GSSCORE

An Institute for Civil Services

INTERVIEW GUIDANCE 2021

CURRENT AFFAIRS & MAJOR DEBATES

of

SCIENCE & TECHNOLOGY

8448496262 | www.iasscore.in

CONTENTS

- Electric vehicle 01
- Artificial intelligence 02
- Net neutrality 04
- Importance of own Navigation System 05
- Big Data Initiative 06
- Nuclear Technology: Pros and Cons 08
- Computer Games addiction and dangers 10
- A Web 3.0 revolution that could relieve us of our social dilemmas 12
- Surveillance reform: The need of Hour 15
- '5G countdown' 17
- Deep Fakes 21
- Pulse oximetry and importance of oxygen 23
- Geopolitics of outer space 25
- Launch of ISpA 27
- PM releases First non-GM Herbicide-Tolerant Rice Varieties 29
- National Policy for Rare Diseases (NPRD) 2021 30
- Liberalisation of the geospatial sector in India 33
- e-Technology to the aid of farmer 35
- ISRO to handle projects of national security 37
- India to Launch Deep Sea Mission 38
- Brain Fingerprinting technology 39
- DNA Technology (Use and Application) Regulation Bill, 2019 42

- **Space Security** 44
- **Sending Humans to Mars** 47
- **Synthetic Biology** 49
- **Artificial Intelligence and its Climate Cost** 51

1 Electric vehicle

Context:

- **Electric vehicles will be a disruption to existing automobile industry. Agree or not?**
- **Will shifting to electric vehicles be beneficial?**
- **What will be the challenges while shifting to the electric vehicles?**

Why to shift to electric vehicles?

- Environment Friendly -NITI Aayog points out that India can cut 64% of road based mobility related energy demand and 37% of carbon emissions by pursuing shared, electric mobility in future.
- Positive externalities – Controlling emissions, will also positively impact public health as air quality in cities would improve. Apart from this, Electric vehicles create an opportunity for employment generation and pushing domestic industry.
- Energy firms find the prospects attractive as they will invest in setting up charging infrastructure. Electric vehicles thus will spur demand for electricity and help in resolving the stress in power sector.
- A shift to electric vehicles would also help in reducing India's import bill on account of crude oil imports.
- Low maintenance and average running costs.
- Electric vehicles can act as storage devices for excess power generated from renewable sources, thus aligning with the push for solar energy.

Challenges while shifting to electric vehicles

- **Availability of Lithium** – India does not have adequate lithium reserves to facilitate manufacture of lithium-ion batteries. Besides, China has been trying to establish a monopoly on lithium reserves by acquiring assets in countries that have rich lithium reserves – such as Bolivia, Chile etc. Thus, securing Lithium supplies could be a major challenge for India.
- **Poor manufacturing base** – The lack of battery manufacturing in India will further make the Indian electric vehicles market dependent on China for imports just as solar power developer's source cheap modules and equipment from China. This does not augur well for the local industry.
- **Enabling environment** – Electric vehicles would also require charging infrastructure to be set up in tandem. Currently, electricity sales in the country are regulated under the Electricity Act and can be carried out with a distribution license from SERCs. To set up a pan-India charging infrastructure, an overhaul of existing regulations is needed.
- **High infrastructure costs involved** – Currently, the cost of setting up a rapid-charging outlet ranges close to INR 25 Lakh, while that of a slow charging station will be around INR 1 Lakh. Building an extensive network of charging stations would, therefore, require substantial investments.
- **More expensive** – Electric vehicles are costlier than traditional cars on account of the cost of Lithium-ion batteries that make up nearly 50% of total costs. Further, EVs are costly on account of components used in them.
- **Performance** – EV cars are not as fast as conventional vehicles.

Government initiatives

- **The National Electric Mobility Mission Plan 2020** is one of the most important and ambitious initiatives undertaken by the Government of India that has the potential to bring about a transformational paradigm shift in the automotive and transportation industry in the country. This is a culmination of a comprehensive collaborative planning for promotion of hybrid and electric mobility in India through a combination of policies aimed at gradually ensuring a vehicle population of about 6-7 million electric/hybrid vehicles in India by the year 2020 along with a certain level of indigenization of technology ensuring India's global leadership in some vehicle segments. It is a composite scheme using different policy-levers such as:

Demand side incentives to facilitate acquisition of hybrid/electric vehicles:

- Promoting R&D in technology including battery technology, power electronics, motors, systems integration, battery management system, testing infrastructure, and ensuring industry participation in the same.
- Promoting charging infrastructure.

Supply side incentives:

- Encouraging retro-fitment of on-road vehicles with hybrid kit
- FAME India - Faster Adoption and Manufacturing of Hybrid and Electric vehicles in India - is a part of the National Electric Mobility Mission Plan.
- In Fame the customer can get the incentive in the form of lower cost of hybrid or electric vehicles at the time of its purchase. Manufacturers can claim the incentive from the government at the end of each month.
- ISRO involvement Lithium-ion (Li-ion) cell technology is one of the most promising electrochemical energy storage technologies owing to its high voltage, high energy density, long life cycle and high storage characteristics. Recent progresses in Li-ion battery technology have made it the favorite power source for electric and hybrid electric vehicles. ISRO's Vikram Sarabhai Space Centre (VSSC) has successfully developed and qualified lithium ion cells of capacities ranging from 1.5 Ah to 100 Ah for use in satellites and launch vehicles.

Balanced view

As time changes and technology advances we have to adapt ourselves for new changes which will bring positive outcomes. Electric vehicles can be disruptions to the automobile industry if the industry fails to innovate in this new technology. Also, given the positive externalities, electric vehicles are way forward till even more new technology comes which will provide greener transportation. Until then, we must adopt electric vehicles and related technologies.

2 Artificial intelligence

Context:

What is artificial intelligence and what are its applications? In such an era of rapid and disruptive changes, Will technology destroy jobs at a faster rate than the rate of creation of jobs? In the context of industrial revolution 4, what should be India's response to artificial intelligence?

Definition

- Artificial Intelligence is intelligence exhibited by machines. Artificial Intelligence (AI) is a computational model capable of activities that we associate with humans such as learning, thinking, decision-making and problem-solving. While an ordinary computer software is capable of decision making within pre-defined algorithm and flowcharts; an AI is unique because it can think, learn, evolve and augment its capabilities beyond the original code.
- The term was coined in 1956 by John McCarthy at the Dartmouth conference, Massachusetts Institute of Technology.

Some AI examples

- In May 1997, an IBM super-computer called Deep Blue defeated world chess champion Gary Kasparov in a chess match.
- Another recent example of 2016 is, AlphaGo, a program driven by Google's DeepMind AI, has won Korean Lee Sedol, one of Go's most dominant players.
- Jarvis system of Mark Zuckerberg.

Application

- AI can drive vehicles and be an autopilot for spaceships. In this role, AI can prevent accident and chart out optimal route for fuel savings while avoiding traffic (or asteroid!) blockades.
- **Manufacturing sector:** Robots are being used for manufacturing since a long time now, however, more advanced exponential technologies have emerged such as additive manufacturing (3D Printing) which with the help of AI can revolutionize the entire manufacturing supply chain ecosystem.
- AI can serve as virtual "Personal Secretary" with its speech recognition and decision making capabilities. With its learning capacity, AI can quickly evolve into a "Manager" capable of optimal logistical planning: from business to warfare.
- **Business Sector:** To take care of highly repetitive tasks Robotic process automation is applied which perform faster and effortlessly than humans. Further, Machine learning algorithms are being integrated into analytics and CRM platforms to provide better customer service. Chatbots being used into the websites to provide immediate service to customers.
- It can defeat smartest human players in the game of chess by learning their moves. Such AI can also evolve to defeat smartest hackers and financial fraudsters by learning their moves. Thus we've a more resilient IT and banking infrastructure.
  - **Cyber Security:** In the 20th conference on e-governance in India it was discussed that AI can provide more teeth to cyber security and must be explored.
- AI equipped robots can perform tasks with more precision than humans- ranging from delicate surgery to handling of dangerous nuclear reactions or conducting counter-terrorism operations.
  - **Intelligent Robots –** Robots can perform the tasks given by a human because of sensors to detect physical data from the real world such as light, heat, temperature, movement, sound, bump, and pressure. Moreover, they have efficient processors, multiple sensors and huge memory, to exhibit intelligence. Further, they are capable of learning from their errors and therefore can adapt to the new environment.
- As a teacher, AI can deliver customized lectures depending on grasping power of a student, and can tirelessly work on weaker students even after school hours.
  - AI can make some of the educational processes automated such as grading, rewarding marks etc. therefore giving educators more time. Further, it can assess students and adapt to their needs, helping them work at their own pace. AI may change where and how students learn, perhaps even replacing some teachers.

- **Machine Translation:** While ordinary software translate sentences from dictionary meaning only but AI can provide real-time translation with accuracy in syntax, context and tone. This can greatly enhance the productivity of tourist guides, business negotiators and diplomats.
  - There are intelligent systems that are capable of hearing and grasping the language in terms of sentences and their meanings while human talks to it. It can handle different accents, slang words, noise in the background, change in human's noise due to cold, etc.
- **Healthcare Sector:** Machine learning is being used for faster, cheaper and more accurate diagnosis and thus improving patient outcomes and reducing costs. For Example, IBM Watson and chatbots are some of such tools.
- **Financial Sector:** It can be applied to the personal finance applications and could collect personal data and provide financial advice. In fact, today software trades more than humans on the Wall Street.

Challenges

- Automation can result in job loss. Humans can never compete with AI-robots. The decrease in demand for human labour due to machines and intelligent robots taking over the jobs in the manufacturing and the services sectors. For Example: In china some customs officers are now robots, in Japan robots as housemaid is an emerging trend.
- **Existential risks:** Stephen Hawkins has once said "The development of full artificial intelligence could spell the end of the human race. Once humans develop artificial intelligence, it will take off on its own and redesign itself at an ever-increasing rate. Humans, who are limited by slow biological evolution, couldn't compete and would be superseded".
- AI technologies falling into terrorist hands may unleash modern terror network including machine and therefore vulnerability of humans may magnify.
- It may lead to moral degradation in society due to decreased human to human interactions.

Industrial revolution 4

- The first industrial revolution used steam power to mechanize production in the 1780s. The second used electricity to drive mass production in the 1870s. The third used electronics and software to automate production and communication from the 1970s.
- Disruptive technology blurring the lines between the digital, physical and even the biological, will be the fourth industrial revolution of AI.
- The fusion of state-of-the-art computational capabilities, extensive automation and extreme connectivity is already impacting nearly every aspect of society, driving global economics and extending into every aspect of our daily life.

Balanced view

The view that artificial intelligence will result in job loss is partially correct. With new technology, new jobs will be created, mostly in creative and cognitive fields. Artificial intelligence is a cornerstone for many technologies, such as internet of things, data mining, big data, self-driving cars, personal assistants, etc. Artificial intelligence is being developed for benefits of humans. This will ease the living and raise lifestyle where humans can devote productive time in new developments. Sustainable development and resource optimization will become much more effective.

3 Net neutrality

Context:

In what ways net neutrality will help in democratizing the internet?

What is net neutrality?

Non-discrimination of data, which is being transferred by telecom infrastructure created by Internet service providers (ISP). ISP have to treat all data as same, thus it will help small entrepreneurs and not only the powerful MNC.

Three stakeholders of Net neutrality -

- **ISP -** building infrastructure for communication and data flow.
- **Digital companies -** act as service providers, data processors. This includes government as well.
- **Users -** uses the service and generates data.

