market to strengthen skills, innovations and employability.
 - **Other Key focus:**
 - » Rs. 100 crore support to each of 35 state universities for Multidisciplinary Education and Research University (MERU) Transformation.
 - » Establishment of Model Degree Colleges.
 - » Grants for strengthening universities.
 - » Focus on remote, LWE affected, Aspirational and low Gross Enrolment Ratio regions.

I) SATHEEE (SELF ASSESSMENT, TEST, AND HELP FOR ENTRANCE EXAMINATION) PORTAL

- Ministry of Education
- The Department of Higher Education, Ministry of Education in collaboration with IIT Kanpur has started **SATHEE** (Self-Assessment, Test and Help for Entrance Examination) portal to provide quality education to every student who intend to participate in competitive Education such as JEE, NEET, and various State level engineering and other examination.
 - Ministry of Education has written to all States/Uts to inform educators and students about this facility which can be used for competitive examinations preparation and for knowledge enhancement.
- SATHEE Mitras to increase rural coverage of students appearing for entrance tests, including the JEE and NEET.
- It uses an indigenously-developed AI programme called **Prutor**, which was developed through IIT-Kanpur.
- Learning material is available in Hindi, English and many regional languages

J) PRERNA PROGRAM

- **Ministry:** Department of School Education & Literacy, Ministry of Education has launched '**Prerana: An Experimental Learning Program**'. **Prerna** is driven by a strong commitment to integrate principles of Indian education system and the philosophy of value-based education which is a corner stone of the NEP, 2020.
- It is a week-long residential program for selected students of class IX to XII.
- It is an experiential and inspirational learning program for students with the best-in-class technology where heritage meets innovation.
- A batch of **20 selected students** (10 boys and 10 girls) will attend the program, every week from various parts of the country.
- **Where?**
 - It will run from a vernacular school established in 1888, Vadnagar, Mehsana, Gujarat.
- The curriculum of Prerna School prepared by IIT Gandhinagar is rooted in nine value-based themes.
- It will feature, Yoga, mindfulness, and meditation. It will help students answer questions like "who am I?", "What is our history and culture", "What can I do for the country" etc.

GS FOUNDATION 2025



3 PILLARS OF THE PROGRAM

- **700 hours of classroom** in 10 months, along with handouts
- **Weekly/Monthly assessments** - subjective and objective **tests** (about 40 total tests)
- **Current Affairs** for 15 months
- **Mentorship** and **doubt resolution** (weekly)
- **Prelims Test Series** (about 25 tests)
- **CSAT module** (about 40-45 lectures)
- **Essay module** (about 10 lectures)

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2. S&T:

1) SPACE: CHANG'E-6: CHINA'S MISSION TO LAND ON FAR SIDE OF THE MOON AND TO COLLECT UNIQUE LUNAR SAMPLES

- In June 2024, China's Chang'e-6 mission lander made a successful soft landing on the far side of the moon and will soon begin collecting unique lunar samples.
 - The lander targeted a southern portion of Apollo crater within the South Pole – Aitken (SPA) Basin on the lunar far side.
- The landing is a critical step towards bringing unique and scientifically invaluable lunar samples to Earth for analysis.
 - The lander will collect 2 kg of samples using a scoop to grab surface regoliths and a drill for subsurface material.
- This is China's fourth successful lunar landing in four attempts. This is also China's second landing on the far side of the moon.
- This is also the third lunar landing in 2024 (Japan's SLIM, Intuitive Machine's Odysseus lander)
- **Future China Lunar Program:**
 - CHANG'E-6 will follow up with two missions to the south pole of the moon. These are Chang'e-7 in 2026 and Chang'e-8 around 2028.
 - By 2030, China wants to send first crewed mission to Moon.

