FWD

FORTUNE WEEKLY DIGEST

› The Great Indian Election

› Semiconductor Fabrication

› Climate Change

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FORTUNE WEEKLY DIGEST

EDITOR'S NOTE

As UPSC aspirants, it is essential to stay updated on current affairs to excel in the examination. This **Fortune Weekly Digest (ForWarD)** brings you the latest news and developments from around the world, carefully curated and analyzed to help you prepare for the Civil Services (Main) Examination.

We understand that time is precious, and we have made sure to present the information in a concise and easy-to-understand manner.

The magazine is divided into different sections. Mains relevant topics have been covered in detail with a UPSC previous year question perspective. The jot downs are examples and interesting facts to enrich your answer writing. Cherrypicks has some key words from the week, helpful again in answer writing and essay. We have also included essay topics and sample questions to help you guage your preparation.

We have designed this magazine to best supplement the daily current affairs notes we have launched by the name of **FIND (Fortune IAS News Daily)** and **FINDER (Fortune IAS News Daily Explainer)** and the **Fortune Prelims Precise** monthly compilation. This magazine will be explained in detail and your queries addressed in a live class we conduct.

At a time when there is no dearth of current affairs materials, our hope is help you get a one-stop solution for all your current affairs needs.

This magazine is a work in progress and your feedback will be appreciated.

We hope that this magazine will serve as a valuable resource for your exam preparation and contribute to your success in the UPSC examination.

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ONE HEALTH APPROACH FOR GLOBAL WELLNESS

"Human health and animal health are interdependent and bound to the health of the ecosystems in which they exist"

- ***The World Organization of Animal Health***

Syllabus: GS II - Government policies and interventions for development in various sectors

PYQ MAPPING

Q) *Public health system has limitations in providing universal health coverage. Do you think that the private sector could help in bridging the gap? What other viable alternatives would you suggest?* ***(2015)***

Q) *Appropriate local community-level healthcare intervention is a prerequisite to achieve 'Health for All' in India. Explain.* ***(2018)***

SHORT TAKES

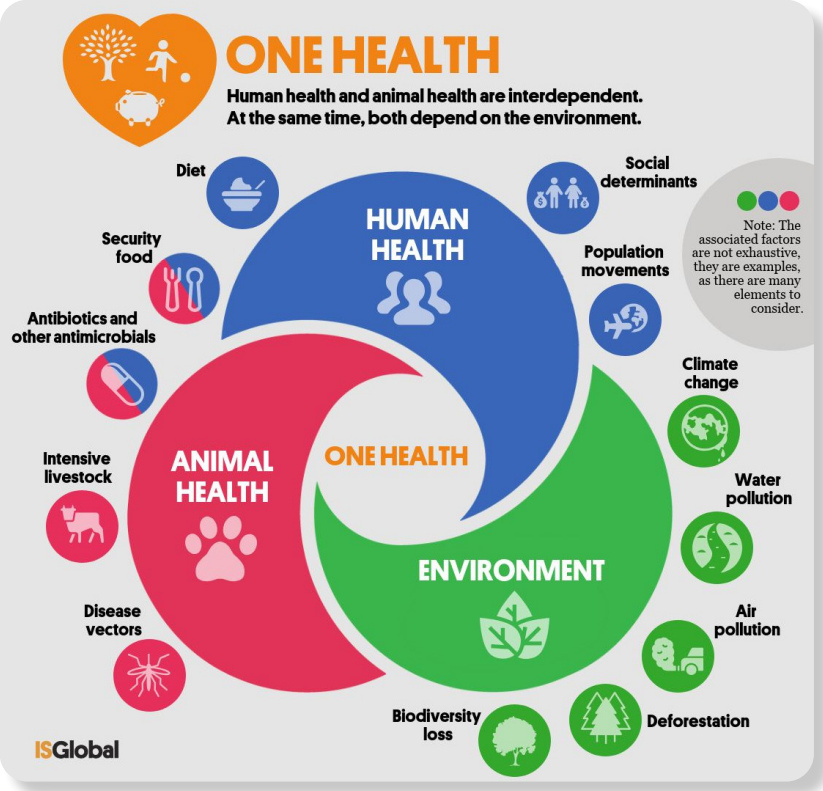
- **PM-STIAC**: Formed in August 2018, the Prime Minister's Science, Technology, and Innovation Advisory Council **(PM-STIAC)** assesses science and technology matters, identifies challenges, devises interventions, and **advises the Prime Minister.** It also supervises the implementation of these interventions across relevant S&T departments, agencies, and government ministries.
- **Silo Mentality:** 'Silos' are **barriers between different units** within a system, stemming from complex governance and financing. The 'silo mentality' refers to a **lack of communication and collaboration**, resulting in inefficient workflows and disjointed efforts.
- **Antimicrobial Resistance (AMR):** Antimicrobials, including antibiotics, antivirals, antifungals, and antiparasitics, treat infectious diseases in humans, animals, and plants. AMR occurs when these medicines become **ineffective against pathogens**. This resistance makes infections harder or impossible to treat, increasing the risk of disease spread and severe outcomes.

WHY IN NEWS?

The Union Cabinet, led by PM Narendra Modi, approved the **creation of a Director post** at the N**ational Institute of One Health**, Nagpur. This individual will also serve as the mission director for a multi-ministerial and multi-sectoral initiative called **National One Health Mission** for integrated disease control and pandemic preparedness.

WHAT IT MEANS?

One Health is a holistic approach that aims to harmonise and optimise the health of humans, animals, and ecosystems.The holistic approach, endorsed by international organisations such as the **World Health Organization (WHO)**, the **World Organization for Animal Health (OIE)**, and the **Food and Agriculture Organization (FAO)** of the United Nations, emphasises collaborative efforts across human-animal-plant-environment interactions to promote the welfare of the entire ecosystem.



EVOLUTION OF ONE HEALTH

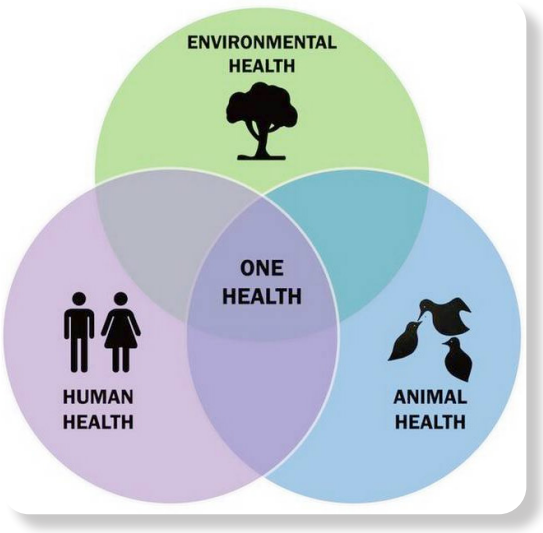
- **Historical Integration**: Before the 19th century, animal and human medicine were **closely intertwined**, with research conducted across both fields without clear boundaries.
- **Revival and Advocacy:** In the 19th century, Sir William Osler promoted the **concept of "One Medicine,"** emphasising the integration of animal and human medicine, which was later revived by Dr. Calvin Schwabe in veterinary public health.
- **Divergence and Concept Expansion**: With the specialisation of medicine in the 20th century, human and veterinary medicine diverged. However, the concept of One Health later emerged, emphasising **interdisciplinary collaboration between human and veterinary medicine**, which further expanded to include environmental health.
- **Modern Initiatives:** Initiatives such as the **Pilanesberg Resolution in 2001**, which urged consideration of wildlife health impacts in development projects, and the introduction of **"One World-One Health" in 2007** by the Wildlife Conservation Society, marked significant milestones in promoting a holistic approach to preventing epidemic disease and maintaining ecosystem integrity.

TIMELINE OF ONE HEALTH IN INDIA

- **Creation:** In July 2022, the Prime Minister's Science, Technology, and Innovation Advisory Council **(PM-STIAC)** endorsed the creation of the **National One Health Mission**
- **Collaboration:** Since then, 13 Ministries and Departments, along with science funding agencies like the Department of Science and Technology, the **Department of Biotechnology (DBT)**, the **Council of Scientific and Industrial Research (CSIR)**, the **Department of Pharmaceuticals**, and **AYUSH (Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homeopathy),** as well as the **Ministries of Health, Animal Husbandry, Environment, and Defence** collaborated to shape the mission, adopting one of the most comprehensive approaches to one health and pandemic preparedness globally.
- **Central Hub:** National Institute for One Health in **Nagpur** would serve as the central hub for coordinating both national and international efforts in the field and was started in 2022.

IMPORTANCE

- **Goals:** The 'National One Health Mission' aims to develop strategies for **integrated disease surveillance**, joint outbreak response, coordinated R&D, and seamless information sharing to control both routine and pandemic diseases more effectively.
- **Agriculture and One Health:** Countries like India, with significant agricultural systems, have a heightened interest in robust One Health systems due to the close proximity of animals and humans. This necessitates rigorous health surveillance to include domestic animals, livestock, and poultry.
- **Tackling Animal Diseases**: Diseases like foot and mouth disease, lumpy skin disease, and canine distemper **not only affect animal productivity**, trade, and conservation efforts but also underscore the importance of One Health initiatives.
- **Better management:**Detecting diseases early in animals can **prevent their transmission to humans** and the introduction of pathogens into the food chain, underscoring the need for coordinated readiness against threats like avian influenza, Nipah, and other potential pandemics.
- **Wide Scope:** The concept of 'One Health' encompasses **more than just diseases**; it includes broader aspects like antimicrobial resistance, food safety, plant diseases, and the influence of climate change on all these factors.
- **Increasing zoonotic diseases:** About 60 per cent of known infectious diseases in humans and 75 per cent of all emerging infectious diseases are zoonotic **(United Nations Environment Programme (UNEP)** and the **International Livestock Research Institute (ILRI) study)**.



RECENT INITIATIVES AND EXAMPLES

National one Health Program for Prevention & Control of Zoonoses

It aims to **prevent zoonotic threats**, aiming to protect communities and minimise losses by enhancing **inter-sectoral coordination.** This involves utilising existing surveillance systems, engaging veterinary and wildlife institutes, conducting capacity building programs, and exploring networking and mapping of laboratory resources alongside information and communication efforts.

National Rabies Control Programme (NRCP)

India launched its new **National Action Plan for Dog-Mediated Rabies Elimination** (NAPRE**) by 2030** on World Rabies Day, 2021. Endemic for rabies, India accounts for roughly **36% of global human rabies deaths transmitted by dogs.**

Programme for Prevention and Control of snakebite envenoming

The Union Health Ministry introduced the National Action Plan for **Prevention and Control of Snakebite** Envenoming (NAP-SE) with the goal of halving snakebite-related deaths by 2030 through a 'One Health' approach. India sees an estimated **3-4 million snake bites annually, causing about 50,000 deaths**, accounting for half of all global snakebite fatalities.