What happens when there is no net neutrality?

- The data is discriminated and preference if given to some data while other data is neglected.
- Discrimination in bandwidth allocation for different companies.
- This amounts to unequal access of internet by digital companies and governments.
- Limited options to the users.
- Monopoly of a few over internet.
- Influence over users for political or commercial goals.

Projects such as zero-rating, free-basics violate net neutrality.

What happens when there is net neutrality?

- Data is not discriminated and even small entrepreneurs have equal chance of growing
- Democratization of internet.
- Wide options for the users.
- Government initiatives can also get same bandwidth as any other website or application.
- Boost to Digital India and proper use of internet by users.

India has one of the strongest net neutrality measures after the Telecom Commission has approved the recommendations of the TRAI on net neutrality.

Conclusion

The Indian government unanimously approved new regulations supporting net neutrality. The regulations are considered to be the "world's strongest" net neutrality rules, guaranteeing free and open internet for nearly half a billion people, and are expected to help the culture of start-ups and innovation. The only exceptions to the rules are new and emerging services like self-driving cars and tele-medicines, which may require prioritized internet lanes and faster than normal speeds.

4 Importance of own Navigation System

Context:

ISRO conceived IRNSS in 2010, when India released to install its own navigation and communication satellites replacing country's dependence on foreign navigational systems such as the US-GPS and the Russian-GLONASS. The system is aimed to provide better communication services. Why having one's own navigation system is important for the nation? How the navigation system can help in Disaster Management?

Applications

- Better mapping of terrestrial boundary of the country, helping in marking precisely coordinates of landmarks like forests, roads etc.
- Disseminating timely disaster alert to vulnerable areas.
- Goods such as ammonium nitrate (MHA recently made regulatory measures) could be geo tagged reducing its wrong use.
- Terrestrial, Aerial and Marine Navigation
- Visual and voice navigation for drivers.
- Precise timing helping in better scientific calculations during experimentations and other activity
- Urban planning in case of smart cities
- Vehicle tracking and fleet management

Significance

- IRNSS will make Indian Armed Forces self-reliant. While advanced nations like US and Russia are having GPS and GLONASS, countries like China, European Union and Japan are trying to have their own full-fledged or partial constellations.
- The current ballistic missile systems are all dependent on positioning systems to accurately hit their target.
- There have been two instances where USA has manipulated or denied this information which has made India go forward with its own independent positioning system.
  - During the Iraq war, the Americans sent wrong GPS signals to the Iraqi jets and missiles, therefore Iraqis could not attack Americans forces in a precise manner.
  - During the Kargil war of 1999, USA denied India the required GPS information which would have helped them to tackle the enemy in a better way.
- Having our own GPS System will ensure that something like this doesn't happen in the future. Plus, if India has to project itself as a superpower so it needs to have such a system in place.
- It will make India self-dependent on its own network system and also extending services up to 1500 km from the mainland, covering SAARC countries as well.
- It will open up a conduit for SAARC countries to come together.

5 Big Data Initiative

Context:

- **Big Data is data whose scale, diversity, and complexity require new architecture, techniques, algorithms, and analytics to manage it and extract value and hidden knowledge from it.**
- **In other words, big data is characterized by volume, variety (structured and unstructured data), velocity (high rate of changing) and veracity (uncertainty and incompleteness). However, the Big Data Initiatives are raising the issue of Right to Privacy also, as it is auto-generated, often without knowledge of people also, for example, US government, Google Corporation, etc. have been collecting data of people accessing internet.**

The Indian government has launched a Big Data Initiative, with the following aims:

- Promoting and fostering big data science, technology and applications in India and developing core generic technologies, tools and algorithms for wider applications in the government.
- Understanding the present status of the industry in terms of market size, different players providing services across sectors/ functions, opportunities, SWOT of industry, policy framework (if any), present skill levels available etc.
- Carrying out market landscape surveys to assess the future opportunities and demand for skill levels in next 10 years.
- Carrying out gap analysis in terms of skills levels and policy framework.
- Evolving a strategic road map and action plan clearly defining of roles of various stakeholders - government, industry, academia, industry associations and others with clear timelines and outcome for the next 10 years.

Some of the key actions required for successful implementation of initiative are:

- **Talent Pool:** Create industry academia partnership to groom the talent pool in universities as well as develop strong internal training curriculum to advance analytical depth.
- **Collaborate:** Form analytics forum across organization boundaries to discuss the pain-points of the practitioner community and share best practices to scale analytics organizations.
- **Capability Development:** Invest in long term skills and capabilities that form the basis for differentiation and value creation. There needs to be an innovation culture that will facilitate IP creation and asset development.
- **Value Creation:** Building rigor to measure the impact of analytics deployment is very critical to earn legitimacy within the organization.

Concern for Privacy

- While there are many benefits to the growth of big data analytics, traditional methods of privacy protections often fail. Many notions of privacy rely on informed consent for the disclosure and use of an individual's private data. However, big data means that data is a resource that can be used and reused, often in ways that were inconceivable at the time the data was collected. Anonymity is also eroded in a big data paradigm. Even if every individual piece of information is stripped of personal information, the relationships between the individual pieces can reveal the individual's identity.
- For example, how accurate is personal information obtained from social media? Should information from social media or other Web-enabled sources be used to screen or rank job applications, or increase the price of medical insurance? Basic profile data, such as age, marital status, education or employment, is typically unverified. A similar lack of verification is common in free email services in which the account holder, by accepting terms and conditions, has agreed to relinquish some degree of privacy for data aggregation purposes.
- Another quality issue is the way that Internet search terms or phrases can be misinterpreted, when this type of data is collected. Examples of poor enterprise use of big data would include using Internet search terms to evaluate product pricing or, perhaps, target potential customers. There can be multiple users on a household computer, and there are many reasons why someone might research a subject on the Internet that is not directly relevant to them. This type of data collection, analysis and usage can result in flawed analytic results leading to bad decisions, a lose-lose scenario for both individuals and the organizations acting upon that data. This lack of big data quality control points to another well-established privacy principle, which is to collect personal data that is consistent and appropriate for the intended purpose.

- Big data has the potential to discriminate in two ways. First, it can be used to identify aberrant data amongst larger sets, leading to the use of big data to discriminate against specific groups and activities. Second, big data will be used to draw conclusions about large groups of people, and yet some will be excluded because their data is not included in the sets, or the quality of their data is poorer. It is important to remember that data does not equal truth. It only offers correlations — for example, links between two different types of activities.

Thus for respecting Right to Privacy following principles should be followed:

- To respect the principle of purpose specification.
- To limit the amount of data collected and stored to the level that is necessary for the intended lawful purposes.
- To obtain, where appropriate, a valid consent from the data subjects in connection with use of personal data for analysis and profiling purposes.
- To be transparent about which data is collected, how the data is processed, for which purposes it will be used and whether or not the data will be distributed to third parties.
- To carry out a privacy impact assessment, especially where the big data analytics involves novel or unexpected uses of personal data.
- To exercise great care, and act in compliance with applicable data protection legislation, when sharing or publishing pseudonymised, or otherwise indirectly identifiable, data sets. If the data contains sufficient detail that is, may be linked to other data sets or, contains personal data, access should be limited and carefully controlled.

6 Nuclear Technology: Pros and Cons

Context:

The Union Cabinet has approved ten 700 MWe PHWRs, without locations or timeline, but as a "fully homegrown initiative" with likely manufacturing orders to Indian industry of about INR 700 billion ($11 billion). However, the development of nuclear power raises many debates related to the cost and safety.

Pros of Nuclear Energy

- **Low Pollution:** Nuclear power also has a lot fewer greenhouse emissions. It has been determined that the amount of greenhouse gases have decreased by almost half because of the prevalence in the utilization of nuclear power. Nuclear energy has the least effect on nature since it doesn't discharge any gasses like methane and carbon dioxide, which are the primary "greenhouse gasses."
- **Low Operating Costs:** Nuclear power produces very inexpensive electricity. The cost of the uranium, which is utilized as a fuel in this process, is low. Also, even though the expense of setting up nuclear power plants is moderately high, the expense of running them is quite low. The normal life of nuclear reactor is anywhere from 40-60 years, depending on how often it is used and how it is being used.
- **Reliability:** It is estimated that with the current rate of consumption of uranium, we have enough uranium for another 70-80 years. A nuclear power plant when in the mode of producing energy can run uninterrupted for even a year. As solar and wind energy are dependent upon weather conditions, nuclear power plant has no such constraints and can run without disruption in any climatic condition.

- **More Proficient than Fossil Fuels:** The other primary point of interest of utilizing nuclear energy is that it is more compelling and more proficient than other energy sources. A number of nuclear energy innovations have made it a much more feasible choice than others. They have high energy density as compared to fossil fuels. The amount of fuel required by nuclear power plant is comparatively less than what is required by other power plants as energy released by nuclear fission is approximately ten million times greater than the amount of energy released by fossil fuel atom.
- **Renewable:** Nuclear energy is not renewable resource. Uranium, the nuclear fuel that is used to produce nuclear energy is limited and cannot be produced again and again on demand. On the other hand, by using breeder and fusion reactors, we can produce other fissionable element. One such element is called plutonium that is produced by the by-products of chain-reaction. Also, if we know how to control atomic fusion, the same reactions that fuel the sun, we can have almost unlimited energy.

	Common antituranium/ nuclear assertions	**Main points of response**
Mining pollution	Uranium mines inevitably polluted Their environment	Uranium mines today aim for zero emission of pollutants. Major uranium mines in Australia and Canada have ISO14001
Miner's health	Uranium is potentially hazardous to Miners' health.	Uranium mining is highly regulated in most countries and standards ensure that no adverse health effects are likely.
Reactor: cost	Nuclear plants are too expensive. they cost at least billion dollars to be build.	Once built, the cost to operate a nuclear Power plant is constant and predictable since the uranium fuel cost amounts very less. The primary costs of a nuclear plant are the operation, maintenance and capital costs.
Reactor: safety	Nuclear reactors are unsafe, Chernobyl was typical, and resulted in a huge death toll.	The nuclear industry has an excellent safety record, with some 14,800 reactor years of operation spanning five decades. The reactors built today are very safe. Even a major accident and melthdown as at Fukushima in 2011 would not endanger its neighbors. There were no deaths or serious radiation doses from the Fukushima a accident.
Reactor: terror attack	Nuclear reactors are vulnerable to terrorist attacks like that on the World Trade Centre in 2001.	any reactor licensable in the west has a substantial containment structure vessel and internal structures. Power reactors are well equipped to survive an impact of that kind without any significant radiological hazard locally.

Nuclear waste	Nuclear wastes (as, or in, spent fuel) are an unresolved problem.	In all countries using nuclear energy there are well established procedures for storing, managing and transporting such wastes, funded from electricity users. Wastesare contained and managed, not released. Storage is sage and secure, plans are well in hand for eventual disposal.
Climate change	Nuclear energy makes only a trivial contribution to reducing carbon dioxide emissions.	Currently nuclear energy saves the emission of 2.5 billion tonnes of CO2 relative to coal. Doubling the world's nuclear output would reduce CO2 emissions from power generation by about one-quarter.
Fear of being used for making nuclear bombs	Reprocessing spent fuel gives rise to plutonium which is likely to be used in bombs.	The plutonium obtained from reprocessing is not suitable for bombs but is a valuable fuel which can be used with depleted uranium as mixed oxide fuel (MOX). Also all traded uranium is sold for electricity production only, and two layers of international safeguards arrangements confirm this.
Insurance	Insurance companies will not insure nuclear reactors so the risk devolves on to government.	All nuclear reactors, at least in the West, are insured. Beyond the cover for individual plants there are national and international pooling arrangements for comprehensive third-party cover. Thus India should ensure the same for its reactors.
Use of renewable	If energy efficiency is all that's needed, then Renewable energy sources should be used instead.	Renewable energy may be used as much as possible, but intrinsic limitations (diffuse, intermittent sources) mean that wind and sun can never economically replace sources such as coal, gas and nuclear for large-scale, continuous, reliable supply.

