TARGET PRELIMS 2024
BOOKLET-54
CURRENT AFFAIRS UPDATES

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LevelUP IAS
dnyaneshwar.mogal.ias@gmail.com
8421928891

2nd Floor, 45 Pusa Road, Opp. Metro Pillar 128, Karol Bagh, New Delhi-110005
Ph: 08045248491, 07041021151 | Email: students@levelupias.com

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.

2nd Floor, 45 Pusa Road, Opp. Metro Pillar 128, Karol Bagh, New Delhi-110005
Ph: 08045248491, 07041021151 | Email: students@levelupias.com

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 i**n 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.

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Ph: 08045248491, 07041021151 | Email: students@levelupias.com

    - **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.**

2nd Floor, 45 Pusa Road, Opp. Metro Pillar 128, Karol Bagh, New Delhi-110005
Ph: 08045248491, 07041021151 | Email: students@levelupias.com

- **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 a 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 Lighting 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.

2nd Floor, 45 Pusa Road, Opp. Metro Pillar 128, Karol Bagh, New Delhi-110005
Ph: 08045248491, 07041021151 | Email: students@levelupias.com

» 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

2nd Floor, 45 Pusa Road, Opp. Metro Pillar 128, Karol Bagh, New Delhi-110005
Ph: 08045248491, 07041021151 | Email: students@levelupias.com

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.

2nd Floor, 45 Pusa Road, Opp. Metro Pillar 128, Karol Bagh, New Delhi-110005
Ph: 08045248491, 07041021151 | Email: students@levelupias.com

- 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 rockets 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.

2nd Floor, 45 Pusa Road, Opp. Metro Pillar 128, Karol Bagh, New Delhi-110005
Ph: 08045248491, 07041021151 | Email: students@levelupias.com

▪ 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**

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Ph: 08045248491, 07041021151 | Email: students@levelupias.com

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.

2nd Floor, 45 Pusa Road, Opp. Metro Pillar 128, Karol Bagh, New Delhi-110005
Ph: 08045248491, 07041021151 | Email: students@levelupias.com

- 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.

2nd Floor, 45 Pusa Road, Opp. Metro Pillar 128, Karol Bagh, New Delhi-110005
Ph: 08045248491, 07041021151 | Email: students@levelupias.com

» **Range**: Upto 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**

2nd Floor, 45 Pusa Road, Opp. Metro Pillar 128, Karol Bagh, New Delhi-110005
Ph: 08045248491, 07041021151 | Email: students@levelupias.com

- 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.

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- 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

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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.

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▪ 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.

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» 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.

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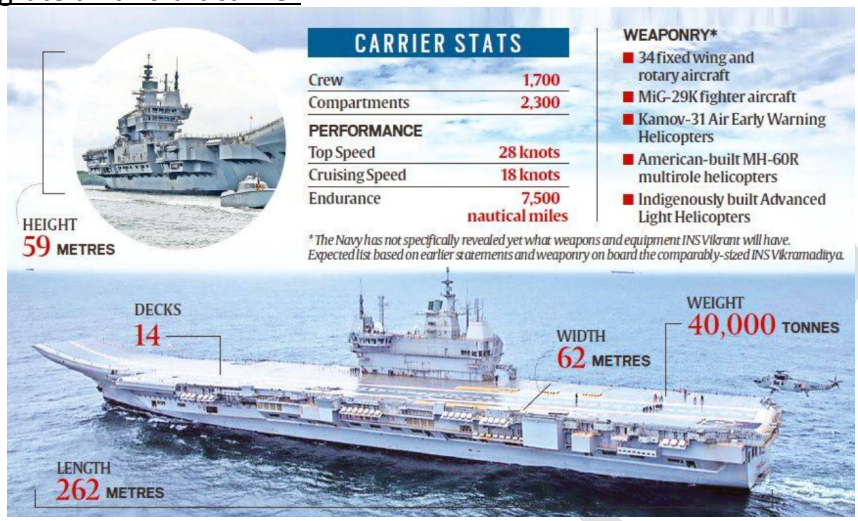
» With an overall indigenous content of 76%, IAC is a perfect example of nation's quest for "Aatma Nirbhar Bharat" and provides thrust to Government's **'Make in India'** initiative.

» 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 PROCURMENT 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 carries 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.

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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	• 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, Vindhyagiri by GRSE

- **INS Vindhyagiri**
  - **Why in news?**
    - President Murmu launches stealth frigate **INS Vindhyagiri** (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).

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- **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 BrahMos 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 Project 15A. They were a step ahead of Delhi Class of destroyers. To be succeeded by Project 15B Vishakhapatnam - class destroyer

LevelUP IAS
priyanshwar.mogal.ias@gmail.com
8421[illegible]0891

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

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.