One Health Initiatives by States

- **Kerala:** Establishment of a **multi-disciplinary Central team** by the National Centre for Disease Control to control the **Nipah virus outbreak** comprising experts in Zoonosis, Epidemiology, Respiratory and Emergency Medicine, and Animal Husbandry for thorough investigation.
- **Odisha**: Successful implementation of the One Health intervention model aimed at **eliminating human anthrax from the tribal district of Koraput.**
- **Tamil Nadu:** Development of a cost-effective data-driven rabies transmission model to combat **rabies challenges** effectively.

CHALLENGES

- **Silo mentality:** The 'silo mentality' means **working independently** within one's own specific field such as epidemiology, veterinary medicine, public health or ecology, without collaboration across human, animal, and environmental health sectors. This hampers communication, coordination, and resource sharing, undermining the holistic approach central to One Health.
- **Antimicrobial resistance (AMR):** In India, high antibiotic use leads to challenges like **increasing resistance among animals and insects**, spreading through the ecosystem. Misuse, low awareness, and residue buildup of antibiotics hinder One Health efforts.
- **Unavailability of proper records:** The absence of proper records, such as prescriptions and hospital records, with medical professionals and institutions, hampers effective disease management and surveillance efforts. **Rural areas of India are affected the most** where healthcare infrastructure is limited.
- **Lack of Knowledge:** In developing countries like India, a significant weakness lies in the lack of awareness about zoonotic diseases among animal handlers and the general public.This hinders effective disease prevention and control efforts.
- **Lack of Trust**: Mistrust among different sectors hampers collaboration and communication. **Blame and tensions**, like veterinarians feeling unfairly accused of antimicrobial resistance, strain relationships with other sectors. This distrust can hinder efforts to address important health issues effectively.
- **Limited Funding**:Collaboration between sectors, particularly in environmental and agricultural fields, is hindered due to **financial constraints.**
- **Lack of training programs:** Limited training programs for health workers and insufficient long-term education on One Health **hinders capacity building** in India, hampering effective zoonotic disease management.

- **Rural-Urban Divide:** Disparities in healthcare access between rural and urban regions impede the effective implementation of One Health.**Limited access to healthcare facilities** and shortages of trained personnel in rural regions can delay disease diagnosis and response efforts.
- **Environmental Factors**: As urbanisation expands, wildlife habitats shrink, heightening the risk of **diseases jumping from animals to humans.** Environmental degradation, pollution, and climate change further disrupt disease transmission patterns, complicating control measures.

WAY FORWARD

- **Prioritising Wildlife and Veterinary public health (VPH):**In India, where people live close to forests, their livelihoods are intertwined with the ecosystem, posing public health risks, including those associated with revered animals like cows and infection risks from primates like monkeys. Implementing **Veterinary Public Health measures** can mitigate disease transmission from animals to humans, safeguarding public health.
- **Focus on research:** Pandemic preparedness requires a strong focus on **Research and Development (R&D)** to develop vital tools like vaccines, therapeutics, and diagnostics, essential for India and global readiness against emerging diseases.
- **Stakeholder collaboration:** Coordinated efforts of government departments, academic centres, and the private sector are important as they are all critical stakeholders in achieving this goal.
- **Better resource utilisation** : Utilisation of expensive infrastructure and improved cross-sector linking will enhance the ability to tackle diseases like **Nipah**, which involve bats, pigs, and humans.
- **Comprehensive monitoring**: Disease surveillance has to go beyond humans and encompass preventive health and hygiene in livestock and poultry, **improved standards of animal husbandry** for greater food safety, and effective communication protocols between animal and public health systems.
- **Integrating AI:** India should aim to enhance its epidemiology and data analytic capabilities by leveraging **artificial intelligence (AI), machine learning,** and disease modelling under the mission, while also coordinating capacity building in epidemiology across sectors.
- **Expansion of new methods:** Emerging approaches like genomic **surveillance from wastewater,** effective **during COVID-19**, will extend to sites where animals gather, broadening disease surveillance across human, livestock, and environmental sectors.

CONCLUSION

Urgent action is needed to combat zoonotic pandemics, necessitating the establishment of a functional **inter sectoral initiative**. In India, cultural beliefs intertwined with rearing practices pose challenges to accepting this approach, highlighting the need for **gradual education** on the interconnectedness of human, animal, plant, and environmental health. One Health activities should focus on **research, training, seeking governmental support,** and institutionalisation while monitoring collaboration strength and integration. Emphasising **early diagnosis, prevention, and control** can prepare us for future pandemics, requiring collaboration among various stakeholders at national and international levels.

SAMPLE QUESTION

Q) Examine the significance and challenges of the One Health approach in promoting global health security and ecosystem integrity? **(10 marks)(150 words)**

THE GREAT INDIAN ELECTIONS

Syllabus: GS II - Parliament and State legislatures

PYQ MAPPING

Q) *'Simultaneous election to the Lok Sabha and the State Assemblies will limit the amount of time and money spent in electioneering but it will reduce the government's accountability to the people' Discuss.* ***(2017)***

Q) *In the light of recent controversy regarding the use of Electronic Voting Machines (EVM), what are the challenges before the Election Commission of India to ensure the trustworthiness of elections in India* ***(2018)***

SHORT TAKES

- **ECI:** The Election Commission of India(ECI) is an autonomous constitutional authority **(article 324)** responsible for administering Union and State election processes in India. The body administers elections to the **Lok Sabha, Rajya Sabha, State Legislative Assemblies** in India, and the offices of the **President and Vice President** in the country. It currently consists of the Chief Election Commissioner and two Election Commissioners.
- **Rule 49-O:** This rule of the **Conduct of Elections Rules, 1961** allows an elector who has been duly registered in the electoral roll and has **signed or thumb-impressed Form-17A** to decide not to cast their vote. In such cases, the presiding officer notes this decision alongside the elector's entry in Form-17A, and the elector confirms this decision with their signature or thumb impression.

INTRODUCTION

This month, India is embarking on the world's largest democratic exercise, with **nearly 100 crore eligible voters**. The elections will decide the fate of 543 contested seats in the lower house of parliament, the Lok Sabha, for a term of five years. To secure power, a party or coalition must obtain a **simple majority of 272 seats.** India follows the first-past-the-post system, involving voters casting a single vote for a candidate in a constituency, with the candidate receiving the most votes winning the seat.

EVM

- **About: EVM (Electronic Voting Machine)** enables anonymous voting and has replaced paper ballots in Indian elections, both at the state and national levels, ensuring a secure and efficient voting process.The use of EVM started back in **1982 Kerala Assembly elections.**
- **Working:** The EVM comprises a **control unit and a balloting unit** connected by a 5-metre cable. The control unit, operated by the polling officer, activates the balloting unit where voters **cast their secret ballots** by pressing buttons against their chosen candidate's name and symbol.
- **Use:** Powered by a **6-volt single alkaline battery**, the EVM can operate in areas without electricity.
- **Security measures**

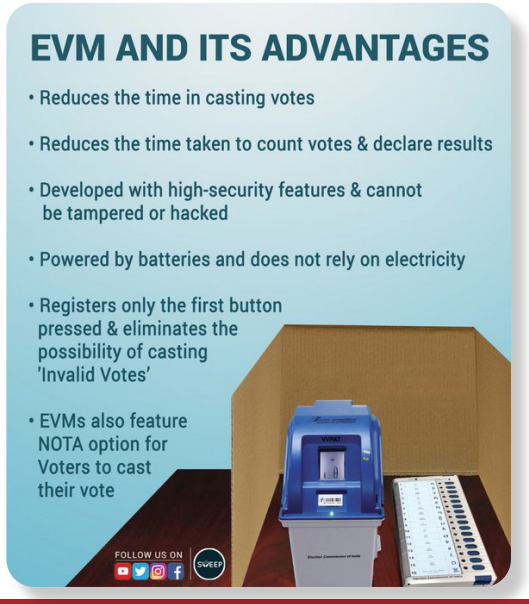
» EVMs undergo stringent security measures akin to those employed by the Reserve Bank of India for cash transportation.

» Only two Indian PSUs, **Bharat Electronic Limited (BEL)** and **Electronics Corporation of India Limited (ECIL)**, manufacture EVM machines. Directly transported from the factory to district administration offices, they are stored in secure strong rooms.

» Prior to presentation to political party representatives, BEL/ECIL engineers conduct thorough checks, with strict restrictions on mobile phones and cameras.

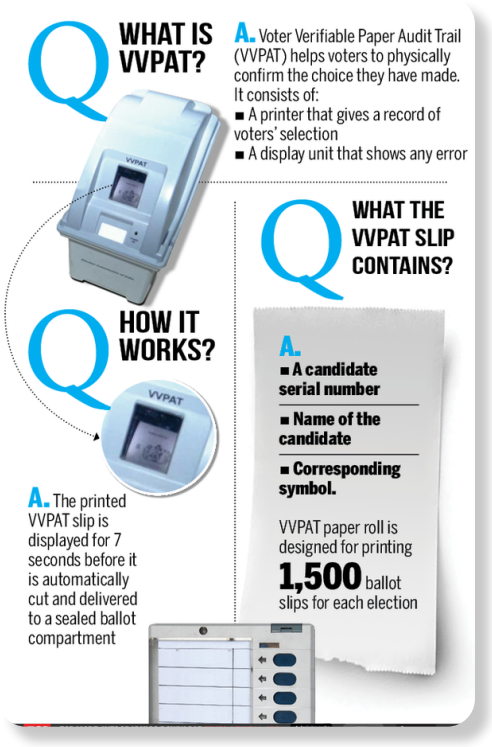
» **Mock voting is conducted using 5% of EVMs**, with computerised randomization and additional rounds during candidate setting and on election day.

» After polling, EVMs are **sealed, monitored by CCTV, and placed under 24-hour security** in strong rooms, with candidates allowed to affix their seals.