2) HEALTH: SURROGACY IN INDIA

- **Definition**
 - » Surrogacy is a practice in which a woman undertakes to give birth to a child for another couple and agrees to hand over the child to them after birth.
- **Two main types of surrogacies**
 - » **Gestation surrogacy** - the pregnancy results from the transfer of an embryo created by in vitro fertilization (IVF), in a manner so the resulting child is genetically unrelated to surrogate.
 - » **Traditional Surrogacy** - the surrogate is impregnated naturally or artificially, but the resulting child is genetically related to the surrogate.
- **Surrogacy in India: A Background**
 - » In 2002, India became the first country to legalize surrogacy. Within 10 years, India had become the surrogacy capital of the world.
 - » **What made India an attractive destination – Class discussion:**
 - But, in 2008, the **Baby Manji Yamada vs. Union of India** Supreme Court highlighted the problems due to lack of proper regulation for surrogacy in India.
- **The Lack of proper regulations had resulted into:**
 - » **Exploitation of surrogate mother**
 - » **No clarity on future of child if the commissioning parents deny taking her/him**.

» Moral issues

- Law Commission of India in its 228th report, 2009 dealt with Surrogacy. It's key recommendations included:
 - Prohibition of Commercial Surrogacy
 - Financial Support for Surrogate child should be provided by surrogacy arrangement.
 - Life insurance cover for surrogate mother should be provided in the surrogacy contract.
 - One of the intended parents should be donor as well , in case of intended parent is single, he or she should be a donor or else go for adoption
 - Legislation itself should recognize a surrogate child to be the legitimate child of the commissioning parent(s) without there being any need for adoption or even declaration of guardian. The birth certificate of surrogate child should contain the name(s) of commissioning parent(s) only
 - Right to privacy of donor as well as surrogate mothers should be protected.
 - Sex selective surrogacy should be prohibited
 - Cases of abortion should be governed by the Medical Termination of Pregnancy Act of 1971 only.
- Government Prohibited foreigners from a renting a Womb in India (2015)

A) THE SURROGACY (REGULATION) ACT 2021

- It prohibited commercial surrogacy and allowed only altruistic surrogacy where no money exchanges hands and where a surrogate mother is genetically related to those seeking a child.
 - » The law also penalizes "not following altruistic surrogacy" for intending couples, intending women and other persons.
- Who can avail surrogacy?
 - » A woman who is a widow or a divorcee between age of 35 to 45 years
 - » A couple, defined as legally married woman and man can available surrogacy is they have a medical condition necessitating surrogacy.
 - The man shall be between ages of 26-55 years and the woman shall be between the ages of 25-50 years, and shall not have previous biological, adopted, or surrogate child.
- Institutions: The law authorizes Centre and State to constitute - National Assisted Reproductive Technology and Surrogacy Board (NSB), and State Assisted Reproductive Technology and Surrogacy Board (SSB).
 - » NSB will advise central government; lay down code of conduct for surrogacy clinics; supervise the functioning of SSBs

B) THE SURROGACY (REGULATION) AMENDMENT RULES, 2024:

- Surrogacy Rules Changed to allow donor gamets for couples with medical conditions (Feb 2024)
 - » The amended rule says "couple undergoing surrogacy must have both gamete from the intending couple. However, in case when the District Medical Board certifies that either husband or wife constituting the intending couple suffers from medical condition necessitating use of

donor gamete then surrogacy using donor gamete is allowed subject to the condition that the child to be born through surrogacy must have atleast one gamete from the intending couple

- This change comes after the Supreme Court Verdict in 2023 which allowed a woman with Mayer-Rokitansky-Kuster-Hauser (MRKH) Syndrome - a rare congenital disorder that affects the reproductive system and can cause infertility - to undergo surrogacy with a donor egg.
- The Feb 2024 amendment also overturned a previous amendment in March 2023 that banned the use of donor gametes.
- » The rule change is not applicable to widowed or divorced women. It reads: "Single woman (widow or divorcee) undergoing surrogacy must use self-eggs and donor sperms to avail surrogacy procedure"

3) HEALTH: MENSTRUAL HEALTH RELATED INITIATIVES

A) DRAFT MENSTRUAL HYGIENE POLICY, 2023

- MoH&FW has formulated Draft Menstrual Hygiene Policy (MHP)
- It envisages comprehensive support through the entire menstrual journey, recognizing the needs of individuals from menarche to menopause with specific focus on prioritizing underserved and vulnerable population.
- The policy intents to serve as a catalyst to raise awareness, challenge societal norms and foster a society that embraces menstrual hygiene as a natural and normal part of life.