7 Computer Games addiction and dangers

Context:

Various studies show that playing too much computer games causes physical damages and increases anxiety and depression in players. The cases of Blue Whale suicides have also came up. What are the steps needed to control this addiction?

Negative effects

Internet addiction is nowadays not considered as a bad habit, but a disease. Its several consequences are

- **Social consequences**
  - It leads to lack of physical interaction with the outside world.
  - He/she may lack face-to-face human contact, experience isolation & loneliness, and the loss of friends or relationships.
- **Physical consequences:**
  - Many children sacrifice precious time that should have been used to do school work or take part in physical exercises instead of playing computer games.
  - This issue can accelerate when coupled with a poor diet, lack of Vitamin D and limited social interaction.
- **Depression:**
  - Children often find comfort in playing computer games, and this creates a vicious cycle that can have a problematic effect on their mental health.
  - Most computer games have internal feature that enables players to set targets and monitor their progress. For a child who is obsessed with computer games, failures, and pressures to achieve the set goals leads to stress.
- The Blue Whale game or Blue Whale Challenge is believed to be a suicide game wherein a group of administrators or a certain curator gives a participant a task to complete daily — for a period of 50 days — the final of which is the participant committing suicide. Participants are expected to share photos of the challenges/tasks completed by them.
- These daily tasks start off easy — such as listening to certain genres of music, waking up at odd hours, watching a horror movie, among others, and then slowly escalate to carving out shapes on one's skin, self-mutilation and eventually suicide.
- The challenge is understood as- to find victims, create an emotional bond with them through arbitrary set of steps demanding completion in order to move forward in the game and then hope they follow through to step 50. 'Jump off a high building. Take your life.' It's simply a control and manipulation scheme directed toward vulnerable people who are predisposed to have serious thoughts of suicide, loneliness, and death. When a person is suicidal, they feel, most of all, alone and worthless. The game creator understands these feelings and is taking advantage of them. Some experts believe these tasks may convince an impressionable young person to hurt themselves because of the "whale's" influence.

Government initiative

- Concerned over the issue of Blue Whale challenge, the Ministry of Electronics and Information Technology (MeitY) has written to major technology firms, including Facebook India, Google India, Instagram, Microsoft India, WhatsApp and Yahoo! India, to remove links of such games from their platforms.
- Further IT platforms to abide by directions given by IT ministry and "any violation will be taken very seriously".

Solutions for computer game addiction

- Parents can consider app locks or Internet locks on their children's devices. There are dedicated apps like 'Family Time', which will allow parents to keep track of their children's gaming and browsing habits, especially if they are addicted to their phones and tablets and laptops.
- **One-to-One counseling with a psychologist or therapist:**
  - This may be the best option if one is able to find an affordable and qualified therapist in his or her area, but unfortunately video game addiction specialists remain quite rare (although this is changing as the problem becomes more prevalent)
- It is important to point out that not all computer games are harmful to the growth and development of children. There are education games that children can play during their free time.

8 A Web 3.0 revolution that could relieve us of our social dilemmas

Context

Web 3.0 is the next step in the evolution of the Internet and Web applications.

Background

- As is well known, the internet is a telecommunications network that was initially born in the military (in the 60s, under the name of Arpanet) and then moved to the scientific and academic community.
- The World Wide Web saw the light in 1991. At this point, the internet was ready to spread with a completely unexpected speed.
- The Internet has changed dramatically since its inception. From Internet Relay Chat (IRC) to modern social media, it has become a vital part of human interactions - and continues to evolve.
- Today, the internet has created astounding pathways for opportunity and success is an understatement.
- It has democratized access to information, created boundless economic opportunities and connected people worlds apart.
- In 1990,fewer than 1% of the world's population was online. Thirty years later, that number has jumped to 59% of the world's ever-growing population.
- This growth has come at a price. Today's internet looks less like its inventors' visions of a decentralized, democratic information network and more like an oligopoly controlled largely by the companies that own the data.
- Big Tech platforms know for whom and what we search, who are our friends and family, what we like and dislike.
- These companies capitalize on our digital identities for their lucrative advertising-based business models, capturing enormous value at the expense of the privacy of their users.
- Most users accept the privacy and opportunity costs because of the convenience and value these services provide.

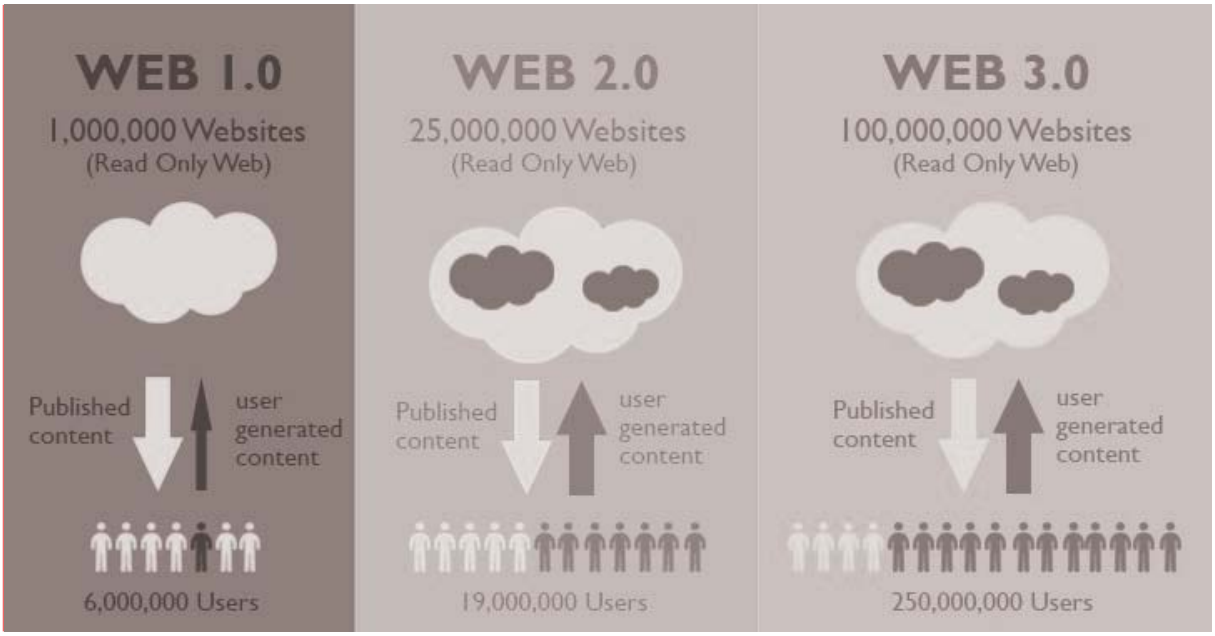
Analysis

■ A brief history of the evolution of the Internet

Websites and web applications have changed dramatically over the last decades. They have evolved from static sites to data-driven sites that users can interact with and change.

■ Web 1.0

- The original Internet was based on what is now known as Web 1.0.
- The term was coined in 1999 by author and web designer Darci Di Nucci, when distinguishing between Web 1.0 and Web 2.0.
- Back in the early 1990s, websites were built using static HTML pages that only had the ability to display information – there was no way for users to change the data.



- **Web 2.0**
  - That all changed during the late 1990s when the shift toward a more interactive Internet started taking form.
  - With Web 2.0, users were able to interact with websites through the use of databases, server-side processing, forms, and social media.
  - This brought forth a change from a static to a more dynamic web.
  - Web 2.0 brought an increased emphasis on user-generated content and interoperability between different sites and applications.
  - Web 2.0 was less about observation and more about participation.
  - By the mid-2000s, most websites made the transition to Web 2.0.

Understanding the 'new internet'

- Web 3.0 is the next generation of Internet technology that heavily relies on the use of machine learning and artificial intelligence (AI).
- It aims to create more open, connected, and intelligent websites and web applications, which focus on using a machine-based understanding of data.
- Through the use of AI and advanced machine learning techniques, Web 3.0 aims to provide more personalized and relevant information at a faster rate.
- This can be achieved through the use of smarter search algorithms and development in Big Data analytics.
- Current websites typically have static information or user-driven content, such as forums and social media.
- While this allows information to be published to a broad group of people, it may not cater to a specific user's need.
- A website should be able to tailor the information it provides to each individual user, similar to the dynamism of real-world human communication.

The 4 Properties of Web 3.0

- To understand the nuances and subtleties of Web 3.0, let's look at the four properties of Web 3.0:

- Semantic Web
- Artificial Intelligence
- 3D Graphics
- Ubiquitous

Challenges of Web 3.0 Implementation

- **Vastness:** The internet is HUGE. It contains billions of page and existing technology has not yet been able to eliminate all semantically duplicated terms. Any reasoning system which can read all this data and understand its functionality will have to be able to deal with vast amounts of data.
- **Vagueness:** User queries are not really specific and can be extremely vague at the best of times. Fuzzy logic is used to deal with vagueness.
- **Uncertainty:** The internet deals with scores of uncertain values. Probabilistic reasoning techniques are generally employed to address uncertainty.
- **Inconsistency:** Inconsistent data can lead to logical contradiction and unpredictive analysis.
- **Deceit:** While AI can help in filtering data, what if all the data provided is intentionally wrong and misleading. Cryptography techniques are currently utilized to stop this problem.

What makes Web 3.0 'superior' to its predecessors?

- **No central point of control:** Since middlemen are removed from the equation, user data will no longer be controlled by them. This reduces the risk of censorship by governments or corporations and cuts down the effectiveness of Denial-of-Service (DoS) attacks.
- **Increased information interconnectivity:** As more products become connected to the Internet, larger data sets provide algorithms with more information to analyze. This can help them provide more accurate information that accommodates the specific needs of the individual user.
- **More efficient browsing:** When using search engines, finding the best result used to be quite challenging. However, over the years, they have become better at finding semantically-relevant results based on search context and metadata. This results in a more convenient web browsing experience that can help anyone find the exact information they need with relative ease.
- **Improved advertising and marketing:** No one likes being bombarded with online ads. However, if the ads are relevant to one's interests and needs, they could be useful instead of being an annoyance. Web 3.0 aims to improve advertising by leveraging smarter AI systems, and by targeting specific audiences based on consumer data.
- **Better customer support**: When it comes to websites and web applications, customer service is key for a smooth user experience. Due to the massive costs, though, many web services that become successful are unable to scale their customer service operations accordingly. Through the use of smarter chatbots that can talk to multiple customers simultaneously, users can enjoy a superior experience when dealing with support agents.
- **Trustworthy yet decentralized:** Instead of relying on trusted intermediaries to coordinate users, Web 3.0 systems use mechanisms such as cryptographic proofs and economic incentives to guarantee users that the system is working as expected. As a result, Web 3.0 networks are trustworthy, yet *decentralized*.