VVPAT

- **About**: **Voter Verifiable Paper Audit Trail (VVPAT)** is a machine, which is attached to the ballot unit (BU) of the Electronic Voting Machine (EVM) which prints out a **slip of paper** with the voter's choice indicated on it.
- **Working;** The VVPAT machine visually confirms a voter's choice by printing a slip with the candidate's details. This **slip is displayed for 7 seconds** behind a glass window for verification before being stored in a compartment below.
- **Use:** Voters are not allowed to take the VVPAT slip home, as it's used to verify votes in randomly selected polling booths. This physical verification enhances trust in the voting process for both voters and political parties.
- **Counting of VVPAT Slips**: The Election Commission initially mandated the counting of VVPAT slips from one randomly selected polling station per Assembly constituency, later **increased to five stations per constituency after a Supreme Court ruling in April 2019.**



INTRODUCTION OF VVPAT

- **Proposal and Development:** The idea of VVPAT emerged in 2010 during a meeting between the Election Commission (EC) and political parties to enhance transparency in the polling process.Bharat Electronics Limited (BEL) and Electronics Corporation of India (ECIL), manufacturers of EVMs, developed a prototype after the matter was referred to the **Technical Expert Committee by the EC**.
- **Field Trials and Approval:Field trials** were conducted in various locations including **Ladakh, Thiruvananthapuram, Cherrapunjee, East Delhi, and Jaisalmer in July 2011**.After refining the design based on feedback from trials and political parties, the expert committee approved the VVPAT design in February 2013.
- **Implementation and Phased Introduction**:Conduct of Elections Rules, 1961 were amended in 2013 to allow for the attachment of a printer with a drop box to the EVM.The first usage of VVPATs occurred in all 21 polling stations of the Noksen Assembly constituency of Nagaland in 2013, leading to a phased introduction. **From June 2017 onwards, 100% of VVPATs were deployed** in elections, culminating in the 2019 Lok Sabha elections becoming the first general election with all EVMs attached to VVPATs.

Property and other Disclosure by Candidates

- **Supreme Court Mandate of 2002:** In May 2002, the Supreme Court established **voters' rights to access crucial information about candidates**, including criminal history, education, and financial details.This landmark judgement aimed to empower voters to make informed decisions during elections.
- **Legislative Response**:Despite the Supreme Court's directive, the Central Government attempted to **limit disclosure requirements through an ordinance** in August 2002.This ordinance introduced penalties for non-disclosure or false disclosure and sought to restrict candidate disclosures to specific details outlined in the Act.
- **SC Upholds Disclosure Norms**: On March 13, 2003, the Supreme Court **invalidated the contentious sections of the ordinance**, reaffirming the importance of transparent candidate disclosures.Following this decision, the Election Commission of India reissued guidelines to ensure compliance with the court's ruling and uphold transparency in electoral processes.
- **SC Ruling of 2024:** The Supreme Court ruled that candidates need not disclose minor movable assets unless they're significant or relevant to their candidacy. Despite arguments for voters' absolute right to know, the **court refused to mandate full transparency for candidates.**

Who can vote

» All citizens **aged 18 and above** who are in the electoral roll, hold the right to vote in various elections, including national, state, district, and local government body elections.

» Registration in the respective constituency is mandatory for obtaining a **Election Photo Identity Card (EPIC)**, without which participation in the electoral process is not permitted.

Who can't vote

» A person who is **not a citizen** of India cannot be registered in the electoral rolls.

» Section 62(5) of the Representation of the People Act, 1951, states that individuals **confined in prison**, whether under a sentence of imprisonment or transportation, or in the lawful custody of the police, are not permitted to vote in any election.

» Those citizens who have been **declared by the law** that they are unstable to vote or barred due to corrupt practices or any illegal act relating to elections are not entitled to be a voter.

NOTA

- **About:** NOTA (None Of The Above) was introduced in 2013 by a Supreme Court directive based on a **2004 public interest litigation** filed by the People's Union for Civil Liberties.
- **Symbol :** The **NOTA symbol** (Ballot paper with a cross) was **designed by the National Institute of Design Ahmedabad** after receiving feedback from villagers, including those below the poverty line and semi-literate voters, who associated the cross sign with rejection. Cleared by the Election Commission, the symbol was used for the **first time in 2015.**
- **Implementation:** The 2014 Lok Sabha polls marked the first national elections where the NOTA option was available. Before NOTA, voters could express their decision of not choosing any candidate under **Rule 49-O of the Conduct of Election Rules, 1961**, but this compromised voter secrecy.
- **Rationale:** The Supreme Court envisioned that the introduction of NOTA would encourage political participation among voters and would prompt political parties to be more discerning in their candidate selections.
- **Validity:** ECI had clarified that the votes polled by pressing the NOTA buttons on the EVMs would not be considered valid. Even if the NOTA button polls most seats, the next human candidate is declared as elected.
- **Exception**: In August 2018, the **Supreme Court barred the NOTA** option in **Rajya Sabha elections**, emphasising that these elections operate on an open ballot system. The ruling suggested that NOTA **could legitimise members' abstention from transferring excess votes**, potentially violating party agreements.
- **Global Adoption**: At least a dozen other countries have a NOTA or negative vote option, from France and Spain in Europe to Brazil and some states in the United States. In the neighbourhood, **Bangladesh has a NOTA option as did Pakistan in 2013**, after which it was **discontinued.**

CONCLUSION

India's electoral process, marked by the use of EVMs, VVPATs, and the NOTA option, exemplifies the country's commitment to **transparency and accountability**. With stringent security measures and technological advancements, India ensures the integrity of its democratic elections, setting a **global standard** for electoral practices. As the nation undertakes its democratic exercise, these mechanisms underscore the significance of citizen participation and informed decision-making, reinforcing the foundational principles of democracy.

SAMPLE QUESTION

Q) Discuss the evolution and significance of electoral reforms in India.Analyse the impact of these reforms on transparency, accountability, and citizen participation in the electoral process. **(15 marks)(250 words)**

SPACE DEBRIS

Syllabus: GS III - *Space Technology*

PYQ MAPPING

Q) *What is India's plan to have its own space station and how will it benefit our space programme?* ***(2019)***

Q) *India has achieved remarkable successes in unmanned space missions including the Chandrayaan and Mars Orbiter Mission, but has not ventured into manned space missions, both in terms of technology and logistics? Explain critically.* ***(2017)***

Q) *Discuss India's achievements in the field of Space Science and Technology. How the application of this technology has helped India in its socio-economic development?* ***(2016)***

SHORT TAKES

Low Earth Orbit (LEO):

- It is a range of **orbits around Earth** that are 1,200 miles (2,000 km) or less in altitude.
- It's the closest orbit to Earth and the easiest to reach in terms of energy and rocket power.

CURRENT STATS BY EUROPEAN SPACE AGENCY

- 36500 space debris objects greater than 10 cm.
- 1 million space debris objects from greater than **1 cm to 10 cm.**
- 130 million space debris objects from greater than **1 mm to 1 cm.**

WHY IN NEWS?

At the **42nd Inter-Agency Space Debris Coordination Committee (IADC)** annual meet in **Bengaluru** on April 16, 2024, ISRO Chairman S. Somanath announced India's commitment to achieving debris-free space missions by 2030.

REASONS

.Defunct satellites:

- These are satellites that have reached the end of their operational life and **no longer function.**
- For instance, commercial satellites typically only last around 15 years due to the harsh space environment.

Rocket stages:

- After launching a spacecraft, **leftover rocket bodies** and boosters are often placed in orbit.
- These can collide with other objects or break up over time.

Missing equipment:

- During spacewalks, astronauts might accidentally drop tools or other objects, which become part of the debris.

Collisions:

- Even **accidental collisions** between operational satellites or debris can be catastrophic.
- The resulting **high-speed smashup** can create thousands of new pieces of debris.
- As an example, the **2009 collision between an operational US Iridium satellite and a defunct Russian Cosmos satellite** created over 2,000 pieces of trackable debris.

Anti-satellite weapons tests:

- Though less frequent, some countries have conducted tests using **missiles to destroy satellites.**
- These tests create a significant amount of debris, as seen in the **destruction of a Chinese weather satellite** in 2007 which resulted in thousands of new debris pieces.

WHAT RISKS DOES SPACE JUNK POSE TO SPACE EXPLORATION

Collisions:

- Due to their high speeds (up to 18,000 mph!), even small pieces of debris can inflict serious damage upon impact.
- A **collision with a critical component on a spacecraft** could cripple its functionality or even destroy it entirely.
- This risk is especially concerning in regions with high debris concentration, like **Low Earth Orbit (LEO).**

Disruptions and Delays:

- The constant threat of collisions necessitates complex manoeuvres for operational spacecraft.

- They frequently need to **dodge debris, requiring additional fuel** and potentially delaying missions or scientific observations.

♣ **Cascading Kessler Syndrome:**

- **Kessler Syndrome** is a theoretical scenario where Earth's orbit becomes so crowded with debris and objects that satellites can no longer be used in certain areas.
- A collision between large objects could create a **chain reaction,** shattering them into countless new debris fragments.
- This would exponentially increase the debris population in orbit, making space travel incredibly hazardous, if not impossible.

♣ **Threat to Astronauts:**

- While space stations like the **International Space Station (ISS)** are shielded, a significant debris strike could still be dangerous for astronauts on board.
- Additionally, debris poses a risk to spacecraft during **Extravehicular Activities (EVAs)** or **spacewalks**.

♣ **Threat to Marine Life:**

- Large objects falling into oceans, with 70% of Earth's surface covered by water, pose threats to marine life and contribute to pollution.

♣ **Reduction of Orbital Slots:**

- The accumulation of space debris in specific orbital regions can limit the availability of desirable orbital slots for future missions.

♣ **Increases costs**

- Space companies will increasingly rely on stronger and robust materials to **withstand collisions**, potentially leading to launch delays or rescheduling as a precaution against debris threats. Consequently, **Increases the cost of space missions.**
- The potential damage and loss caused by even small debris pose **significant risks to missions.**
- A collision has the capacity to cripple or completely destroy a satellite, necessitating c**ostly replacements** and resulting in mission failures.

POSSIBLE SOLUTIONS

✔ **Passivation:**

- This involves depleting the energy sources (fuel, batteries) of defunct satellites at the end of their mission and **reduces the risk of explosions** creating new debris.
  - For example, **ESA's Clean Space initiative** promotes passivation techniques for their satellites

✔ **Limiting debris generation during launches:**

- This involves **designing rockets to minimise leftover stages** and debris from separation events.
  - For instance, **SpaceX's Falcon 9 rocket** is partially reusable, reducing the number of stages left in orbit.

✔ **Operational procedures:**

- Space agencies and satellite operators can collaborate on manoeuvres to avoid collisions between operational spacecraft and tracked debris.
  - For example, the **US Department of Defense's Joint Space Operations Center (JSpOC)** tracks debris and issues collision warnings to satellite operators.

✔ **Docking and deorbit:**

- This concept involves sending a servicing spacecraft to capture a defunct satellite and deorbit it safely into Earth's atmosphere for burn-up.

- Example: **ClearSpace-One, a Swiss start-up**, is developing a mission to capture a defunct satellite with a robotic arm.

Harpoons or nets:

» These technologies involve using projectiles or tethered nets to snag debris objects and deorbit them.

» Example: The **RemoveDebris project** by a consortium of European companies is a demonstration mission testing a harpoon technology.

» **Japan's JAXA** partnered with **Nitto Seimo**, a company that specialises in fishing equipment, to develop the net.

i. The **net** was made of a strong, lightweight material and was designed to be unfolded in space.

ii. Launched from a satellite, the net would use **electricity to create a magnetic field**, attracting debris.

iii. Eventually, the net and debris would be de-orbited and burn up in the atmosphere

INDIA'S ROLE IN MITIGATING SPACE DEBRIS

Space Situational Awareness (SSA):

» ISRO has established a **network of radars and telescopes** to track space objects and assess collision risks for Indian satellites.