B) SCHEME FOR PROMOTION OF MENSTRUAL HYGIENE

- By MoH&FW
- It promotes Menstrual Hygiene among adolescent girls in the age group of 10-19 years.
- The funds are sanctioned based on the proposal received from the States/Uts in their program implementation plan (PIP) under National Health Mission.
- The ASHA workers promote the scheme by distributing the sanitary napkin packs at a subsidized rate of Rs 6/- for a pack of 6 napkins and arranging monthly meetings with the adolescent girls in their area to deliberate on varied health issues including menstrual hygiene management.

C) JAN SUVIDHA SANITARY NAPKINS:

- Under Pradhan Mantri Bhartiya Janaushadhi Pariyojna (PMBJP), Government has launched Jan Aushadhi Suvidha Sanitary Napkins at Rs 1 /- per pad for women to ensure easy availability of the menstrual health services at affordable prices.

D) MENSTRUAL LEAVES:

- Bihar and Kerala are the only two states in India which have a menstrual leave policy as of April 2024.
- **Note:** In May 2024, the Sikkim High Court, the country's Smallest High Court, has introduced menstrual leave policy for its women employees.
 - Such leave will be granted on the prior recommendations of the medical officer of the High Court. "This leave will not be counted against the employee's overall leave count,".

4) DEFENCE: PAKISTAN'S HANGOR CLASS SUBMARINE – BUILT BY CHINA (APRIL 2024)

- News:
 - The first Hangor class submarine, built by China for Pakistan, was launched in April 2024 at a Wuhan shipyard.
- THE Hangor-class, an export variant of the Chinese Type 039A Yuan class, is a diesel electric attack submarine. It is named after the now decommissioned PNS Hangor, which famously sank India's frigate INS Khukri during the 1971 war.
 - It is equipped with an Air Independent Propulsion (AIP) system, which significantly increases the submarines' endurance underwater.
 - It is an attack submarine and has torpedo tubes and capabilities to launch anti-ship missiles, as well as Babur-3 subsonic cruise missile, which has a range of 450 km.
- It is a direct rival of India's Kalvari class (Scorpene class) of diesel electric attack submarine.
 - Note: Hangor is significantly bigger than Kalvari class; but Kalvari is much more manoeuvrable.
 - Note: Kalvari class don't come with AIP but, Navy is currently in the process of installing an indigenously developed AIP system to its Kalvari class submarine.

3. ECONOMY

1) AGRICULTURE

A) NEED OF REFORMING POULTRY INDUSTRY

- Current Context: outbreak of H5N1
- BirdFLu (H5N1): First case of transmission from Chicken to Humans -> in 1997 from HongKong; first case in India was reported in Maharashtra in 2006.
 - Pathogen has crossed many species barrier and has even caused mortality among the polar bears in the Arctic, and seals and seagulls in Antarctic.
 - **Fatality Rate in Humans:** WHO estimate it at 52% (based on 463 deaths recorded since 2003 among the 888 people diagnosed with the virus. Human infections are linked to close contact with bird or its environment.
- Antibiotics are regularly given to birds as a prophylactic and as growth promoters. Many of these antibiotics are classified as critically important and highly important by the WHO and are sold to farmers for preventive use.
- Heavily stocked animals in unsanitary conditions -> detrimental effect on welfare of animals but also negative impact on those who consume the food derived from these animals.
 - **Violation of the Prevention of Cruelty to Animals (PCA) Act, 1960** – Keeping animals in intensive confinement constitutes a crime. Further, operational activities at these industrial facilities cause unnecessary pain and suffering to the animals because of mutilation, starvation, thirst, overcrowding, and other ill-treatment, which is also violation of PCA.

- **Pollution:** The impact of emissions in the atmosphere, effluents in the water system, and the solid waste in the soil is felt by humans, other animals and environment.
 - There is issue of odour pollution, particulate matter and greenhouse gas emissions.
 - **CPCB** has classified poultry units with more than 5,000 birds as a polluting industry that require compliance and regulatory consent to establish and operate.
- **Recommendations of Law Commission of India** in its 269th report:
 - Non-therapeutic antibiotic given to poultry causes antibiotic resistance. More open, cleaner, and ventilated living spaces are likely to cause less need of anti-biotics in animals. This will also make their eggs and meat safer to eat.