Closing thoughts

- These systems require collective user cooperation to succeed, these projects make it a core tenet to protect, not exploit, their users and their privacy. These Web 3.0 systems – the new internet – could upend advertising-based business models, so far one of the most successful business models of all time.

- Though there is no concrete definition for Web 3.0 yet, it is already set in motion and will surely continue towards further iterations.

9 Surveillance reform: The need of Hour

Context

Recently a report named 'Pegasus Project' was published that says that over "300 verified Indian mobile telephone numbers were targeted using spyware made by the Israeli firm, NSO Group.

Background

■ Surveillance in India

- In India the government can surveillance through existing laws that offer impunity for surveillance. However, there are several issues associated with the surveillance regime.
- The Indian surveillance government relies on existing provisions under **the Indian Telegraph Act of 1885** and the **Information Technology (IT) Act of 2000.**
- These provisions are problematic and give the government complete anonymity regarding its capture and monitoring functions.
- While the provisions of the **Telegraph Act** relate to telephone conversations, IT Act deals with all communications made using a computer application.
- **Section 69 of the IT Act** and the **Restrictions Act of 2009** does not work better than the Telegraph Act, and it provides even the weakest protection against those tested.
- There is no provision, however, that allows the government to hack into anyone's phones as hacking of computer equipment, including cell phones and applications, is a criminal offense under the IT Act.
- However, self-monitoring, whether under the law or outside of it, is a gross violation of the fundamental rights of citizens.

What is Pegasus?

- Pegasus is a spyware that works by sending an exploit link.
- If the target user clicks on the link of spyware, the malware or the code that allows the surveillance is installed on the user's phone.
- Once the Pegasus is installed, the attacker has complete access to the target's phone.
- The first case on Pegasus's spyware operations emerged in 2016, when Ahmed Mansoor, a human rights activist in the UAE, was targeted with an SMS link on his iPhone 6.
- Apple responded by making out an update to "patch" or fix the issue.
- Pegasus delivers "a chain of zero-day exploits to penetrate the security features on the phone and installs Pegasus without the user's knowledge or permission.

About the Pegasus Malware Attack

- The surveillance was carried out on users in 20 countries, "between in and around April 2019 and May 2019".
- The surveillance was carried out by using a spyware tool called **Pegasus** that was developed by an **Israeli firm, the NSO Group.**

- Only a missed call on the app was all that was needed to install the software on the device.
- No clicking on a misleading link was required.

"Zero-day exploit"

- It is a completely unknown vulnerability. Even the software manufacturer is not aware of it, and there is, thus, no patch or fix available for it.

Impact

- **Threat to Freedom of the Press:** Monitoring affects media freedom. In 2019, similar allegations were made about Pegasus' use of journalists and human rights activists.
- The World Press Freedom Index produced by Reporters Without Borders ranked India in 142 out of 180 countries by 2021.
- Privacy and free speech are what enable good reporting. They protect journalists from the threat of private and public sanctions through official reporting.
- **Contrary to the Right to Privacy:** The very existence of a security system affects the right to privacy and the exercise of freedom of speech and personal freedom under Articles 19 and 21 of the Constitution, respectively.
- Fear of citizens knowing that their email is being read by the government could affect their ability to express, accept and discuss unfamiliar ideas.
- In the absence of secrecy, the safety of journalists, especially those whose work criticizes the government, and the personal safety of their sources are at stake.
- **State of Authorization:** Employment promotes the spread of dictatorship in the public service because it allows managers to exercise an unequal amount of power in the citizenry and have an impact on their lives.
- **Against Procedure:** Employment, when fully implemented by an authority, reduces Articles 32 and 226 of the Constitution as is the case in private.
- Therefore, the affected person cannot show a violation of their rights. This violates not only the purposes of proper procedure and separation of powers but also violates the requirement of process protection as mandated in **Puttaswamy v. Union of India (2017).**

Analysis

■ Issues with Surveillance system

- Monitoring itself, whether under the law or outside of it, is a gross violation of the fundamental rights of citizens.
- **Violations of freedom of speech:** The existence of a system of surveillance affects the right to privacy and the exercise of freedom of speech and personal freedom under **Articles 19** and **21** of the Constitution, respectively.
- It prevents people from learning and exchanging strange, controversial or provocative ideas.
- **There is no element of legal scrutiny:** There is also no space for the intended person to go to court of law before or during or after or acts of observation as the system itself is confidential.
- **No oversight:** In the absence of parliamentary or legislative oversight, electronic surveillance gives the council the power to influence both subject matter and all categories of people, resulting in a negative impact on free speech.
- **Opposition to the separation of powers:** Constitutional officials such as the sitting judge of the Supreme Court have been reported to be under the control of Pegasus.

- The acquisition of immeasurable power by a single branch of government threatens the separation of state power.
- Existing provisions are not enough to prevent the spread of dictatorship because they allow the authorities to use an unequal amount of power.

What measures are required?

- **Administrative Justice:** In order to satisfy the principle of "proper legal process", to maintain the separation of powers effectively and to meet the requirements of procedural protection and environmental justice, it is necessary to consider judgments.
- Only the judiciary can determine whether certain conditions of oversight are equal, whether there are other complex mechanisms in place, and balancing the need for government objectives with the rights of the people affected.
- The need to oversee the processes of general surveillance systems, as well as the investigation into Pegasus burglary, is also important because leaked details of the target numbers contained the telephone number of a sitting High Court judge sitting, which also casts doubt on Indian independence.
- Monitoring conversion is a need for an hour in India as a complete overhaul of the monitoring framework is outdated.
- Not only is the existing security weakened but the proposed law relating to the protection of personal data of Indian citizens fails to address scrutiny while providing extensive relief to government officials.
- There needs to be greater clarity in the system as in the current system, organs of state are not accountable to anyone other than government itself.
- The current argument, therefore, is not about 'whether to be watched at all', but about 'how, when, and what kind of surveillance'.
- If the purpose Protecting national security can be achieved through minor violations of fundamental rights, the government is constitutionally obliged to implement a mechanism that, in fact, involves minor violations.
- Changes in the Indian surveillance regime should include code of conduct that looks at the ethical aspects of employment.

Conclusion

This is also the right time across the world, there is an increasingly urgent debate about how to protect basic rights against encroachment by an aggressive and intrusive state, which wields the rhetoric of national security like a sword. The only way to solve this problem is to implement immediate and comprehensive surveillance reform.

10 '5G countdown'

Context:

- **5G is the 5th generation of mobile networks, a significant evolution of today's 4G LTE networks.**
- **It is the next-generation cellular technology that will provide faster and more reliable communication with ultra-low latency.**

Background

- Previously, Jio had revealed it had set up core architecture and was ready to switch to 5G as soon as the spectrum auction came around.
- Mukesh Ambani had announced in July that Jio would start testing its homegrown 5G solution as soon as the spectrum was available. The announcement was made during RIL's 43rd Annual General Meeting.
- At the Qualcomm 5G Summit in October, Jio had announced the development of its 5G Radio Access Network (RAN) designed to test 5G network at scale.
- Jio has been working with companies like Samsung and Qualcomm to bring 5G to India.

Analysis

■ What is 5G?

- 5G is the 5th generation of mobile networks, a significant evolution of today's 4G LTE networks.
- It is the next-generation cellular technology that will provide faster and more reliable communication with ultra-low latency.
- Even after the entry of 5G into the Indian networks, the earlier generation mobile technologies (2G, 3G and 4G) will continue to remain in use and that it may take 10 or more years to phase them out.
- 5G uses radio waves or radio frequency (RF) energy to transmit and receive voice and data connecting our communities

■ What are the potential applications of 5G?

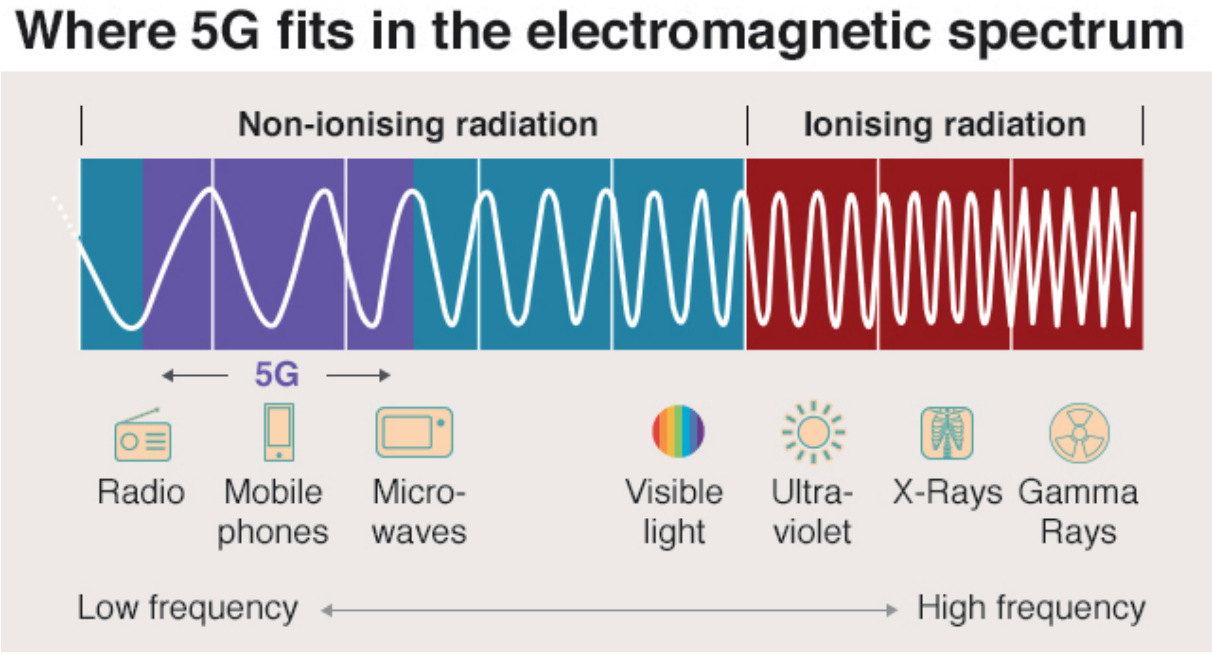
Sustainable pricing of spectrum, stable policy and regulatory landscape, and innovative use cases are estimated to be key enablers accelerating the growth of the 5G market in India. Agriculture, automotive, manufacturing, healthcare, energy & utilities, and media & entertainment are likely to be the potential end-user industries of 5G.

- **Telecom sector:** 5G will positively impact India's telecom market, the second largest in the world and "still growing", as increased data consumption and heightened adoption of technology due to the pandemic has prepared the market for the advent of next-generation technology.
- **Agriculture**: It is expected to revolutionize the agriculture industry through high-speed data transfer in agricultural drone, smart irrigation, precision farming, and monitoring of soil, crop and livestock.
- **Automotive industry:** In the automotive industry, 5G is expected to fast track the implementation of connected cars, V2X (vehicle to everything), autonomous driving, and smart transportation system.
- **Manufacturing industry:** The manufacturing industry is predicted to leverage 5G in connected and smart factories, synchronized planning, smart supply-chain network, and smart logistic operations.
- **Healthcare industry:** Furthermore, 5G is likely to digitally transform the healthcare industry through the application of **internet of medical things (IoMT),** connected healthcare, patient data management and online consultation.
- **Application in smart cities:** 5G is expected to find extensive use in smart cities. The major smart city applications of 5G are anticipated to be smart utility management systems, smart grids and metering systems, smart traffic management systems, smart traffic lights, video surveillance and analytics, and waste management.