Collision Avoidance Manoeuvres (CAMs):

» ISRO has successfully performed **collision avoidance manoeuvres** to safeguard its operational spacecraft from debris threats.

IS4OM - Collision Risk Monitoring System:

» **ISRO's System for Safe and Sustainable Operations Management** (IS4OM) continuously monitors objects in orbit to identify and mitigate potential collision threats.

Membership in Key Organisations:

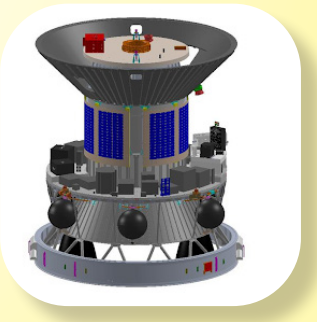
» India is a member of the **Inter-Agency Space Debris Coordination Committee (IADC)**, the **International Astronautical Federation (IAF) Space Debris Working Group**, and the **United Nations Committee on the Peaceful Uses of Outer Space (COPUOS).**

Advocacy for Stronger Mitigation Measures:

» ISRO, the Indian Space Research Organisation, emphasises the importance of **stricter space debris mitigation** guidelines to ensure sustainable space activities.

ISRO POEM-3:

» **ISRO's PSLV-C58/XPoSat** mission left zero debris in Earth's orbit by transforming the last stage into the PSLV Orbital Experimental **Module-3 (POEM-3)** , a kind of orbital station, which safely re-entered the atmosphere after the mission instead of floating in orbit.



i. The PSLV has **four stages**. After using up their fuel, the **first three stages** fall into the ocean.

ii. The **fourth stage**, known as **PS4**, usually becomes **space debris** after launching the satellite.

iii. However, for the PSLV-C53 mission, the PS4 stage will have a new role as a stable platform for experiments. The PS4 will orbit the Earth while staying stable.

iv. This new approach **turns part of the PSLV** into a **laboratory** for space research.

v. POEM has its own **Navigation Guidance and Control (NGC) system**. This system acts as the platform's brain, ensuring it stays in a stable position accurately.

vi. POEM is equipped with payloads and **obtains its power from solar panels** installed around the PS4 tank, supplemented by a **lithium-ion battery**.

vii. For navigation, it utilises four sun sensors, a magnetometer, gyroscopes, and the **NavIC** system.

viii. Additionally, it features specialised control thrusters powered by stored helium gas and is equipped with a telecommand capability for receiving instructions.

'Project NETRA'

- It is an **early warning system** in space to detect debris and other hazards to Indian satellites.
- Under NETRA, the ISRO plans to put up many observational facilities: connected radars, telescopes, data processing units and a control centre.
- It can **track objects as small as 10 cm**, up to a range of 3,400 km and equal to a space orbit of around 2,000 km.

CONCLUSION

Addressing the increasing threat of space debris demands **international collaboration**, **multifaceted mitigation strategies**, and public engagement to ensure sustainable solutions for the future of space exploration and safety.

SAMPLE QUESTION

Q) Considering the growing concern over space debris and its potential impact on space exploration and safety, How does India plan to fulfill its commitment to achieving debris-free space missions by 2030? **(10 marks)(150 W)**

RIGHT AGAINST CLIMATE CHANGE IMPACTS

Syllabus: GS III - *Environmental Conservation*

PYQ MAPPING

Q) Describe the major outcomes of the 26th session of the Conference of the Parties (COP) to the United Nations Framework Convention on Climate Change (UNFCCC). What are the commitments made by India in this conference? ***(2021)***

SHORT TAKES

- **Great Indian Bustard:** The Great Indian Bustard (Ardeotis nigriceps) holds the distinction of being the **State bird of Rajasthan.** Additionally, it serves as the **flagship species for grassland ecosystems**, **symbolising the overall health of these habitats**. According to the IUCN Red List, it is categorised as **Critically Endangered.**
- **The Kyoto Protocol**: Adopted on December 11, 1997, and

WHY IN NEWS?

The Supreme Court recently acknowledged the **right to be protected from the detrimental impacts of climate change** as a distinct entitlement. The Court highlighted **Articles 14 (ensuring equality before the law and equal protection of laws) and 21 (guaranteeing the right to life and personal liberty)** of the Indian Constitution as significant foundations for this right.

The judgement came as the court's modification of **M.K. Ranjitsinh v. Union of India (2021)** verdict that pertains to a case concerning the conservation of the critically endangered Great Indian Bustard (GIB).

Background of the case

In response to a petition for protection of the **critically endangered Great Indian Bustard (GIB)** and **Lesser Florican**, the Supreme Court in 2021 initially r**estricted the installation of overhead transmission lines** within their habitat in Rajasthan and Gujarat. However, the government found this impractical due to its impact on renewable energy prospects and climate change commitments. Upon the request of three government departments, the Court modified its order, emphasising the broader concern of climate change risks faced by people.

BACKGROUND OF THE CASE

- **Indian scenario:** This ruling is particularly significant amidst India's **escalating environmental concerns**, including air and water pollution, deforestation, and climate change impacts**.**

entering into force on February 16, 2005, it has 192 Parties. It requires industrialised nations and transitioning economies to adhere to individual emission reduction targets, operationalizing the UN Framework Convention on Climate Change, which mandates mitigation policies and reporting. **India ratified the protocol in 2002.**

- **Paris Agreement:** It is a legally binding treaty on climate change, was adopted by 196 Parties at COP21 in Paris on December 12, 2015. It came into force on November 4, 2016, with the primary goal of limiting the global average temperature increase to well below 2°C above pre-industrial levels and striving to cap it at 1.5°C. **India has ratified the agreement in 2016.**

  - **Example -** The recent flooding triggered by Glacial Lake Outburst **(GLOF) in Sikkim** has resulted in loss of lives and livelihoods.

- **Prompt to make laws**: Recognizing environmental rights serves as a nudge to Parliament, urging lawmakers to address these issues legislatively.The absence of a specific legislation addressing climate change and its impacts, despite numerous regulations and policies is an issue of concern
- **Environmental and climate justice**: The judgement recognises the multifaceted impacts of climate change on different communities. It signifies the **expansion of legal rights** to include a clean environment, reflecting a proactive approach to addressing environmental pollution and upholding international commitments.
- **Holistic approach**:The ruling highlighted the need for a comprehensive approach to **environmental conservation** and **climate change mitigation**, considering India's commitments and **constitutional principles.**
- **Initiate Public Discourse:** This ruling will initiate public conversations around environmental issues creating a greater awareness and action towards **safeguarding the planet.**
- **Empowerment**: It empowers citizens to utilise **constitutional courts** as a platform to litigate environmental concerns in the future, thereby fostering accountability and enforcement of these rights.

  - **Example -** The **Global Climate Litigation Report 2023**, published by the UNEP, highlighted 2,**180 climate-related cases across 65 countries.**

Important Rulings, Global Conventions or other Constitutions which provide such a right

Ruling by European Court of Human Rights (ECHR)

Europe's highest human rights court ruled in favour of 2,000 Swiss women, aged over 64, who sued the government for insufficient action on climate change. The ECHR recognized the right to effective protection from the severe adverse effects of climate change under the Convention and ruled that Switzerland violated the **European Convention on Human Rights (ECHR)** by failing to implement effective measures to combat climate change. The case, brought by KlimaSeniorinnen Schweiz, argued that inadequate climate policies violated their right to life under the European Convention on Human Rights. They highlighted their vulnerability to extreme heat, citing IPCC reports to support their case.

Climate Constitutionalism

- **Chile:** Chile drafted a new constitution that prioritised environmental protection, Indigenous rights, and climate action, dedicating a chapter to nature and ecological concerns. But it was **rejected by more than 60% of people.**
- **Algeria:** The preamble of the constitution adopted in 2020 acknowledges the impact of climate change and expresses a commitment to environmental protection and sustainable resource management for future generations.
- **Thailand:** Thailand's **2017 Constitution**, emphasises national reforms for sustainable development, including environmental protection. Section 258 highlights the **need for a water resource management system** considering water demand, environment, and climate change.

Global Conventions

- **IPCC**

  The Intergovernmental Panel on Climate Change **(IPCC)** was established in 1988 **by the World Meteorological**

Organization (WMO) and the **United Nations Environment Programme (UNEP)** to provide governments with scientific information crucial for climate policy formulation. It currently has **195 member** countries **including India.**

- **UNFCCC**

Established in 1992, the **UNFCCC** (United Nations Framework Convention on Climate Change) oversees the global response to climate change, with nearly **universal membership** of **198 Parties.** It serves as the parent treaty for the 2015 Paris Agreement and the 1997 **Kyoto Protocol**. All agreements under the UNFCCC aim to stabilise greenhouse gas concentrations to prevent dangerous interference with the climate system, allowing for natural ecosystem adaptation and sustainable development.

COP: The Conference Of Parties **(COP)**, is the supreme decision making body of UNFCCC. It adopts legal instruments and makes decisions to enhance effective implementation of decisions.

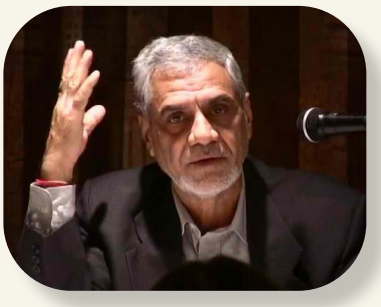
CHALLENGES FOR CLIMATE JUSTICE IN INDIA

- **Need for climate policy making:** Environmental rights, though recognized, will remain largely unexercised due to the **absence of concrete policies and legislation**. Despite numerous environmental rights cases, issues like clean air continue to pose significant challenges, highlighting the need for **effective policy implementation.**
- **Lack of Public Awareness:** Limited public awareness and understanding of environmental rights and climate justice hinder grassroots movements and **citizen participation** in environmental conservation efforts, posing a challenge to fostering a culture of environmental stewardship.
- **Insufficient Institutional Capacity**: It includes resource constraints and **bureaucratic inefficiencies** which undermines the effective implementation of environmental policies and initiatives.
- **Economic Interests**: Conflicting interests between economic development objectives and environmental conservation goals pose a challenge to **striking a balance between sustainable development and ecological preservation.**

WAY FORWARD

- **Enacting laws:** Implementing legislation and policies is paramount to **safeguarding citizens' rights against climate change**, translating legal protections into tangible measures that address environmental challenges effectively.
  - » **Example:** Amending the Energy Conservation Act 2001 to empower the Central Government to provide for a **carbon credit trading scheme.**
- **Inclusion in Manifestos:** Political parties vying in Lok Sabha Polls should p**rioritise the integration of citizens' rights against climate change** into their manifestos, outlining comprehensive action plans to ensure the realisation of these rights through robust policy frameworks and initiatives.
- **Enhancing International Cooperation:** Addressing global environmental issues such as climate change, biodiversity loss, and pollution requires collaborative efforts and cooperation among nations. **Strengthening international agreements, frameworks, and partnerships**, as well as promoting dialogue and knowledge sharing is necessary.
  - » **Example:** Collaborative initiatives like the **Paris Agreement**
- **Effective administration:** Governments must not only acknowledge but also prioritise Supreme Court rulings emphasising the intrinsic link between ecology and human dignity. By aligning environmental jurisprudence with policy agendas, particularly in critical areas such as **combating Delhi's air pollution**, administrations can bridge gaps and ensure coherent and effective responses to environmental challenges.
  - » **Example:** Creating **Climate Smart Villages**

The Green Avenger of India



About: Mahesh Chandra Mehta, the **"Green Avenger of India,"** is a leading environmental lawyer and activist known for his influential use of **Public Interest Litigations (PILs)** to shape environmental jurisprudence in India.