A. SOCIAL JUSTICE

1) WOMEN: NATIONAL COMMISSION OF WOMEN

- NCW was set up as a statutory body in Jan 1992 under the **National Commission for Women Act, 1990**.
- It consists of a chairperson, five members and a member secretary all to be nominated by Central government.
- Key Functions of the National Commission of Women (NCW) includes:
 - » Reviewing the existing constitutional and legal framework related to women and recommend changes to make them more effective.
 - » Take up violation of rights of women with appropriate authority.
 - » Act on complaints suo motu in relation to issues concerning deprivation of women.
 - » Inspect institutions where women are kept as prisoners or otherwise and if necessary, take up with relevant authorities any remedial action.
- The commission also has powers that are vested in a **Civil Court**.
- It submits an annual report before the central government. Apart from this, it submits other reports which it deems to be fit.

2) SCHEDULED TRIBES: PARTICULARLY VULNERABLE TRIBAL GROUPS (PVTGs)

- **Particularly vulnerable tribal group** (PVTG) (earlier: Primitive tribal group) is a government of India classification created with the purpose of enabling improvement in the conditions of certain communities with particularly low development indices
- The **Dhebar Commission (1960-1961)** stated that within Scheduled Tribes there existed an inequality in the rate of development. In 1973, during the fourth Five Year Plan a sub-category was created within Scheduled Tribes to identify groups that considered being at a lower level of development.
- Till now, 75 tribal groups have been categorized by Ministry of Home Affairs as PVTGs. They reside in 18 states and UT of A&N Islands.
- These groups are **characterized by**
 - » A pre-agriculture level of technology
 - » Stagnant and declining population
 - » Extremely low literacy

- » Subsistence level of economy

A) PM-PVTG DEVELOPMENT MISSION

- First announced in the 2023-24 budget, the scheme was launched by PM Modi in Nov 2023 from Jharkhand's Khunti district on the occasion of tribal icon Birsa Munda's birth anniversary and the third Janjatiya Gaurav Divas.
- It has a budgetary allocation of Rs 24,000 crores and is dedicated to the holistic development of all 75 PVTGs living in 22,000+ villages of 18 states and UT.
- The objective of the scheme is to improve the socio-economic conditions of PVTGs by providing basic facilities like road and telecom connectivity, electricity, housing, clean water, sanitation, improved education, healthcare, nutrition, and sustainable livelihood to PVTG families and habitations.
- This is an umbrella initiative under which 9 ministries will implement 11 interventions, including PMGSY, PMAY(G), Jal Jeevan Yojna etc.
 - » Note: MoTA is the nodal ministry for overall policy planning and coordination.

B) PM JANMAN (PRADHAN MANTRI JANJATI ADIVASI NYAYA MAHA ABHIYAN) (PM-JANMAN)

- Approved by Union Cabinet in Nov 2024.
- Budget: 24,104 crore for three years.
 - » Central share - Rs 15,336 crores
 - » State Share - Rs 8,768 crores
- It is aimed at providing PVTG households and habitations with basic facilities such as safe housing, clean drinking water, sanitation, improved access to education, health and nutrition, road and telecom connectivity, and sustainable livelihood opportunities.
 - » In addition, saturation will also be ensured in PMJAY, Sickle Cell Disease Elimination, TB Elimination, 100% immunization, PM Poshan, PMJDY etc.
- This initiative is part of Pradhan Mantri - PVTG Development Mission.

C) 1 WEEK INFORMATION EDUCATION AND COMMUNICATION CAMPAIGN FOR THE PM-JANMAN PACKAGE (DEC 2023)

- In this campaign, the Union government has set a target of one week to achieve Aadhaar, caste certificate, and Jan Dhan account saturation across 15,000 PVTG habitations in 100 districts.
 - » It will cover 100 districts of 18 states and the UT of Andaman and Nicobar Islands.
- Need of this IEC campaign?
 - » After announcing the PM JANMAN package, it was understood that to proceed with any aspect of the PM-JANMAN package, they would first need to ensure intended PVTG beneficiaries are provided with documentation like Aadhaar, caste certificates and Jan Dhan Accounts - essential to sign them for benefits under the package.