- **Supporting applications and services:** It is expected to form the backbone of emerging technologies such as the Internet of Things (IoT) and machine to machine communications, thereby supporting a much larger range of applications and services, including driverless vehicles, telesurgery and real-time data analytics.
- **Government:** This revolution will also provide an opportunity for the government to improve it's connected with the citizens. Digitalisation could help improve the delivery of government services to citizens and also lower transaction costs for citizens.

■ Why does India need 5G?

- **Internet speed:** The quick adoption of 5G technology, which has been in the works for some time now, can facilitate a quick ramp-up in internet speeds in this country. 5G has a high data speed, which improves mobility and user experience.
- **Creating adequate infrastructure:** India has been the largest consumer of data in the world. The country accounted for the consumption of 11 GB data per month per user, on an average. The existing broadband technology falls short to meet the soaring demand owing to lack of adequate infrastructure.
- **Filling required gaps:** 5G has enormous potential to accomplish the various gaps of the existing 4G LTE technology like low mobility speed, high latency and capital intensive deployment.
- **Smarter, faster and efficient infrastructure:** This new technology backbone is smarter, more efficient and up to 100 times faster than the 2G, 3G and 4G networks currently in use in India and can open up the economic potential of an unimaginable magnitude.
- **Transformation of vital sectors:** It can exponentially transform sectors such as communications, data management, analytics, fintech, healthcare, autonomous vehicles and entertainment facilitate smart cities, smart homes, and the IoT.



■ What are the fundamental issues in rolling out 5G networks?

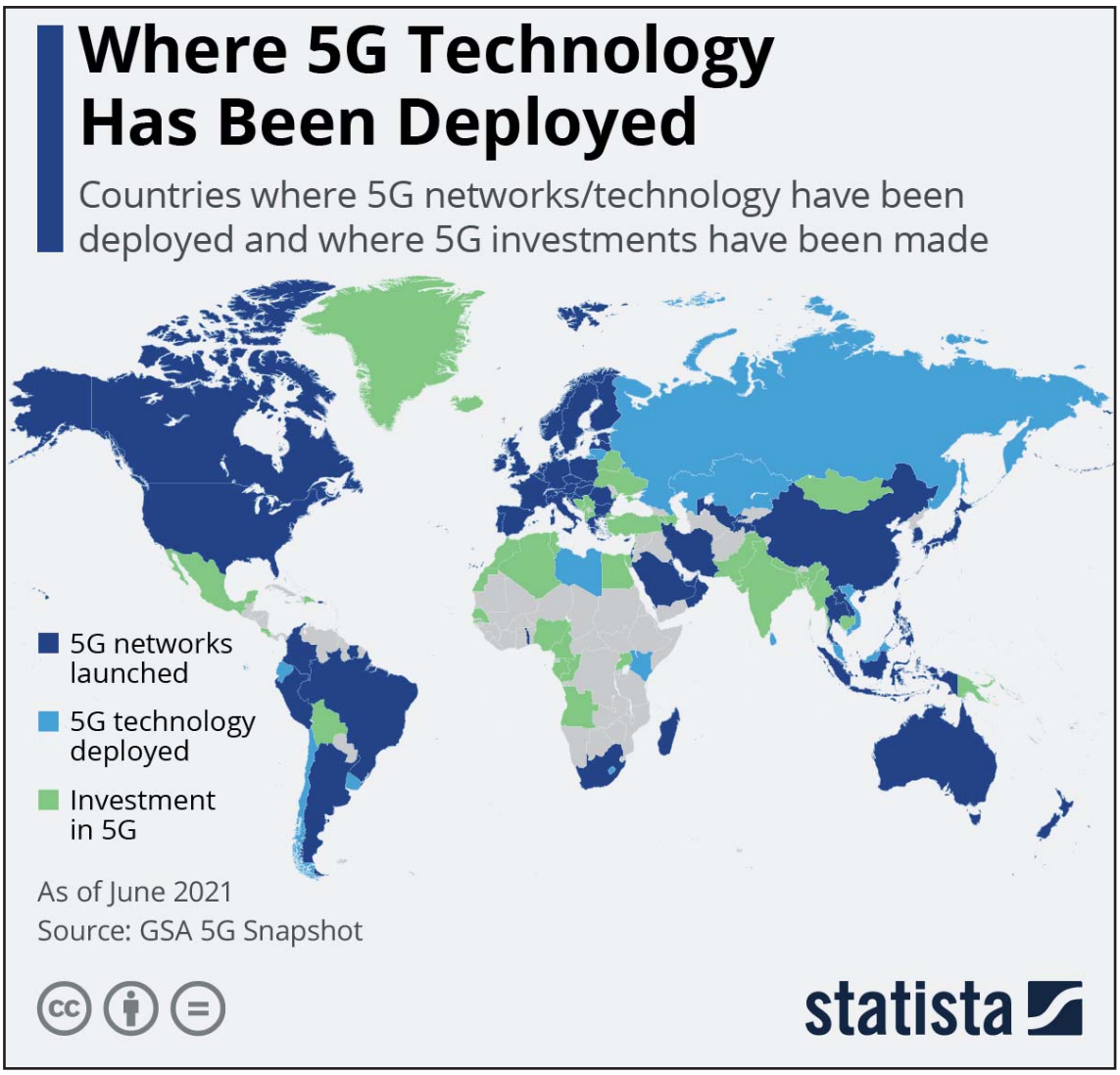
- **Spectrum**: In India, 5G spectrum is yet to be allocated. This means full-fledged trials are still pending which is needed for telecom operators to test their technology.
- **Too expensive affair:** The 5G spectrum auction has been delayed in India is because it is too expensive for telecom companies.

- **Findings space:** One other challenge when deploying 5G is the acquisition of sites.
- **Fiberization:** Another major challenge that has to be tackled is the paucity of fibre optic links. In India, only about 25-30 percent of telecom towers are connected by fibre links; the rest are connected by radio waves.
- Universal adoption of 5G will require at least 50-60 percent of towers to be connected by fibre – ideally, before the launch of the new technology. In the US and China, about 80 percent of all telecom towers have fibre links.
- Other challenges are:
  - Right of Way(RoW) and lack of uniform policy framework
  - Limited giga-backhauling to meet future requirements
  - Industry crippling under margin pressure
  - Network modernisation and densification will be complex
  - Strengthening the security apparatus with evolving technologies

■ Which countries have already launched 5G services?

Globally, 5G network deployment is rapidly moving from trials to early commercialisation.

- In April 2019, South Korea and the U.S. became the first countries to commercially launch 5G services.



- China too has handed out commercial 5G licences to its major carriers earlier than expected.
- Other countries include Japan, Australia, United Kingdom, Qatar, Kuwait, the United Arab Emirates and others.

Conclusion

With a confluence of technologies (IoT, big data, edge computing, AI, etc.) maturing together, 5G is set to be a game-changer for the telecom industry and is expected to yield enormous economic opportunities. The augmentation of enterprise 5G will impact almost all major sectors, with the potential to unlock USD4.8 trillion globally. To make 5G a reality in India, government and industry collaboration with 5G network providers is needed to achieve long-term objectives.

11 Deep Fakes

Context:

AI-generated fake videos (or deep fakes) are becoming more common and convincing. These videos have become one of the key weapons used in propaganda battles for quite some time now.

Background

- Deep Fakes constitute fake multi-media content — often in the form of videos but also other media formats such as pictures or audio — created using powerful artificial intelligence tools.
- Deep Fake makes it possible to synthesize media — switch faces, lip-syncing, and puppeteers — mostly without consent. This creates a threat to internal security, political stability, and business disruption in a nation.
- Currently, most social media companies such as Twitter and Facebook have banned deepfake videos. They have told that if they detect any video as deep fake manipulated or synthetically generated, it will be taken down.
- Today, as technology advances, it is becoming increasingly easier for anyone to produce deep fakes and deep fakes are becoming harder to detect using traditional techniques.
- In this article, we will therefore first understand deep fakes and then the various challenges they pose for our society and ways to address them.

Analysis

■ What is deep fake?

- Deep Fakes are called so because they use deep learning technology, a branch of Artificial intelligence that applies neural network simulation to large data sets, to create fake videos.
- Using this technology, a person's head movements and expressions, etc are transferred onto some other person's video in such a way that it becomes difficult to tell that it is a deep fake unless one closely observes the source media file.
- Here the AI learns what a source face looks like and then transposes it onto another target to perform a face swap seamlessly.

An illustration of how a Deep fake video is created

■ How are deepfakes detected currently?

- Currently, deep fakes are identified manually or by software, using some identifiers like:
  - Flicking, blur with bleeding color, etc. in poorly produced deep fake videos
  - Unusual eye blinking pattern in deep fake videos
  - Using markers known as "soft biometrics" of a person i.e., his/her eyebrow movements, lip movements, etc.

■ Why are deep fakes becoming harder to detect?

- Newer and more advanced deep fakes use a machine learning technique called generative adversarial network, or GAN.
- This type of machine learning system consists of two neural networks, operating in concert. One network generates the fake and the other tries to detect it, with the content iterating back and forth, and improving with each iteration (repetition of the process).
- This dynamic is replicated in the wider research landscape, where each new deep fake detection technique gives the deep fake makers a new challenge to overcome, making deep fakes increasingly foolproof.
- Thus, any deep fakes detector will only be going to work for a short while before deep fake makers account for it in their algorithm.

What are the threats posed by deep fakes?

- **Can lead to a new type of Warfare:** A deepfake can be used as a powerful tool by a nation-state or on-state actors to undermine public safety and create uncertainty and chaos in the target country.
- **Can undermine Democracy:** Deep Fakes can be used to power false information about public policy, institutions, and politicians which can be exploited to change stories and manipulate beliefs.
- A high-quality deepfake can create false information that can cast a shadow on the legitimacy of the voting process and election results.
- Deep fakes can become an effective tool to induce polarization, amplify division in society, and suppress dissent.
- **Can be used for targeting women:** The malignant use of a deepfake can be seen in pornography, inflicting emotional, reputational, and in some cases, violence towards the individual. Women can be disproportionately affected.
- **Can cause damage to personal reputation:** Deepfake can depict a person indulging in antisocial behaviors and saying vile things. Even when the deep fake is debunked, it may be too late to remedy the initial harm caused to the victim.
- **Can be used for financial and other frauds:** Deepfakes can be deployed to extract money, confidential information, or exact favors from individuals.

How to counter deep fakes?

- **Technological Interventions:** Technical countermeasures used to mitigate the impact of deep fakes fall into three categories: media authentication, media provenance, and deepfake detection.
- **Media Authentication** includes solutions that help prove integrity across the media lifecycle by watermarking, media verification markers, signatures, and chain-of-custody logging
- **Media provenance** includes providing information on media origin, either in the media itself or as metadata of the media.

- **Deepfake detection** includes solutions that leverage various detection techniques to determine whether target media has been manipulated or synthetically generated.
- **Increased public awareness and behavioral change in society:** Media literacy for consumers and journalists is the most effective tool to combat disinformation and deep fakes. Also, there is a need to take the responsibility to be a critical consumer of media on the Internet, think, and pause before sharing on social media.
- **Proper Regulation:** Effective regulations involving a discussion with the tech industry, civil society, academicians and policymakers can help to disincentivize the creation and distribution of malicious deep fakes.