Cases

1. **M C Mehta v. Union of India (1988)**: This case addressed **Ganga pollution**, leading to Supreme Court directives to control industrial discharge and halt the practice of disposing corpses in the river.
2. **M C Mehta v. Union of India (1996):**The **Taj Trapezium Case** addressed **pollution around the Taj Mahal**, leading to Supreme Court directives to control industrial activities and preserve the monument.
3. **M C Mehta v. Union of India (2002):** The case aimed to tackle rising **vehicular pollution in Delhi**, leading to Supreme Court directives to regulate emissions, **promote CNG** use, and enhance public transportation, thereby curbing air pollution in the capital.

Recent SC Judgements on Environmental Justice

- **On Vedanta Case, 2024:** The SC bench emphasised the need to keep the **Vedanta Sterlite Copper plant shut** due to environmental violations and local protests. Additionally, it highlighted the principle of intergenerational equity, underscoring the responsibility to conserve resources for future generations. The right to a clean environment was reaffirmed.
- **On a petition against the Forest Conservation Amendment Act, 2023:** The Supreme Court issued an interim order requiring the government to use the **"dictionary definition" of forests when identifying forest land nationwide.** Additionally, the court mandated that any construction of zoos or **wildlife safaris in forest areas**, permitted by the amendment, must receive prior approval from the Supreme Court.
- **On firecrackers, 2023:** The Supreme Court clarified its 2018 and 2021 orders **banning barium** and other banned chemicals in firecrackers, stating that they apply nationwide, not just in the **National Capital Region**. The ruling mandates the use of only **"green firecrackers"** across all states.
- **On stubble burning, 2023**: In response to worsening air quality in Delhi-NCR, SC directed **Punjab, Rajasthan, Uttar Pradesh, and Haryana to halt stubble burning,** a significant contributor to poor air quality. The court also instructed the Delhi Government to prevent open burning of municipal solid waste.
- **On Jim Corbett National Park,2024:** The Supreme Court exposed collusion between politicians, forest officials, and contractors in the illegal felling of **6,000 trees in Jim Corbett National Park.** Additionally, it banned tiger safaris in core areas of national parks to minimise disturbance to wildlife, emphasising that wildlife should not be treated as zoo exhibits.
- **On Yamuna river pollution,2021**: SC took suo motu notice of **water bodies' pollution due to untreated sewage.** During the hearing of an urgent petition by the D**elhi Jal Board (DJB)**, the SC addressed the issue of Haryana's discharge of pollutants into the Yamuna river, seeking immediate action to halt it.

CONCLUSION

The recent Supreme Court ruling on the right to be free from the adverse effects of climate change is a landmark moment in India's environmental jurisprudence. It emphasises the need for legislative action and policy reforms to protect citizens' rights and address environmental challenges effectively. By recognizing the **interconnection between environmental protection and human well-being**, the ruling highlights the importance of holistic approaches to mitigate climate risks and foster environmental resilience in India.

SAMPLE QUESTION

Q) Discuss the evolving discourse surrounding environmental rights and climate justice in India, examining its potential implications for policy and governance. **(10 marks)(150 W)**

SEMICONDUCTOR FABRICATION

Syllabus: GS III - *Growth & Development; Indigenization of Technology*

PYQ MAPPING

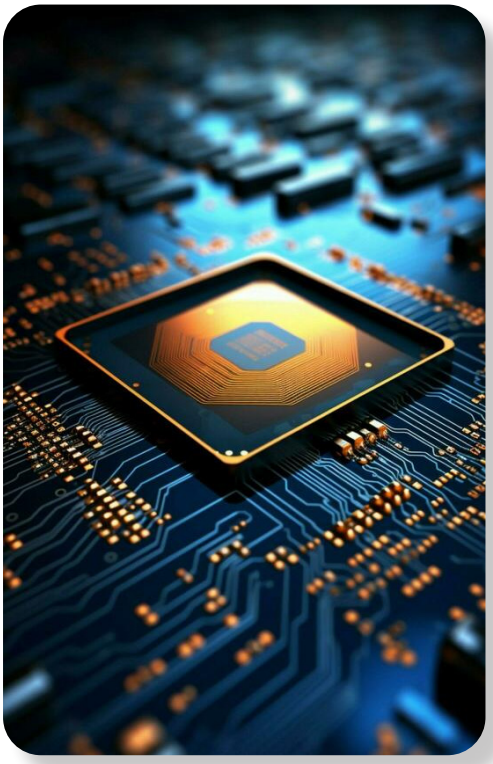
Q) *Give an account of the growth and development of nuclear science and technology in India. What is the advantage of the fast breeder reactor programme in India?* ***(2017)***

Q) *What is an FRP composite material? How are they manufactured? Discuss their applications in the aviation and automobile industry.* ***(2013)***

SHORT TAKES

Advanced Driver-Assistance System (ADAS)

- It is a **collection of technologies** that utilise sensors, cameras, radar, and other advanced technologies to **gather real-time data** about a vehicle's surroundings.
- This data is then used to provide the driver with information and take corrective actions **to avoid accidents or enhance the driving experience.**



WHY IN NEWS?

Recently, the Union cabinet approved **three chip projects** worth Rs 1.26 lakh crore. These include **India's first semiconductor fabrication plant** to be set up in **Dholera, Gujarat, by the Tata Group**.

INTRODUCTION

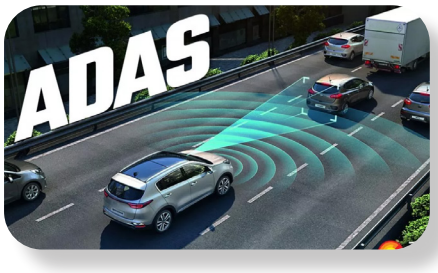
- Semiconductors are materials which have a **conductivity between conductors and insulators.** This unique property makes them essential components in a vast array of electronic devices.
- Most used semiconductor materials are **silicon, germanium,** and **gallium arsenide.**

SIGNIFICANCE

- **Tunable Conductivity:**
  - Unlike conductors (metals) that readily conduct electricity and insulators (plastics) that resist it, semiconductors have an **intermediate conductivity** that can be manipulated.
  - **Doping**, the process of **adding impurities**, allows us to create regions within a semiconductor with **either increased or decreased electron flow**. This control forms the basis for various electronic functions.
- **Building Blocks of Electronics:**They are used to create fundamental electronics components like:
  - **Diodes**: These one-way valves **allow current to flow in one direction only**. They are used in power supplies, voltage regulation, and signal processing.
    i. Example: Converting AC current from the wall outlet to DC current for your laptop
  - **Transistors**: These **act as electronic switches**, **amplifying or regulating current flow**. They are the fundamental building blocks of **integrated circuits (ICs)**.
    i. Example: The millions of transistors on a CPU that perform calculations in your computer.
  - **Integrated Circuits (ICs)**: Also known as **microchips**, ICs contain billions of interconnected transistors and other components on a tiny silicon wafer.
    i. They are the brains of modern electronics, responsible for complex information processing and control.
    ii. Example: The microchip in your smartphone that handles everything from making calls to running apps.

APPLICATION

- **Consumer Electronics:**
  - From s**martphones and laptops to TVs** and game consoles, semiconductors power the devices we use daily.
  - They enable features like **high-resolution displays**, **fast processing speeds**, and **efficient power management**.
- **Computers:**
  - The central processing unit **(CPU)**, graphics processing unit **(GPU)**, and memory chips in computers are all built on semiconductor technology.
  - This allows for complex calculations, stunning visuals, and efficient data storage.
- **Communication Networks:**
  - Semiconductors are **crucial for routers, switches**, and other **network infrastructure** that enables internet connectivity and mobile communication.
- **Automotive Industry:**
  - Modern cars rely heavily on semiconductors for engine control units, safety systems, and **advanced driver-assistance features (ADAS).**



- **Medical Technology:**
  - Semiconductors are used in **medical imaging equipment, pacemakers**, and other life-saving devices. They enable advancements in diagnostics, treatment, and patient monitoring.
- **Renewable Energy**:
  - Semiconductors are essential components of **solar panels, wind turbines**, and other renewable energy technologies.
  - They help convert sunlight and wind energy into usable electricity.

CHALLENGES FACED BY INDIA IN SEMICONDUCTOR MANUFACTURING

- **Required Huge Capital Investment:**
  - Establishing a **semiconductor fabrication plant (fab)** demands hefty investments due to the need for advanced cleanrooms, state-of-the-art equipment, and ultra-pure materials.
  - Example: **TSMC**, a prominent chip manufacturer, recently revealed plans for a $100 billion injection into its fabs over the next three years.
  - This discourages private companies in India, as the return on investment might take a long time.
- **Lack of Cutting-Edge Technology:**
  - Currently, India focuses on **"lagging-edge" technology** nodes, which are a generation or two behind the most advanced chips.
  - This limits their ability to compete with established players like **Taiwan and South Korea** who produce the latest semiconductors.
- **Immature Ecosystem:**
  - India lacks a robust domestic supply chain for raw materials, equipment, and testing facilities.
  - This dependence on foreign imports can create bottlenecks and increase costs.
- **Resource Shortage:**
  - **Rare earth minerals**: A report by India Exim Bank highlights China's dominance in the global **Rare Earth Elements (REE) supply chain**, with **India relying on them** for a significant portion of its needs.

- **Skilled Workforce Shortage**:
  - » Building and operating fabs require a highly skilled workforce with expertise in physics, materials science, and microfabrication techniques.
  - » While India has a large pool of engineers, there's a gap in specialists needed for chip manufacturing.
  - » Experts predict India will need around **1.5 million skilled workers** in the semiconductor industry **by 2026-27.**
- **Infrastructure Bottlenecks:**
  - » Semiconductor fabs require uninterrupted power supply, massive amounts of ultrapure water, and special waste disposal systems.
  - » India's current infrastructure might not be able to reliably meet these demands.
  - » For example, a **power outage at a fab can damage expensive equipment** and ruin entire batches of chips.