D) SCHEME FOR DEVELOPMENT OF PVTG

- It is a central sector scheme launched in 2008 by MoTA exclusively for PVTGs.
- **Flexibility to state:** Under the scheme, Conservation cum development (CCD)/Annual Plans are to be prepared by each state/UT for their PVTGs based on their need assessment, which are then appraised and approved by the Project Appraisal committee of the Tribal Ministry.
- Activities for development are taken in the fields of education, health, livelihood and skill development, agriculture development, housing & habitat, conservation and culture etc.

3) STs: PVTGs – CURRENT SITUATION OF PVTGS IN INDIA:

- **Report by Anthropological Survey of India (AnSI) about PVTGs:** The PVTGs of India – Privileges and Predicaments
 - » **Key Findings**
 - a. Baseline surveys exist for only 40 groups out of 75 PVTGs -> displays government's apathy towards PVTGs
 - b. Regional and state specific variations in welfare schemes for PVTGs
 - For instance, Odisha has established exclusive micro-projects for PVTGs, there are none such in for the five PVTGs in Gujarat.
 - Unequal treatment in same state
 - c. State wise distribution
 - Among the 75 listed PVTGs the highest number are found in Odisha (13).
 - Other states
 - Bihar including Jharkhand (9), MP including Chhattisgarh (7), Tamil Nadu (6), Kerala (5), Gujarat (5), WB (3), MHA (3), Kar (2), UK (2), Rajasthan (1), Tripura (1), Manipur (1).
 - All four Tribal groups in Andaman and 1 in Nicobar Islands are recognized as PVTGs.
 - d. Huge Variation in the number of PVTGs
 - A few individuals as in case of Great Andamanese (57), Onge(107) and Sentinelese (around 50) to more than 4 lakh population of Sahariyas in MP and Rajasthan.
 - e. Literacy rate going up
 - Literacy rate has gone up significantly over the past.
 - From a single digit, the literacy rate has gone upto 30-40% in some PVTGs.
 - Female literacy rate is still considerably lower compared to male counterparts.
 - f. Considerable increase in age of marriage among PVTGs
 - The incidence of girl child being married while still being a minor, among these tribes have been decreasing.

A) PVTGs IN DIFFERENT STATES

State / UT Name	PVTGs Name
Andhra Pradesh and Telangana	1. Bodo Gadaba 2. Bondo Poroja 3. Chenchu 4. Dongria Khond 5. Gutob Gadaba 6. Khond Poroja 7. Kolam 8. Kondareddis 9. Konda Savaras 10. Kutia Khond 11. Parengi Poroja 12. Thoti
Bihar and Jharkhand	13. Asurs 14. Birhor 15. Birjia 16. Hill Kharia 17. Konvas 18. Mal Paharia 19. Parhaiyas 20. Sauda Paharia 21. Savar
Jharkhand	Same as above
Gujarat	22. Kathodi 23. Kohvalia 24. Padhar 25. Siddi 26. Kolgha
Karnataka	27. Jenu Kuruba 28. Koraga
Kerala	29. Cholanaikayan (a section of Kattunaickans) 30. Kadar 31. Kattunayakan 32. Kurumbas 33. Koraga
Madhya Pradesh and Chhattisgarh	34. Abujh Macias 35. Baigas 36. Bharias 37. Hill Korbas 38. Kamars 39. Saharias 40. Birhor
Chhattisgarh	Same as above
Maharashtra	41. Katkaria (Kathodia) 42. Kolam 43. Maria Gond
Manipur	44. Marram Nagas
Odisha	45. Birhor 46. Bondo 47. Didayi 48. Dongria-Khond 49. Juangs 50. Kharias 51. Kutia Kondh 52. Lanja Sauras 53. Lodhas 54. Mankidias 55. Paudi Bhuyans 56. Soura 57. Chuktia Bhunjia
Rajasthan	58. Seharias
Tamil Nadu	59. Kattu Nayakans 60. Kotas 61. Kurumbas 62. Irulas 63. Paniyans 64. Todas
Tripura	65. Reangs
Uttar Pradesh and Uttarakhand	66. Buxas 67. Rajis
West Bengal	68. Birhor 69. Lodhas 70. Totos
Andaman & Nicobar Islands	71. Great Andamanese 72. Jarawas 73. Onges 74. Sentinelese 75. Shorn Pens