Conclusion

In today's world of the internet and social media, infodemic and its associated problems of fake news and disinformation have become a major challenge for the internal as well as external security of nations. Deep fakes only add to these challenges. An important step, therefore, would be to increase public awareness of the possibilities and dangers of deep fakes. Informed citizens will act as a strong defense against misinformation and a national security threat.

12 Pulse oximetry and importance of oxygen

Context:

In this second wave of COVID-19 pandemic pulse oximeters have become a daily household item and regrettably hypoxia has become the leading cause of death.

Background

- The Karnataka's Covid Technical Advisory Committee has recommended that government provide medical kits for all patients in home isolation which must include pulse oximeters along with other drugs.
- This device measures SpO2 of blood working on the principle of pulse oximetry and falling oxygen saturation level is a signal of hypoxia.

Analysis

■ What is pulse oximetry?

Pulse oximetry is a non-invasive method for monitoring a person's oxygen saturation in blood. There are two types of pulse oximetry- transmissive and reflectance.

■ What is transmissive pulse oximetry?

- A sensor is placed on a thin part of the patient's body, usually a fingertip or earlobe, or an infant's foot from which EM radiation can pass easily.
- Fingertips and earlobes have higher blood flow rates than other tissues, which facilitates heat transfer, thus giving accurate reading.
- The device will pass two different wavelengths of light through the body part to the photodetector.
- It measures the change in absorbance at each of the wavelengths, allowing it to determine the absorbances due to the "pulsing arterial blood" alone, excluding venous blood, skin, bone, muscle and fat and hence calculating the SpO_2.

■ What is reflectance pulse oximetry?

- ➤ It is a less popular alternative to transmissive pulse oximetry.
- ➤ This method does not require a thin section of the body and therefore it is well suited to a universal application such as the feet, forehead, and chest, but it also has some limitations.

Effects of Non-functional Haemoglobin on Oxygen Saturation Measurements

- ⊙ If the patient has a large amount of non-functional haemoglobin, the reading is not accurate.
- ⊙ Non-functional haemoglobin is defined as haemoglobin which is incapable of carrying oxygen, but does include carboxyhaemoglobin (HbCO) and methaemoglobin (METHb).
- ⊙ Functional haemoglobin is defined as haemoglobin capable of carrying oxygen.
- ⊙ It includes oxygenated haemoglobin (HbO_2) and deoxygenated haemoglobin (Hb).

Common issues with pulse oximetry

- ⊙ **Light Interference**
  - ➤ Sometimes external light sources may cause inaccurate readings when they interfere with the light (radiation) with different wavelengths.
- ⊙ **Movement Artifacts**
  - ➤ Movement artifacts, such as shivering, have been overcome with the latest SpO2 algorithms. However, unusually rapid and vigorous movement may cause movement artifact in the pulse.
- ⊙ **Sensor application**
  - ➤ The sensor should fit the application site snugly. If the sensor is too tight, it might cause venous pulsation. If the sensor is too loose, the light emitting from the emitters may not pass completely through the site and may cause absurd readings. If adhesive sensors are not of the right size, the emitter and detector may not line up correctly.
- ⊙ **Inadequate Blood Flow**
  - ➤ Blood pressure cuffs, tight clothing or restraints may interfere with blood flow. Use another application site or loosen clothing.
- ⊙ **Nail Polish**
  - ➤ Some nail polish and false fingernails may cause false readings. If possible, switch to an unpolished nail, or consider another application site.

Why is oxygen important for body?

- ⊙ **Fuel for cells:** Oxygen is fuel for our cells and helps provide the basic building constituents that our bodies need to survive. The cells in our body combine oxygen with hydrogen and nitrogen to produce various proteins that build new cells/tissues. When oxygen is combined with hydrogen and carbon, we get carbohydrates that provide energy to our bodies that is necessary for our survival.
- ⊙ **Constructing replacement cells**: Oxygen is also a vital element for constructing replacement cells for our bodies. Each day, about 700 billion cells in our bodies wear out and must be replaced, without oxygen our bodies cannot build these new cells.
- ⊙ **Immune system:** Oxygen is also an important part of our immune system. It is used to help kill bacteria, and it fuels the cells that make up our body's defences against viruses and other invaders. Air that has passed through (UV air sanitizers) is particularly good for our body's immune system, as it has been cleansed of bacteria and other agents before it enters our respiratory systems.

- Finally, it is important to note that the human eye is in particular need of oxygen to function well. However, the eye receives oxygen in a manner that is unique from the rest of the body. Few blood vessels travel to the eye, so our eyes absorb much of the oxygen they need directly through the cornea. The cornea is built in such a way to diffuse oxygen directly into the body from the air.

Conclusion

Pulse oximetry results may not be as accurate for people with darker skin. Their oxygen levels are sometimes reported as higher than they really are. This possibility should be considered when interpreting pulse oximetry results. A person's oxygen levels may be low if they feel short of breath, are breathing faster than usual, or feel too sick to do their usual daily activities, even if a pulse oximeter says their oxygen levels are normal. Supplementaloxygen or other treatments may be needed if they have shortness of breath or their SpO2 number is less than 95%.

13 Geopolitics of outer space

Context:

It is in the interest of India's new strategies in outer space and also about the urgency of drafting new rules for the road to peace and stability in the atmosphere.

Space Geo-strategy

- The US traditionally held a foreign position in the commercial sector. Its military rivalry with Russia set a precedent in the security sector.
- The emergence of China as a major space force - both socially and militarily - reshapes astro politics.
- Significant expansion of China's spatial capabilities and China's desire for foreign domination has provided a new urgency for democratic powers to come together to protect their national interests and promote sustainable order in the upper atmosphere.

Importance for India

- Space has emerged as the fourth possible arm of the country's defense.
- With the US, Russia and China already seeking to become a Space Force, India will need to be properly equipped to deal with emerging security challenges.
- Space power has the power to use space while denying reliable use to any enemy.
- India already has a significant ability to use space. But it is the ability to deny the use of space to the opponent, understandably, is a small thing.
- Speaking of satellites, India has active satellite military satellites, compared to more than 40 civilians. Our first military satellite was launched in 2013 only.
- However, India has made some progress in the pursuit of space power.
- The newly commissioned Mission Shakti demonstrated India's ability to identify enemy satellites.
- The newly formed DSA (space defense agency) will be supported by the Defense Space Research Organization (DSRO) with the mandate to develop weapons to "degrade, disrupt, destroy or defraud an opponent's space".

Issues associated with Outdoor Space Geopolitics

- **Space naming:** The war and the equipping of space are in stark contrast to the constructive commercial and scientific projects. Space warfare will undermine the internal trust and cooperation needed to maintain systems deployed in space for the purpose of peace.
- Despite these realities, military development and space warfare projects in the air have been on the rise for the purpose of one country.
- **Atmospheric Disposal:** Satellite-destroyed satellites disperse into smaller pieces, then add to space debris. Freeway floating debris is a potential hazard to active satellites and collisions with them can leave satellites inactive.
- As countries introduce more and more satellites, each of which is a strategic or commercial asset, avoiding collisions could be a challenge in the future.
- **Demand for Space Mines:** This demand for space mines will create a new era of conflict and cooperation and lead to a new space race.
- According to the US Chamber of Commerce, the trade space industry is estimated to be USD 1.5 trillion by 2040.
- **Moon Rush:** After the discovery of the water on the moon and the "Peaks of Eternal Light", the moon is moving faster towards the southern moon, it is a new phenomenon. For example: China's Chang'e 4 has softened down the Von Karman crater on the dark side of the southern polar region.
- The American lunar system now aims to bring man back to the moon for the next ten years.
- NASA's focus is on the southern poles and, if successful, will be the first personnel to reach the South Pole.
- Jeff Bezos (owner of Amazon) has launched a Blue Moon project that seeks to house men and women on the moon over the next few years.
- Atmospheric Awareness (SSA) involves monitoring the movement of all objects - natural (meteorites) and man-made satellites - and tracking the weather.
- Today, space is important in our lives and disruptions to space-based communications and world views will have negative consequences.
- **Spatial Awareness (SSA):** There are tens of thousands of objects in Earth orbit that could be harmful to satellites and presentations. Spatial Awareness (SSA) refers to keeping track of things in their path and predicting where they will be at any given time.

Possibility of India's Outer Space Destiny

- India, which has developed significant spatial skills for decades, is a highly invested group. The US realizes it can no longer unilaterally define space order and seeks partners.
- The India-US joint statement issued in Washington highlighted the graduation plans, "A Space Memorandum of Understanding that will assist in the sharing of information and services in ensuring the long-term sustainability of space operations by the end of the year".
- International cooperation on climate awareness is similar to maritime awareness agreements - which allow for the distribution of information across maritime metrics.
- The new space mission team set up by Quad will identify new opportunities for collaboration and share satellite information for peaceful purposes such as monitoring climate change, disaster preparedness and preparedness, sustainable use of seas and marine resources, and addressing shared domain challenges.
- Quad leaders also promised to "consult on the rules, procedures, guidelines and guidelines for ensuring the sustainable use of space."

Way Forward

- **Public-Private Partnerships:** India needs to structurally regulate the regulatory, commercial and scientific aspects of the space program.
- Funding for Space Research and development should be expanded and independent research institutes should be encouraged to work together.
- There is a need to establish an independent regulator to control ISRO and new border operators in the same field.
- **Need for a Strong Regulatory Framework:** Delhi must also enact a strong regulatory framework to promote India's local work and protect its international interests.
- India should take into account the challenges that arise in the current space order, review some of its past political ideas about the external environment and participate in the development of new global systems that will strengthen the context of the Space Agreement.

  In order to effectively protect our spacecraft, India must have a reliable and accurate track record of celestial objects, from debris and spacecraft to celestial bodies.
- As precise tracking forms the basis for almost all unimaginable objects in space, therefore, this most important skill must be developed traditionally.
- For space defense to be effective, India must acquire minimum, reliable capabilities for a wide range of space, physical, technological and cyber weapons.

Conclusion

The scale of the challenges and opportunities in the outer space, however, requires urgent and very sweeping changes. That can only be justified by the highest political level. Back in 2015, the speech of the Prime Minister in the Indian Ocean focused on national attention in maritime affairs. India can do the same with space interventions today.

14 Launch of ISpA

Context:

Recently, the Prime Minister launched the Indian Space Association (ISpA) – mooted to be the premier industry association of space and satellite companies.

Analysis

What is it?

- Indian Space Association (ISpA) is an industry body consisting of various stakeholders of the Indian space domain.
- ISpA will be represented by leading domestic and global corporations that have advanced capabilities in space and satellite technologies.
- Indian Space Association would help in facilitating the collaboration between private and public players and would lead to India's space mission growing in an organised way.

- The association will engage with stakeholders across the ecosystem for the formulation of an enabling policy framework that fulfils the Government's vision.
- ISpA will also work towards building global linkages for the Indian space industry to bring in critical technology and investments into the country to create more high skill jobs.

Stakeholders of ISpA

The members of the organisation include government bodies such as Indian Space Research Organisation (ISRO) and private telecom companies such as Bharti Airtel's One Web, Tata Group's Nelcom, L&T, MapMyIndia, and others.

What does ISpA aspire to achieve?

- ISpA aims to contribute towards the accelerated development of India's space industry and making the country a leading player in this segment. It aims to contribute to the Government of India's vision of making India Atmanirbhar and a global leader in the space arena, which is fast emerging as the next growth frontier for mankind.
- The association will engage with stakeholders across the ecosystem for the formulation of an enabling policy framework that fulfils the Government's vision.
- ISpA will also work towards building global linkages for the Indian space industry to bring in critical technology and investments into the country to create more high skill jobs.