INDIAN GOVERNMENT INITIATIVES

India Semiconductor Mission (ISM)

- As part of **Atma Nirbhar Bharat vision**, Government of India launched this mission in 2021 with a total financial outlay of Rs76,000 crore under the aegis of the **Ministry of Electronics and IT (MeitY).**
- The programme aims to provide financial support to companies investing in semiconductors, display manufacturing and design ecosystem.
  - » Scheme for setting up of **Semiconductor Fabs in India**
  - » Scheme for setting up of **Display Fabs in India**
  - » Scheme for setting up of **Compound Semiconductors / Silicon Photonics / Sensors Fab** and S**emiconductor Assembly**, **Testing, Marking and Packaging (ATMP)** / **(Outsourced Semiconductor Assembly and Test) OSAT** facilities in India.
  - » **Design Linked Incentive (DLI)** Scheme

IndiaAI Mission:

- The India AI Mission Initiative, led by the **Ministry of Electronics and Information Technology**, aims to implement a structured approach to fostering India's AI innovation ecosystem through a **public-private partnership model.**
  - » **IndiaAI Compute Capacity:** India AI Mission aims to develop AI compute infrastructure of 10,000 or more Graphics Processing Units (GPUs) through public-private partnerships.

Budgetary Allocation:

- In the **2024 interim budget**, the Indian government allocated **Rs 6,903 crore** for semiconductor and display manufacturing, which is a **130% increase** from the 2023-2024 budget of Rs 3,000 crore.

Production Linked Incentive (PLI) Scheme:

- The PLI scheme offers financial incentives for companies that manufacture electronic components and semiconductors in India.

Exploration and Resource Assessment:

- **Geological Survey of India (GSI) & Atomic Minerals Division (AMD):**
  - » These organisations are conducting extensive exploration activities to identify and assess potential Rare Earth Minerals deposits within India.
- **Leveraging the Mines and Minerals (Development and Regulation) Amendment Act 2023:**
  - » **Private Sector Participation:** The act allows private companies to explore and potentially mine certain REMs. This opens doors for increased exploration efforts and potentially faster development of domestic REM resources

FDI: The government of India **allows 100% foreign direct investment (FDI)** in the electronics system design manufacturing **(ESDM) sector**, which includes the semiconductor industry.

WAY FORWARD

- **Financial Incentives:**
  - » Continue offering competitive financial packages like subsidies and tax breaks to attract investments for fabs and chip design facilities.
  - » **Example**: The **US is providing a USD 3.5 billion subsidy** to their domestic semiconductor manufacturing units.
- **Infrastructure Development:**
  - » **Example:** T**aiwan's Hsinchu Science Park** is a prime example. It houses major chipmakers like TSMC and boasts advanced infrastructure, research institutions, and a skilled workforce, making it a global hub for semiconductor manufacturing
- **Building a Robust Ecosystem:**
  - » Develop a strong domestic supply chain for raw materials, equipment, and testing services.
  - » Partner with existing players and encourage new ventures, **similar to South Korea's model**
    - i. **Example**:**Samsung partnered with Micron Technology** for memory chip production, leveraging combined resources and knowledge.
- **Talent Development:**
  - » **Collaboration with Academia**: The government should partner with universities and institutions like **IITs (Indian Institutes of Technology)** to develop specialised curriculum and training programs in semiconductor design and manufacturing.
- **International Collaboration:**
  - » **Collaborating with international partners** can facilitate technology transfer, access to global markets, and knowledge sharing. Joint ventures, strategic alliances, and participation in industry consortia can help Indian semiconductor manufacturers compete effectively on the global stage.
- **Investment in Research and Development:**
  - » **Promoting investment in research and development** while fostering partnerships among industry, academia, and research institutions can facilitate technological advancements in the semiconductor sector.
  - » **Example: South Korea heavily invests** in advanced fabs.
    - i. Companies like **Samsung possess some of the world's most sophisticated fabrication facilities**, allowing them to manufacture cutting-edge chips.

CONCLUSION

By strategically adopting the global best practices in infrastructure development, talent cultivation, and fostering a collaborative ecosystem, **India has the potential** to not only overcome current challenges but also can emerge as a major player in the global semiconductor industry.

SAMPLE QUESTION

Q) Discuss the specific challenges that India encounters in semiconductor manufacturing, and how can the country address these challenges and position itself as a significant player in the global semiconductor industry? **(15 M)(250 W)**

HIGGS BOSON

Syllabus: GS III - *Science and Technology*

PYQ MAPPING

Q) *Launched on 25th December, 2021, James Webb Space Telescope has been much in the news since then. What are its unique features which make it superior to its predecessor Space Telescopes? What are the key goals of this mission? What potential benefits does it hold for the human race?* ***(2022)***

SHORT TAKES

Hadrons:

- In particle physics, a hadron is a subatomic particle made of two or more **quarks** (the fundamental particles that make up matter) held together by the **strong interaction.**
- Two Main types of Hadrons:

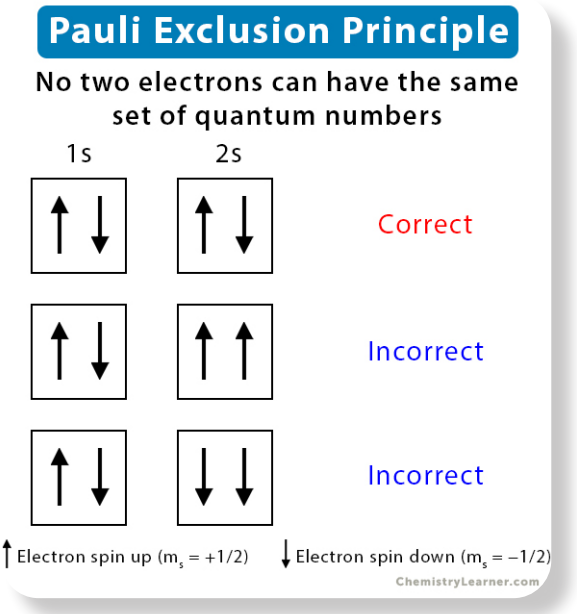
1. **Baryons**:
   - Composition: Made of **three quarks**.
   - Example: Protons and neutrons, the building blocks of **atomic nuclei, are baryons.**
   - Stability: **Relatively stable** compared to other subatomic particles due to the strong force binding the three quarks tightly.
2. **Mesons**:
   - Composition: Composed of a **quark-antiquark pair.**
   - Example: **Pions**, which play a role in the strong force.
   - Stability: Generally **less stable than baryons.** The quark-antiquark pair can **annihilate each other**, leading to a shorter lifespan.

Pauli's Exclusion Principle:

- It states that no two electrons in the same atom can have identical values for all four of their quantum numbers. In other words, (1) no more than two electrons can occupy the same orbital and (2) two electrons in the same orbital must have opposite spins

String Theory

- String theory is a theoretical framework in physics that **replaces point-like particles with one-dimensional objects called strings**.
- These strings are smaller than atoms, electrons, or quarks, and vibrate, twist, and fold to produce effects in many tiny dimensions.
- These effects are interpreted by humans as everything from particle physics to large-scale phenomena like **gravity.**



INTRODUCTION

The Higgs boson, nicknamed the **'God particle'** by the media, after a book by **Nobel laureate Leon Lederman**, is a fundamental particle in the Standard Model of particle physics. Proposed in the 1960s by physicists Peter Higgs, François Englert, and Robert Brout, its existence was confirmed in 2012 by experiments at **CERN's Large Hadron Collider.**

WHY IN NEWS?

Peter Higgs, the Nobel prize-winning physicist who proposed a new particle known as the Higgs boson, passed away earlier this year on April 8, 2024.

STANDARD MODEL OF PHYSICS

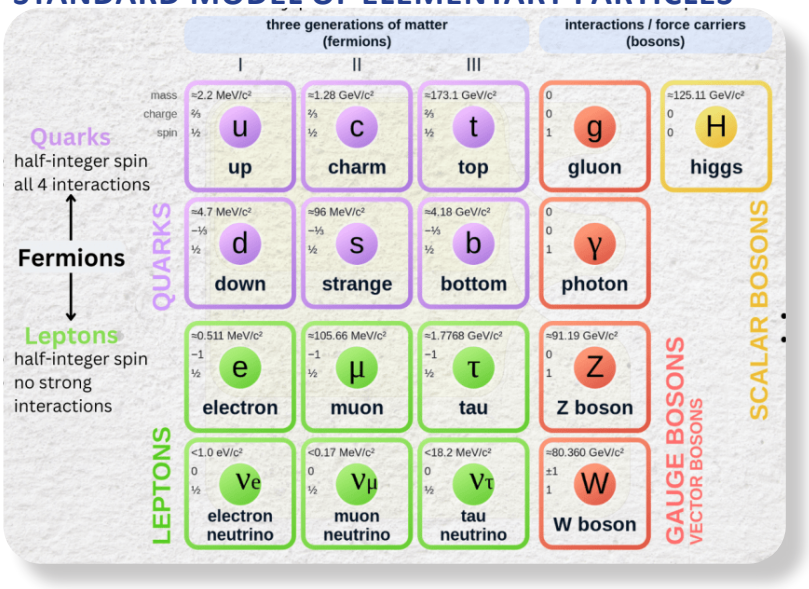
It is the idea that everything in the universe is made of a few fundamental particles and that those are governed by four fundamental forces.

- **Four Fundamental Forces: _**
  - » the **strong force, the weak force, the electromagnetic force, and the gravitational force**
- **Twelve Fundamental Particles:**
  - » **up quarks, down quarks, strange quarks, charm quarks, top quarks, bottom quarks, electrons, electron neutrinos, muons, muon neutrinos, tau, and tau neutrinos.**
  - » The 12 particles are further classified as **"Quarks & Leptons"**

QUARKS AND LEPTONS

Quarks: Quarks are **subatomic particles** that are the fundamental building blocks of visible matter.