B) PVTGS OF ANDAMAN AND NICOBAR ISLANDS

- Great Andamanese
- Jarawas
- Onges
- Sentinelese
- Shompen

C) TRIBALS OF A&N ISLANDS

- **Four Ancient Negrito Tribe in the Andaman Islands:** The Great Andamanese, Onge, Jarawa, and Sentinelese
- **Two Mongoloid Tribal communities in Nicobar Islands:** the Shompen and Nicobarese (not PVTGs)
 - Except Nicobarese, the population of other tribal groups in A&N islands have decreased drastically over the years

D) SHOMPEN TRIBE

In April 2024, for the first time, members of the Shompen, one of the PVTGs in the country took part in the election process by casting their votes in A&N Lok Sabha constituencies. 7 members of the tribe exercise their franchise.

- Shompen reside in the dense tropical rain forests of the Great Nicobar island.
- Their estimated population is 229 as per the 2011 census.



E) GREAT ANDAMANESE TRIBE

- They inhabit isolated parts of Southeast Asia and the Andaman Islands.
- At present only about 59 members of the community survive - 34 live in the Strait Island, the rest are in Port Blair.
- The language of the Great Andamanese, Sare, has largely been lost, with the last surviving speaker dying a few years back. The tribe now speaks mostly Hindi.
- Major factors contributing to the diminishing population of the Great Andamanese include environmental 'disturbances', contagious diseases as a result of contact with city dwellers, and a high mortality rate assisted by addictions to alcohol, tobacco and opium

4) DISABLED:

A) RIGHTS OF PERSONS WITH DISABILITIES ACT, 2016

- RPD Act, 2016 replaced the PwD act 1995 and is in accordance with the obligations to UNCRPD to which India is a signatory.
 - » It recognizes Disability as a fluid and shifting concept and incorporates measures towards a full acceptance of people with disabilities ensuring their full participation and inclusion in society.
- Key Provisions
 - » Disability has been defined based on the evolving and dynamic concept
 - » Types of Disabilities have been increased
 - 1995 act: 7 kinds of disability
 - New Act: It recognizes 21 different kinds of disabilities including cerebral palsy, hemophilia, multiple sclerosis, autism and thalassemia, disability from acid attacks and Parkinson's disease etc. which were not recognized earlier.
 - Further, the centre will have the power to add more types of disabilities to the list.
 - » Rights of PwD
 - The act confers several rights and entitlements to disabled persons.
 - » Accessibility: Disabled friendly access to all public buildings, hospitals, modes of transports, polling stations etc.
 - » 4% reservation for disabled in higher education, government jobs, reservation in allocation of land, poverty alleviation schemes etc

- » **Right to Free Education:** Every child with benchmark disabilities will have right to free education between **6 and 18 years.**
- » **Higher penalties for discrimination against disabled**
 - The act stipulates upto 2 years of jail term and a maximum of Rs 5 lakh for discrimination against differently abled persons.
- » **Improved Institutional framework**
 - Central and State Advisory Boards on Disability are to be set up to serve as apex policy making bodies at the central and state levels.
 - Office of chief commissioner of Persons with Disabilities has been strengthened who will be assisted by 2 commissioners and an advisory committee comprising of not more than 11 members drawn from experts in various disabilities.
 - Similarly, Office of state commissioner of disabilities has been strengthened.
 - **Regulatory Body and Grievance Redressal agencies**
 - » Chief Commissioner of PwD and the state commissioners will act as regulatory bodies and grievance redressal agencies and also monitor implementation of act.
 - Provisions for District level committees to be constituted by state governments to address local concerns.
- » **Special Courts**
 - Special courts will be designated in each district to handle cases concerning violation of rights of PwDs.
 - » **Responsibilities has been caste on appropriate governments** to take effective measures to ensure that the persons with disabilities enjoy their rights equally with others