Why is a dedicated body like ISpA needed?

Though India too has made significant strides in space exploration over time, state-run ISRO has been at the centre and front of this progress. Several private sector companies, however, have shown an interest in India's space domain, with space-based communication networks coming to the fore. Of late, ISRO's rockets have been carrying the payload and communication satellites of various countries; now, private players will also look to broach this space with the new organisation.

Significance of ISpA

- Globally, private enterprises like SpaceX are increasingly contributing to unlocking the possibilities of space.
- It will emerge as a forum of the space industry in the Indian private sector and partner the Government of India and other key stakeholders across space industry segments in making the nation self-reliant in the area as well as to become a global service provider.
- ISpA could help develop the capacity to design, build and launch larger satellites for clients all around the world. This would happen more efficiently if there were multiple players competing and pitching in to research this.
- Satellite-based internet services could also take broadband access to remote areas, which are difficult to link through terrestrial networks. This is hugely important for the "Digital India" concept to work evenly across the nation.
- The progress of the space sector can help people in their daily lives, through better imaging, mapping and connectivity facilities.
- Apart from this, farmers can take advantage of forecast technologies in order to better protect the ecology from any impending adversities, while entrepreneurs can harness the space sector to quicken the speed of operations from shipment to deliveries.

15 PM releases First non-GM Herbicide-Tolerant Rice Varieties

Context:

To counter the twin challenges of climate change and malnutrition, PM Narendra Modi launched 35 new indigenously-developed crop varieties developed by ICAR. The one that is making it into the news is the country's first-ever non-GM (genetically modified) herbicide-tolerant rice varieties.

About New Varieties of Rice:

- It is the country's first-ever non-GM (genetically modified) herbicide-tolerant rice varieties **(Pusa Basmati 1979** and **Pusa Basmati 1985)** that have been developed by the Indian Agricultural Research Institute (IARI).
- These varieties have been developed by crossing over **Pusa 1121** & **Pusa 1509** with **Robin** (It is a drought-tolerant, heat-tolerant and deep-rooted variety derived from **Nagina 22**.)
- Instead of going GM techniques, ICMR has developed it through mutation breeding. This ensures that no foreign genes are in the new varieties.
- Both the newly developed varieties contain a **mutated acetolactate synthase (ALS) gene**, which enables farmers to spray **Imazethapyr**, which is a cheaper and broad-spectrum herbicide, to control weeds.

Mechanism of its herbicide-tolerance:

- Imazethapyr is used by the farmers to remove broadleaf, grassy and sedge weeds. But it cannot be used on normal rice varieties as it is the incapability to distinguish between weeds and crops, and it might kill the paddy crop itself.
- But the newly developed variety has **mutated acetolactate synthase (ALS) gene,** the herbicide, in this case, do not bind with the enzyme that this mutated gene produces which inhibits the production of amino acids and hence saves the paddy crop, as the plant continues to grow and only the weed gets killed. This mechanism is known as **herbicide tolerance through mutation breeding.**
- There is no foreign gene is involved in the whole process. The plant can now "tolerate" the application of herbicide and selective action of herbicide can be made possible.

Efficient use of water and reduction in labour:

- As the newly developed varieties can be directly seeded, it can save the labour and water input to a great extent as compared to conventional transplanting varieties.
- This is made possible because, in the new varieties, the application of herbicides like Imazethapyr is possible, which eradicate a wide range of weeds.
- In conventional transplanting varieties, the direct application of herbicides is not possible as it cannot distinguish between the rice plants and the weeds. This is one of the primary reasons why paddy seeds are first grown as young plants before planting in the fields.
- Standing water in the nursery provides a natural barrier towards eliminating weeds. But this process is both water and labour intensive as the young seedling is supposed to be maintained in standing water up to a depth of 5 cm for about 25-35 days.
- IARI has stated that the new varieties are herbicide-tolerant and the chemical application will only target weeds, thereby allowing farmers to sow paddy directly just like any other crop.

Direct Seeding Techniques (DSR) requires 30 per cent less water for cultivation, saves up to Rs 3,000 per acre in transplantation in labour charges and about 10 to 15 days in cultivation as it doesn't need to prepare a nursery.

Why this is better than GM herbicide-resistant rice?

- Herbicide-resistant (GM) varieties of rice do have the potential to improve the efficiency of weed management but it also comes with risks.
- There is a risk of potential transfer of genes from Herbicide-resistant varieties to their wild relative. This can result in hybrid varieties of its wild and weedy relative.
- The chance of such occurrences is higher in India because the flowering times of cultivated rice and its wild relatives overlap.
- Such a gene can result in loss of native biodiversity and impact crop invasiveness.
- Herbicide-resistant (GM) varieties of rice may contribute to the problems of crop volunteers and the evolution of herbicide resistance.
- It gives us a cheaper option, as Imazethapyr (herbicide) can be used as a pesticide which is cheaper than **Pendimethalin and Bispyribac-sodium.**
- Not only Imazethapyr has a wider range of weed control, but it is also much safer because the **mutated ALS gene** in the two newly developed varieties is not present in humans or animals.

- **Pre-emergent herbicides:** These are chemicals applied before germination. It can also be applied immediately after sowing using ordinary seed drills. E.g.: pendimethalin.
- **Post-emergent herbicides:** these chemicals are sprayed 20-25 days after the sowing of the seeds. E.g.: Bispyribac-sodium, Fenoxaprop-p-ethyl, etc.

Some Facts about Rice:

- It is mainly a tropical crop and a hot and humid climate is most suitable.
- It requires an average temperature of 20°C to 35°C and annual rainfall of 150 cm.
- Rice is a Kharif crop in India that is sown during the southwest monsoon. The sowing time of rice is June-July and it is harvested in the months of November-December.
- It requires well-drained fertile loamy and clayey loamy soil. Ganga-Sutlej plains and the black soil region of the Deccan are the most suited types for its cultivation.

16 National Policy for Rare Diseases (NPRD) 2021

Context:

The World Rare Disease Day takes place worldwide on the last day of February every year. The day aims to improve knowledge amongst the general public of rare diseases while encouraging researchers and decision-makers to address the needs of those living with rare diseases.

What are rare diseases?

- Rare diseases, as the name suggests, are health conditions that have a very low prevalence.

- Any disease that affects a small percentage of the population is a rare disease.
- In many parts of the world, they also go by the term 'orphan disease', for the lack of a market large enough to capture the support and resources needed to develop treatments for them.
- Most rare diseases are genetic, and present throughout a person's lifetime, even if symptoms do not immediately appear.
- Many rare diseases appear early on in life, and about 30 percent of children with rare diseases will die before reaching their fifth birthday.
- At first glance, it might seem to be a marginal issue that affects a handful of people, but there are more than 7,000 diagnosed rare diseases in the world and over 350 million individuals suffer from them, with nearly one-fifth in India.

- The WHO defines rare disease as a debilitating lifelong disease or disorder condition with a prevalence of 1 or less per 1000 population.
- United States: In the United States, a rare disease is defined as a condition that affects fewer than 200,000 people in the US.
- European Union: In the European Union, a disease is defined as rare when it affects fewer than 1 in 2,000 people.

Key-figures

- Over 350 million people are living with one or more of over 7,000 identified rare diseases around the world.
- Rare diseases currently affect 3.5% - 5.9% of the worldwide population.
- 72% of rare diseases are genetic whilst others are the result of infections (bacterial or viral), allergies, and environmental causes, or are degenerative and proliferative.
- 70% of those genetic rare diseases start in childhood.

Rare Disease Day

- **Rare Disease Day** was first celebrated in 2008 on 29th February, a Leap day that comes once in four years.
- Since then, the occasion has been observed on the last day of February, a month with fewer days than others, to build awareness.
- The main objective of Rare Disease Day is to **raise awareness** amongst the general public and decision-makers about **rare diseases and their impact on patients' lives**.

What causes rare diseases?

- There are many different causes of rare diseases. The majority are thought to be genetic, directly caused by changes in genes or chromosomes.
- **Hereditary:** In some cases, genetic changes that cause disease are passed from one generation to the next.
- **Acquired:** In other cases, they occur randomly in a person who is the first in a family to be diagnosed. Many rare diseases, including infections, some rare cancers, and some autoimmune diseases, are not inherited.
- While researchers are learning more each year, the exact cause of many rare diseases is still unknown.

What are the most common rare diseases?

- Hemangiomas (blood vessels forming a birthmark)
- Lupus (an inflammatory disease)

- Cystic fibrosis (a genetic disorder affecting lungs and the digestive system)
- Hirschsprung disease (blockage of the large intestine)
- Muscular dystrophies (progressive weakness and degeneration of the muscles)
- **Other common rare disease** includes sickle cell anaemia, primary immunodeficiency in children, autoimmune disease.
- About 80% of all rare diseases are genetic in origin, most of them monogenic.

Where does India stand in terms of its efforts?

- With its sizeable population, India has an increased frequency of rare diseases when compared to the rest of the world.
- In January this year, the Delhi High Court directed the Union Government to finalize and operationalize the new **National Health Policy for Rare Diseases** by 31 March 2021.

National Policy for Rare Diseases 2020

- The Ministry of Health and Family Welfare had published a draft of **the National Policy for Rare Diseases 2020** for stakeholder inputs, after the Delhi High Court judgments on cases filed by families of rare disease patients in 2016.
- The policy embraces a minimalist approach and maintains that **healthcare is a State subject.**
- Parallel to the preparation of the draft policy, the Indian Council of Medical Research (ICMR) announced the launch of a national registry, which aimed to cover a set of rare and ultra-rare disorders that are prevalent in India, in 2017.
- The process of nation-wide data collection is yet to take off and there is little publicly available data to inform decision-making.

Where does India lack?

- India does not have a definition for rare diseases.
- Rare diseases are not covered under the **Rights of Persons with Disabilities Act.**
- There is no law that recognizes medical disability, depriving patients of all facilities and benefits.
- This year's budget made no new allocation for such a plan.
- Only 450 of the 8,000 known rare diseases in the world are recognized in India, an anomaly that underscores a mounting health crisis in which many patients go without being diagnosed accurately or treated on time.

Measures were taken by foreign countries

- The **Orphan Drugs Act (ODA) of 1983** in the United States marked the most significant milestone in shaping rare disease policies around the world.
- ODA offers significant tax and other incentives to companies investing in the research and development of treatments for rare diseases.
- Several European countries, Japan and others have adopted policies over the last 35 years - but the adoption has been far and few in some of the most populous countries such as China and India.

Challenges/Issues

- Lack of awareness among the medical fraternity
- Lack of dedicated healthcare policies, schemes, and diagnostic facilities

- Absence of counseling or even just a database of rare diseases
- **Lack of efforts:** Despite the large number of patients suffering from rare diseases, efforts to properly diagnose and treat these conditions have been lagging.
- **Limited help:** Due to the low prevalence of individual diseases, medical expertise is rare, knowledge is scarce, care offerings inadequate, and research limited.
- **Denied treatment:** Despite the large overall estimate, patients with a rare disease are the orphans of health systems, often denied diagnosis, treatment, and the benefits of research.
- **Expensive treatments:** The unavailability and high cost of treatment remain one of the biggest obstacles.

What measures are required?