STANDARD MODEL OF ELEMENTARY PARTICLES



- They are the **smallest elementary particles** in the universe and are **unstable** in their elementary form.
- Quarks are found deep within the atoms that make up our bodies, and even within the protons and neutrons that make up atomic nuclei.
- **There are 6 Quarks: Up Quark; Down Quark; Charm Quark; Strange Quark; Top Quark; Bottom Quark .**
- They come in six different flavours distinguished by their charge and mass:
  - » Up: Charge of **+2/3** and a mass of **2.2 MeV/c2**
  - » Down: Next to up quarks in terms of light mass, with a mass ranging from **4.1–5.7 MeV/ c2** and an electric charge of **-1/3 e.**
  - » Top: The **most massive quark**
  - » Bottom: **2nd most massive quark**
  - » Charm quark: **2nd Generation quark**
    - i. Has a positive electric charge of **+2/3** of the elementary charge (e).
    - ii. More **massive than the strange quark**. Its mass is around **1.27 GeV/c²** (GeV/c² is a unit of mass-energy).
  - » Strange quark: Carries a negative electric charge of **-1/3 e**
    - **i. Less massive**, with a mass of about **0.10 GeV/c²**.
  - » The six quarks are paired in the three generations – the "up quark" and the "down quark" form the first generation, followed by the "charm quark" and "strange quark", then the "top quark" and "bottom (or beauty) quark".
  - » The lightest and most stable particles make up the first generation, whereas the heavier and less stable particles belong to the second and third generations.
  - » All stable matter in the universe is made from particles that belong to the first generation; any **heavier particles quickly decay** to the next most stable level.
  - » The UP & DOWN are the lightest and the most stable. They form proton and neutrons.
    - **i. 2 up+1 down=proton**
      - Combination of charge = +⅔ +⅔-⅓ = +1
    - **ii. 2 down+1 up=neutrons**
      - Combination of charge = +⅔-⅓-⅓ = 0 (neutral)

Leptons: For every quarks, there is an anti-quark to form antiparticles called **leptons**. They are six in numbers.

- They are either charged(**electron, muon, tau**) or uncharged(**electron neutrino, muon neutrino, tau neutrino**).
- **Neutrinos** are the second most abundant particle in the universe, emitted by stars, nuclear reactors or anything having radioisotopes as they have rare interaction with matter; they are called **ghost particles.**

Fermions

- Fermions are particles which have **half-integer spin** and therefore are constrained by the **Pauli exclusion principle.**
- Particles with **integer spin** are called **bosons**.
- Fermions include electrons, protons, neutrons. Also it includes all quarks and leptons.

FUNDAMENTAL FORCES AND BOSON

- There are **four fundamental forces** namely **gravitation force, electromagnetic force, weak and strong force.**
- To explain the origin of force, the concept of **boson(force carrier particles**) was used for each force

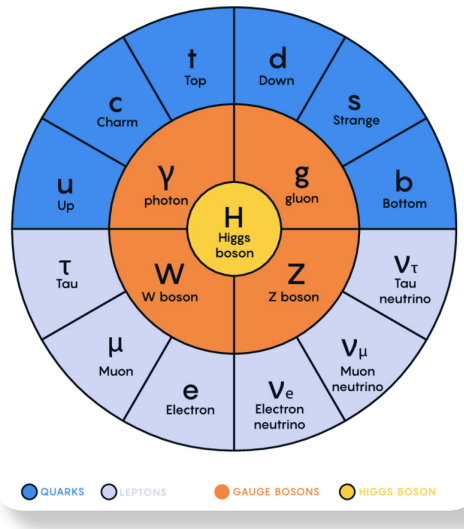
Force	Particles Experiencing	Force Carrier Particle	Range	Relative Strength*
Gravity acts between objects with mass	all particles with mass	graviton (not yet observed)	infinity	much weaker ↓ much stronger
Weak Force governs particle decay	quarks and leptons	W^+, W^-, Z^0 (W and Z)	short range	
Electromagnetism acts between electrically charged particles	electrically charged	γ (photon)	infinity	
Strong Force** binds quarks together	quarks and gluons	*g* (gluon)	short range	

W Boson

- Discovered in 1983, the W boson is a fundamental particle, Together with the **Z boson**, it is responsible for the weak force.
- The **W boson,** which is electrically charged, changes the very make-up of particles.
- It **switches protons into neutrons**, and **vice versa**, through the weak force, triggering nuclear fusion and letting stars burn.
- In contrast to the photon, which is massless, the W bosons are **quite massive**, so the weak force they mediate is very short ranged.

Force Carrier Particles or Bosons

- Particles of matter transfer discrete amounts of energy by exchanging bosons with each other.
- Each fundamental force has its own corresponding boson.
- Bosons have spin like **0, 1, 2, 3 etc.**
- Bosons can again be divided into **Gauge Bosons and Higgs Bosons.**



1. **Gauge Bosons (Responsible for energy transfer)**
   - Gravitational Force – **Graviton** (Not part of standard model)
   - Weak Nuclear Force – **W and Z bosons** (ie W+, W- and Z-0 bosons)
   - Electromagnetic Force – **Photon.**
   - Strong Nuclear Force – **Gluon**.
2. **Higgs Boson or God's Particle (Responsible for mass)**
   - The proposed Higgs Boson particle is responsible for the mass of every particle.
   - If you crash protons together at these extremely high energies, **very, very, very occasionally—**about once in a billion times—the collision will yield a **Higgs particle**. They exist for the tiniest fraction of a second before decaying into other particles.
   - It explains the origin of mass **immediately after the Big Bang.**
   - The Higgs field is the energy field associated with the Higgs boson and particles associated with the Higgs field are called **Higgs bosons.**
   - Higgs boson is the smallest possible excitation of **Higgs field**
   - Massless particles were made to interact with the Higgs field, this caused the conversion of energy to mass.

IMPORTANCE OF ANALYSING HIGGS BOSON

- **Understanding Mass**: By studying the Higgs boson, we gain insight into **how particles acquire mass.**
  - This is a fundamental property of matter, yet the mechanism behind it wasn't fully understood before the Higgs boson's discovery.
- **Searching for New Particles:**
  - **The Higgs Portal**: The Higgs boson might interact with yet-to-be-discovered particles in subtle ways.
  - By studying its interactions and rare decay processes, scientists can search for indirect evidence of these new particles.
  - The Higgs could act as a portal to a **whole new realm of physics.**

- **Unveiling the Universe's Composition:**
  - **Dark Matter and Dark Energy:** These mysterious substances make up most of the universe's mass and energy, yet we don't fully understand them.
  - The Higgs boson might hold clues to their nature.

    Studying it could help us understand how the universe works on a grand scale.

Large Hadron Collider

- The **Large Hadron Collider (LHC)** is the **world's largest** and **most powerful particle collider** and the **largest machine in the world.** It was constructed by the **CERN** (European Organization for Nuclear Research) between 1998-2008.
- It lies in a **tunnel 27 km in circumference and as deep as 175 m underneath the France -Switzerland border near Geneva.**
- It's designed to **smash subatomic particles** together at incredibly high speeds to study the fundamental building blocks of matter and the forces that govern them.
- The **aim is to enable physicists** to experiment different theories regarding particle physics, including
  - measuring the **properties** of the **Higgs boson**,
  - Identify **dark matter,**
  - Find evidence for **string theory,**
  - Understand **antimatter.**
  - Search for **extra dimensions of space** and **microscopic black holes**,
  - Look for signs of **unification of fundamental forces**,
  - Learn about the fundamental forces that have shaped the universe since the beginning of time and will determine its fate.

Recent Developments

Here are some recent developments related to ongoing research on the Higgs boson at the Large Hadron Collider (LHC):

- **Increased data collection:** The LHC is currently in Run 3, which started in July 2022.
  - This run involves collecting even more data on particle collisions compared to previous runs, allowing for more precise measurements.
- **Focus on rare processes:** Scientists are analysing rare Higgs boson decay processes, where the **Higgs boson breaks down into other particles.**
  - These rare decays can offer unique insights into the Higgs boson's nature.
- **Higgs coupling measurements**:
  - Ongoing research is focused on measuring the strength of the Higgs boson's interaction with other known particles, such as top quarks, W and Z bosons, and photons. Any deviations from predicted values could be significant.

India's Role

India has played a significant role in the development and operation of the Large Hadron Collider (LHC) at CERN, the European Organization for Nuclear Research. Here's a breakdown of India's contributions:

Construction:

- Indian scientists and engineers were **involved in the design and construction of several crucial components** of the LHC:
- **Superconducting Magnets:** These powerful magnets guide and accelerate the particles within the LHC ring. India designed, developed, and supplied thousands of **precision magnet positioning system jacks** and other components for these magnets.
- **Superconducting Corrector Magnets:** India contributed to the construction of these magnets, which **help fine-tune the particle beams for optimal collisions.**

Experiments:

- Indian scientists are actively involved in two of the major LHC experiments:
  - **CMS (Compact Muon Solenoid)**: This is one of the **largest detectors at the LHC**, designed to study a wide range of particles and phenomena produced in the collisions. Indian institutions like the **Tata Institute of Fundamental Research (TIFR)** and **Variable Energy Cyclotron Centre (VECC)** collaborate on CMS research.
  - **ALICE (A Large Ion Collider Experiment)**: This experiment focuses on studying the **quark-gluon plasma**, a state of matter believed to have existed shortly after the Big Bang. Indian scientists contribute to ALICE research as well.
- **Computing Grid:**
  - India plays a vital role in the LHC's computing grid, a massive network of computers that processes and analyses the enormous amount of data generated by the LHC experiments.

CONCLUSION

The Large Hadron Collider successfully proved the existence of the Higgs boson, further exploration with this powerful machine could hold the key to unravelling even deeper mysteries of our universe, potentially leading to groundbreaking discoveries in areas like dark matter and extra dimensions.

SAMPLE QUESTION

Q) With the LHC playing a pivotal role in confirming the Higgs boson's existence, what exciting new avenues of exploration, in our quest to understand the universe's fundamental nature, might future LHC experiments open up? **(15 M)(250 W)**

MODEL ESSAY

"The worst form of bondage is the bondage of dejection which keeps men hopelessly chained in loss of faith in themselves"

Introduction

- Quote by Rabindranath Tagore
- Elaborate the concept of bondage- beyond physical constraints -psychological, emotional, philosophical, social aspects.
- Highlight how dejection and loss of self-confidence hinders personal growth and progress

Meaning of the quote:

The quote means that feeling hopeless can make people lose faith in themselves, holding them back from reaching their goals. This form of bondage, fueled by a loss of faith in oneself, not only hampers personal growth but also stifles societal progress. It shows how important it is to stay positive and believe in yourself to overcome challenges and succeed in life.

Different Perspectives

- **Psychological Aspect:** Manifests as loss of self esteem, diminished motivation, negative self talk, irrational thinking, relinquishing their dreams and aspirations, believing themselves to be unworthy or incapable of achieving them, may easily fall into negative influences.
- **Interpersonal relationships:** Individuals plagued by feelings of inadequacy and self-doubt may struggle to form meaningful connections with others, fearing rejection or disapproval. This can result in social isolation and a deep sense of loneliness, further exacerbating feelings of dejection and hopelessness.
- **Philosophical Interpretation:** Relate with the myth of Sisyphus/Naranathu Bhranthan- a man who rolls a huge rock up a hill for eternity. About existentialism and crisis associated with it
- **Social Context:** Plight of marginalised communities- oppression- conditioning- patriarchy
- **Economic impact:** Vicious cycle of poverty-unemployment and underemployment
- **Political Context:** Political polarisation- lack of participation- leads to lesser democratic system
- **Expression in literature:** Bondage as a recurring theme in literature. **Eg:** Charlotte Bronte's **Jane Eyre** -the protagonist struggles against the constraints of Victorian society and her limited options as a woman.