B) SUGAMYA BHARAT CAMPAIGN (ACCESSIBLE INDIA CAMPAIGN)

- » It is a flagship campaign focused on enhancing accessibility, creating awareness and sensitization for creation of **universal barrier free** environment. This will enable persons with disabilities to gain access for equal opportunities and live independently and participate fully in all aspects of life in an inclusive society.
- » It was launched as an AIC on 3rd Dec 2015.
- » By Department for Empowerment of Persons with Disabilities (Divyangjan), Ministry of Social Justice and Empowerment
- » The campaign **targets 3 different verticals** for achieving this universal accessibility.
 1. **Built up Environment**
 2. **Transportation Ecosystem**
 3. **Information and Communication Eco-system**

C) SUGAMYA BHARAT APP

- » It is helpful in crowdsourcing grievances of accessibility being faced on ground in infrastructure and services and forwarding for redressal.
- » It also is helpful in sensitization and awareness generations.

D) SCHEME FOR IMPLEMENTATION OF PERSONS WITH DISABILITY ACT (SIPDA)

- It is a central sector umbrella scheme run by DEPwD for implementing various initiatives for socio-economic empowerment of PwDs.
- The scheme provides **financial assistance** for skill development, creation of barrier free environment, running some institutions in the field of other related activities related to implementation of the Act.
 - » For e.g. the scheme provides for ramps, rails, lift, toilets for wheelchair users etc in government buildings.

E) DEENDAYAL DISABLED REHABILITATION SCHEME (DDRS)

- It provides financial assistance to NGOs for projects relating to rehabilitation of persons with disabilities.

F) ANGANWADI PROTOCOL FOR DIVYANG CHILDREN

- **Why in news?**
 - » MoW&CD launches 'Anganwadi Protocol for Divyang Children' at National Outreach Program in New Delhi (Nov 2023)
- **Details**
 - » This protocol embodies a social model for Divyangjan Inclusive Care under the POSHAN Abhiyan, with a step-by-step approach:
 1. **Step-1:** Screening for early disability signs
 2. **Step-2:** inclusion of community events and empowering families
 3. **Step-3:** Referral support via ASHA/ANM & Rashtriya Bal Swasthya Karyakram (RBSK) teams.
 - » Through Divyang protocol, every district administration will be guided in addressing special needs for education and nutrition, providing **Swavlamban cards** for the empowerment of divyang children and their families.

G) COUNTRY'S FIRST HIGH-TECH SPORTS TRAINING CENTRE FOR DIVYANGJAN INAUGURATED

- On 2nd Oct 2023, on the occasion of Mahatma Gandhi's birthday, PM Modi inaugurated the country's first high-tech sports training centre for Divyangjan, named after former PM Shri Atal Bihari Vajpayee.
- **Name:** Atal Bihari Vajpayee Training Centre for Disability Sports

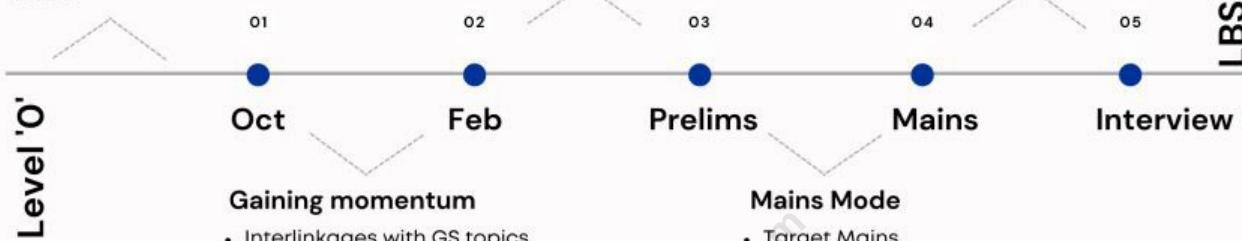
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