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- 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 10 years from Russia for a sum of $3 billion. It is being called (**Chakra-III)** and is being fitted in Russia. It's 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)		• 5 commissioned • The last one ***Vagsheer*** *has* ***began sea trial***.

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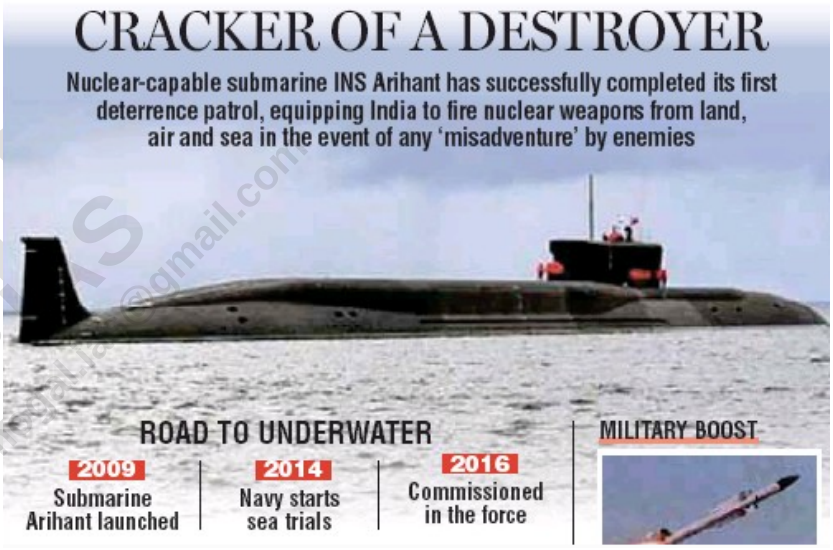
			INS Vagir			
Sindhughosh Class	Attack Submarine	Diesel Electric Submarine	INS Sindhu* (7 in service)	Soviet Union	3,076	A total of 10 were commissioned but now only 3 in service.
Shishumar class	Attack submarine	Diesel Electric	INS Shshumar INS Shankush INS Shalki INS SHankul	Germany	1,850 tonnes	They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

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- 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.

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- **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 t**o 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 sub-marines)

- **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 maneuve**r 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 Mazgon 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)

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- **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 coutries 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)

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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**.

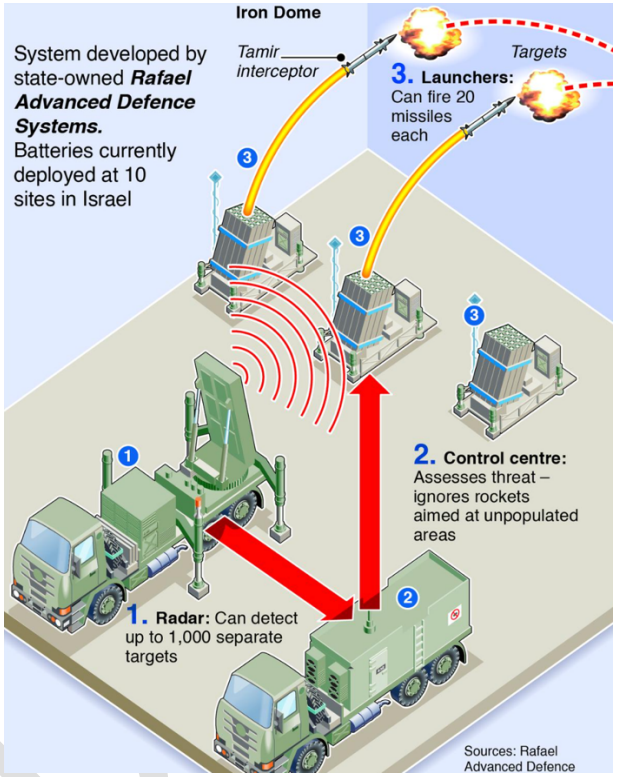
It is an all-weather system and can engage multiple targets simultaneously and be deployed over land and sea.

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 income 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 assembles 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)

2nd Floor, 45 Pusa Road, Opp. Metro Pillar 128, Karol Bagh, New Delhi-110005
Ph: 08045248491, 07041021151 | Email: students@levelupias.com

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.

LevelUP IAS
dnyaneshwar.mogal.ias@gmail.com
8421928891

2nd Floor, 45 Pusa Road, Opp. Metro Pillar 128, Karol Bagh, New Delhi-110005
Ph: 08045248491, 07041021151 | Email: students@levelupias.com