Consequences: Positive and Negative

Positive

- **Art forms:** Finds expression in performing arts, theatre, painting and music. **Eg:** Therukoothu(Street Theatre) expressing political and social issues
- **Emergence of new religions:** with more liberal and inclusive values. **Eg**: Buddhism, Jainism etc
- **Social, religious and cultural reforms:** Challenging the existing traditional norm **Eg**: Villuvandi strike by Ayyankali, Reforms by Raja Ram Mohan Roy, Bhakti movement
- **Social Uprising**: Assertion of freedom- demand for fundamental human rights and social justice. Eg: French Revolution, Indian freedom movement

Negative

- **Mental Health:** Hopelessness leads to stress,anxiety, depression. **Eg:** Vincent van Gogh, the renowned Dutch painter, battled severe depression and self-doubt, reflecting in his art and relationships. Despite immense talent, he struggled for recognition and validation, ultimately succumbing to his inner demons, ending his life at 37.
- **Less productivity:** Self-doubt inhibits ambition, innovation, and the pursuit of goals. **Eg:** In the workplace, employees plagued by feelings of dejection may shy away from taking on

new challenges or pursuing advancement opportunities, fearing failure or rejection.

- **Retards Social Progress:** social isolation and disconnection from one's support network. Also causes disunity ,stratification and fragmentation in society. **Eg:** Condition of LGBTQIA+ community.
- **Condition of women:** Domestic abuse, dowry deaths, honour killing, marital rape **Eg**: According to National Crime Records Bureau(NCRB) reports on an average, every hour a woman succumbs to dowry deaths in India with the annual figure rising upwards of 7000.
- **Historical injustice**: Generations affected by bondage-scars of past injustices - cycles of intergenerational trauma and distrust.**Eg:** Apartheid in South Africa- racial segregation of the black population.

Overcoming the challenges

- The Transformative **Power of Self-Belief.** While the bondage of dejection may seem insurmountable, it is not an immutable fate. **Eg: Serena Williams** openly shares her struggles with self-doubt and adversity. Yet, she persists, driven by unwavering self-belief and determination, showcasing the transformative power of resilience.
- **Emotional intelligence:** This process begins with self-awareness and acceptance, acknowledging one's strengths and weaknesses without succumbing to feelings of inadequacy or self-doubt.
- Promote Mental Health Awareness and Support
- Create educational environments that promote inclusivity, diversity, and positive self-esteem.
- Build strong community networks that provide social support and empowerment.
- Promote civic participation in the political process to strengthen democratic systems and representation of diverse voices.
- Implement initiatives to address economic disparities and promote economic empowerment.
- Encouraging popular art forms to reach a wide audience and convey powerful messages that can inspire change. **Eg**; Movies like Badhaai Do and Saavdhan contribute significantly to shifting society's unfavourable attitude about the LGBTQIA+ community.

Conclusion

- The need to confront the bondage of dejection across all its dimensions.
- Pave the way for a society where individuals can thrive with confidence and hope.
- Conclude by highlighting -need for self-belief - resilience to overcome adversity and pursue aspirations. By **recognizing our worth and potential, fostering optimism and perseverance**, we transcend dejection's limits, fulfilling our potential as individuals and societal contributors.

Sample Questions

- Overcoming poverty is not a task of charity, it is an act of justice.
- Our greatest ability as humans is not to change the world, but to change ourselves .
- Our worth as nation will largely depend on worth we ascribe to women.

ETHICS - CASE STUDY

Q) You are posted as the Deputy Commissioner (Assessment) of Income-Tax in a fast developing city. You've been entrusted with this significant and delicate assignment due to your esteemed reputation and demonstrated competence.

Your family has joined you. You are worried about the school admission of your 7 year old son, who has to change school in the middle of the academic year. Fortunately, the best school in the city, which is run by a famous educational trust, is ready to offer a place to your son. You quickly admit him in the school. A week later, your subordinate discovered that the school is involved in huge tax evasions and has sent a show cause notice to the school. The school managing trust has lodged an appeal against this assessment and the matter is to be decided by you being the Deputy Commissioner (Assessment). The school principal calls you and requests you to consider the school's appeal.

a. Discuss the ethical issues involved here.

b. Evaluate the available choices and determine which aligns best with your ethical principles in your professional capacity.

ETHICS - EXAMPLES

1. **Constitutional ethics/ morality**: The Supreme Court has recognised a much-felt, but less articulated right against the adverse effects of climate change as a distinct fundamental right in the Constitution.
2. **Emotional Intelligence**: IIT Delhi has set up a committee of teachers and students to assist undergraduates facing academic struggles, including those leading to extreme cases like suicides. In rare situations, students with poor academic records are allowed to stay with family members on campus.
3. **Workplace Ethics**: The Director General (CRPF) has instructed all units to conduct regular "samvad (dialogue)" sessions with their personnel to address various issues concerning the welfare of the jawans.
4. **Gender Equality:**The Supreme Court pulled up the Indian Coast Guard (ICG) over the treatment meted out to a woman, who was discharged as a short service commission officer in 2021, and ordered the maritime force to re-induct her.
5. **Determination:** Europe's top human rights court ruled in favour of 2,000 determined Swiss women, all over 64 years old, who sued their government for not doing enough to tackle climate change.
6. **Compassion:** Punarjagran Samiti, led by Babu Lal, educates underprivileged children in unconventional settings like under trees, near flyovers, and in slums. This unique approach ensures marginalised communities receive education where traditional facilities are lacking.

MAINS JOT DOWN

GS- II - *ISSUES RELATED TO WOMEN*

- **AMFi-CRISIL** released a report titled **'Mutual Growth'** which states that financial decision-making and labour force participation rate **(LFPR)** of women are rising in India.
- Female **LFPR rose to 41.5%** (PLFS of Oct 2023) against 24.6% five years back.
- Impact of climate change on women
  - » **National Family Health Survey (NFHS)** 4 and 5 data showed that women living in **drought-prone districts** were more underweight, experienced more intimate partner violence and had a higher prevalence of girl marriages.

GS- III - *HEALTH*

- The **WHO data** indicates that there are only **0.8 doctors per 1,000 people**, which is below the advised ratio.
- Even though over 75% of Health-care professionals work in metropolitan regions, which **only account for 27% of the population**, the shortage is particularly severe in rural areas.
- **National Crime Records Bureau (NCRB)** reports that **1.71 lakh people died by suicide in 2022.**
- The suicide rate has **increased to 12.4 per 1,00,000** — the **highest rate** ever recorded in India.
- **41% of all suicides** are by young people **below the age of 30.**
- **Global hepatitis report 2024** released by WHO, the report revealed that India accounted for **11.6% of the global burden and ranked second after China** for hepatitis B & C cases.

GS- I - *WOMEN EMPOWERMENT*

- The number of **women candidates grew 16-fold from 1957 to 2019**, as per latest ECI data.
  - » In 1957, there were just 45 women candidates contesting theLok Sabha election; by 2019, this figure had **risen to 726.**
  - » The percentage of women in Parliament has increased from **4.5% in 1957 to 14.4% in 2019.**

GS- III - *INTERNAL SECURITY CHALLENGES*

- The Supreme Court has voiced concern over misuse of social media platforms with posting of messages, comments and articles on subjudice matters.
- A bench of Justices Aniruddha Bose (now retired) and Bela Trivedi made the observation while initiating a contempt action **against Assam MLA Karim Uddin Barbhuiya** for his misleading Facebook post regarding a case reserved for judgement.

GS- II - *INTERNATIONAL RELATIONS*

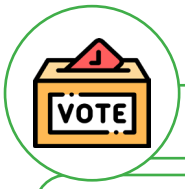
- As part of the **'Early Warnings for All (EW4All)'** initiative announced by the UN in 2022, India is helping Nepal, Maldives, Sri Lanka, Bangladesh and Mauritius to develop EWS to reduce loss of life and property due to extreme weather events.

GS- III - *RENEWABLE ENERGY RESOURCE*

- To incentivise India's solar module manufacturing industry, the **Ministry of New and Renewable Energy (MNRE)** has brought into effect from April 1 an executive order, **The Approved Models and Manufacturers of Solar Photovoltaic Modules (Requirements for Compulsory Registration) Order, 2019.**
- This order was first issued by the MNRE in 2019 and requires makers of solar modules to voluntarily submit to an inspection of their manufacturing facilities by the **National Institute of Solar Energy**, a Ministry-affiliated body.
- Being on the list as an 'approved' manufacturing facility certifies a company as a **legitimate manufacturer of solar panels** and not a mere importer or assembler.
- This became necessary because India's solar industry, its claim of indigenousness notwithstanding, is heavily reliant on imports of cheaper and comparable-quality solar modules from China.

GS- II - *EDUCATION*

- The **Annual Status of Education Report (ASER) 2023** was released:
  - The ASER 2023 Beyond Basics survey was carried out in 28 rural districts across 26 States of the country.
  - The report highlighted that overall, **26% of 14–18-year-olds cannot read a standard two-level text** in their regional language.
  - As per the findings of the report,**57% of the 14–18-year-olds** surveyed students, who **do not have basic reading skills** are enrolled in standard 10 or below. **28% of these children are not enrolled in school**, college or a vocational institution



GS- II - *ELECTION*

- The Supreme Court, while hearing an appeal on election petition, held that **election candidates have right to privacy** as regards to matters which are of no concern to voters or are irrelevant to candidature of public life.

CHERRYPICKS OF THE WEEK

Greenium: It is the amount by which the yield on the green instrument is lower, compared with the conventional instrument.

- It is the idea that investors might be willing to accept a slightly lower yield on a green bond compared to a regular bond, because they value the environmental benefits of the project.
- Empirical studies of greenium in Sovereign Green Bond issuance suggests that it is larger for emerging market economies.

Special Rupee Vostro Account (SRVA)

- A Vostro account is a bank account that other foreign banks hold with "our" bank in the domestic currency i.e rupees.
- SRVA is an additional arrangement to the existing system that uses freely convertible currencies and works as a complimentary system.

Lxchiq:

- The first FDA-approved vaccine to prevent disease caused by Chikungunya virus infection.

Mivan Technology:

- Mivan, short for "Aluminum Formwork System", is a modern construction technique that uses lightweight aluminium panels to cast concrete.
- The lightweight, high-strength panels are easy to handle and reusable, and the method allows for quick assembly of formwork.

Tartrazine and Rhodamine-b:

- Tartrazine is a synthetic yellow food dye that is a cheaper alternative to natural food dyes.
- Rhodamine B is a chemical compound used in synthetic dyes for colouring silk, jute, leather, cotton, and wool.
- It is also used in the cosmetics and plastics industries