- **Sufficient information regarding the disease**
- **Effective policy formulation**
- **Collaborative approach**

17 Liberalisation of the geospatial sector in India

Context:

In a positive development, the Ministry of Science and Technology released new guidelines for the 'Geospatial sector' in India, which deregulates existing protocol and liberalizes the sector to a more competitive field.

What is geospatial data?

- Geospatial data is data about objects, events, or phenomena that have a **location on the surface of the earth.**
  - The location may be static, or dynamic-
  - **static** like the location of a road, an earthquake event, malnutrition among children
- **dynamic** like a moving vehicle or pedestrian, the spread of an infectious disease
- Geospatial data generally combines location information, attribute information (the characteristics of the object, event, or phenomena concerned), and sometimes temporal information or the time at which the location and attributes exist.
- Geo-spatial data involves both information of public interest such as roads, localities, rail lines, water bodies, and public amenities. It also provides information regarding security interest like location of critical infrastructure, military base, deployed weapons etc.

Where geospatial data is used?

- While for decades, geospatial data has been a priority for strategic reasons and internal and external security concerns, this priority has seen a shift in the past 15 years.
- Geospatial data has now become imperative for the government in planning for infrastructure, development, social development, natural calamities as well as the economy.
- Today, more sectors such as agriculture, environment protection, power, water, transportation, communication, health (tracking of diseases, patients, hospitals, etc) relies heavily on this data.

PM Swamitva Yojana

- PM Swamitva Yojana is a shining example of the use of geospatial data to empower the country's rural population.
- The Swamitva scheme helps to map rural inhabited lands using drones and the latest survey methods.
- It aims to ensure streamlined planning, revenue collection and provide clarity over property rights in rural areas.

Government monopoly in the sector

- Mapping was till now remained a government preserve, handled by the Central government's **Survey of India.**
- Private companies needed to navigate a system of permissions from different departments of the government (depending on the kind of data to be created) as well as the defense and Home Ministries, to be able to collect, create or disseminate geospatial data.
- Initially conceptualized as a matter solely concerned with security, geo-spatial data collection was the prerogative of the defense forces and the government's law enforcement agencies.
- GIS mapping was also rudimentary, with the government investing heavily in it after the Kargil war highlighted the dependence on foreign data and the need for indigenous sources of data.

Survey of India

- Survey of India, the **National Survey and Mapping Organization** of the country under the **Department of Science & Technology**, is the oldest scientific department of the Government of India.
- It was set up in **1767.**
- In its assigned role as the nation's Principal Mapping Agency, Survey of India bears a special responsibility to ensure that the country's domain is explored and mapped suitably, provide base maps for expeditious and integrated development and ensure that all resources contribute with their full measure to the progress, prosperity, and security of our country now and for generations to come.

What are the new guidelines?

- The new guidelines will apply to geospatial data, maps, products, solutions, and services offered by government agencies, autonomous bodies, academic and research institutions, private organizations, non-governmental organizations, and individuals.
- There shall be no requirement for prior approval, security clearance, license, or any other restrictions on the collection, generation, preparation, dissemination, storage, publication, updating, and/or digitization of geospatial data and maps within the territory of India.
- Individuals, companies, organizations, and government agencies, shall be free to process the acquired geospatial data, build applications and develop solutions in relation to such data and use such data products, applications, solutions, etc by way of selling, distributing, sharing, swapping, disseminating, publishing, deprecating and destructing.
- Self-certification will be used to convey adherence to these guidelines.
- There will also be a negative list of sensitive attributes that would require regulation before anyone can acquire and/or use such attribute data.

Which areas will be exempted?

- The guideline is not for access, but only for surveying.

- There is a restriction on revealing the attributes or features of sensitive areas even though there would be none on surveying the area itself.
- There will be exceptions to sensitive defense or security-related data.

What was the need for deregulation?

- This system of acquiring licenses or permission, and the red tape involved, can take months, delaying projects, especially those that are in mission mode – for both Indian companies as well as government agencies.
- There is also a huge lack of data in the country which impedes planning for infrastructure, development, and businesses that are data-based.
- The mapping of the entire country that too with high accuracy, by the Indian government alone could take decades.
- The government, therefore, felt an urgent need to incentivize the geospatial sector for Indian companies and increased investment from private players in the sector.

What will be its impacts?

- Liberalization of the system will ensure:
  - more players in the field
  - competitiveness of Indian companies in the global market
  - more accurate data available to both the government and individual Indian to formulate plans and administer
- **Employment generation**: With this policy, the private sector would be able to bring innovation in this sector and produce more solutions based on it, resulting in an increase in employment in the geospatial sector, while also pushing forth the economic growth.
- Indian companies will be able to develop indigenous apps, for example, an Indian version of google.
- **Increase in Public-private partnership:** There is also likely to be an increase in public-private partnerships with the opening of this sector with data collection companies working with the Indian government on various sectoral projects.
- **Domestic innovation:** At the moment, India relies heavily on foreign resources for mapping technologies and services. The liberalization of the mapping industry and democratization of existing data sets will spur domestic innovation and enable Indian companies to compete in the global mapping ecosystem by leveraging modern geospatial technologies.
- **Economic development:** The government also expects an increase in investment in the geospatial sector by companies, and also an increase in the export of data to foreign companies and countries, which in turn will boost the economy.

18 e-Technology to the aid of farmer

Context:

Tech firm Microsoft will run a pilot for the agriculture ministry's AgriStack in 100 villages in six Indian states to "develop farmer interface for smart and well-organised agriculture" aimed at improving efficiency and reducing waste.

What is Agristack?

- The Agristack digital infrastructure will collect details of farmers and their landholdings, what crops they cultivate, the climatic factors at play in specific geographies, and average output, before linking these details to farmers' individual Aadhaar biometric IDs.
- The database will ally a farmer's Aadhaar ID with the location of his/her farm holdings while also accounting for their location, size and dimensions towards determining the level of output that can be expected, and the amount of income that can be derived.
- This data may be available with local governing bodies like Panchayats while GPS technology can be used to further corroborate government data.
- The database will also need to include information relating to the type and quantity of crops being grown.
- Data relating to cropping patterns will be crucial in informing agribusinesses so they can customise packages to individual farmer needs.
- Again, satellite imagery can be used to accrue this data along with records from local government bodies.
- The Agristack innovation has the potential to significantly drive down lag times between farmers, intermediaries and businesses.

Significance of digitalization of agriculture

- Digital technologies including the Internet, mobile technologies and devices, data analytics, artificial intelligence, digitally-delivered services and apps—are changing agriculture and the food system.
- Examples abound at different stages of the agri-food value chain: farm machinery automation allows fine-tuning of inputs and reduces demand for manual labour; remote satellite data and in-situ sensors improve the accuracy and reduce the cost of monitoring crop growth and quality of land or water; and traceability technologies and digital logistics services offer the potential to streamline agri-food supply chains, while also providing trusted information for consumers.
- Digital technologies can also help governments improve the efficiency and effectiveness of existing policies and programmes, and to design better ones. For instance, freely available and high-quality satellite imagery dramatically reduces the cost of monitoring many agricultural activities.
- This could allow governments to move towards more targeted policies which pay (or penalise) farmers based on observed environmental outcomes. In addition to monitoring compliance with environmental policies, digital technologies enable automation of administrative processes for agriculture and the development of expanded government services, such as in relation to extension or advisory services.
- Finally, digital technologies can support trade in agriculture and food products, by connecting private sector suppliers to new markets, and enabling new ways for governments to monitor and ensure compliance with standards and to provide faster and more efficient border procedures that are essential for perishable products.

Digital technologies in agriculture

- **Internet of Things (IoT):** world agricultural the disrupting unstructured and structured data to provide insights into food production.
- **Data driven farming:** by analyzing and correlating information about weather, types of seeds, soil quality, probability of diseases, historical data etc farmers will make more informed decision
- **Chatbots:** AI powered chatbots can also be leveraged by agriculture sector.

Challenges for digitalization of agriculture

- For policymakers, the challenge will be to shape policy and regulatory settings so that they facilitate opportunities offered by digital technologies.
- At the same time, and not unique to the agriculture sector, digital technologies raise questions about privacy, interoperability, and even potential liability issues, all of which will need careful consideration.
- Reaping the benefits of digital technologies in agriculture requires the participation and co-operation of farmers, researchers, private sector, non-profits and government.

What can governments do to reap the benefits of digital technologies for the agriculture sector?

- Policymakers will need to consider potential benefits, costs and risks, and to understand the factors affecting technology uptake so that interventions can be targeted to where there is a market failure, or a public interest.
- This requires understanding how technology can help in different components of the policy cycle, and may require government bodies to expand their skillsets, invest in technology and training, or partner with other actors (both government and non-government).
- Digital technologies may create new roles or responsibilities for governments, including to enable the digital infrastructure (is there a case for governments to be a provider or a rule maker of new digital infrastructure, and under what circumstances); but on the other hand, if technology can reduce information asymmetries and transactions costs, less government intervention may be needed.

19 ISRO to handle projects of national security

Context:

The India Space Research Organisation (ISRO) would be in charge of projects linked to "national security and advanced technology" — like the forthcoming Chandrayaan 2 missions and the Gaganyaan mission. However, the bulk of commercial activities would increasingly be handled by the newly formed New Space India Limited.

Chandrayaan 2 and Gaganyaan Mission

- Chandrayaan-2 mission brought together an Orbiter, Lander and Rover with the goal of exploring South Pole of the Moon.
- This mission aimed at studying not just one area of the Moon but all the areas combining the exosphere, the surface as well as the sub-surface of the moon in a single mission.
- However the landing was not successful, thus only its obiter is functional.
- Gaganyaan will be first human space mission by ISRO.

NSIL

- **New Space India Limited (NSIL)** is a wholly-owned Government of India Company, under the administrative control of Department of Space (DOS).
- It is commercial arm of ISRO

- Mandates of NSIL are as follows:
  - Owning satellites for Earth Observation and Communication applications and providing space based services
  - Building satellites and launching them as per demand
  - Providing Launch Services for satellite belonging to customer
  - Building launch vehicles through Indian Industry and Launch as per satellite customer requirement
  - Space based Services related to Earth Observation and Communication satellites on commercial basis
  - Satellite building through Indian Industry
  - Technology Transfer to Indian Industry
  - Marketing spin-off technologies and products/ services emanating out of ISRO's activities.

IN-SPACe

- Indian National Space Promotion and Authorization Center (IN-SPACe) is the nodal agency for allowing space activities and usage of DOS owned facilities by Non Government Private Entities (NGPEs).
- It will act as a link between the ISRO and private sector companies, assessing how best to utilise India's space resources and increase space-based activities.
- It will evaluate demands of private sector companies—including educational institutes—and will find ways to attune their demands, in consultation with ISRO
- It will work out a suitable mechanism for promotion & hand holding, sharing of technology and expertise to encourage participation of NGPEs in space activities

20 India to Launch Deep Sea Mission

Context:

India will soon launch an ambitious ''Deep Ocean Mission'' that envisages exploration of minerals, energy and marine diversity of the underwater world, a vast part of which still remains unexplored.

About

- The mission, which is expected to cost over Rs 4,000 crore, will give a boost to efforts to explore India's vast Exclusive Economic Zone and Continental Shelf.
- The mission will also involve developing technologies for different deep ocean initiatives.
- The multi-disciplinary work will be piloted by the MoES and other government departments like the Defence Research and Development Organisation, Department of Biotechnology, Indian Space Research Organisation (ISRO), Council for Scientific and Industrial Research (CSIR) will be stakeholders in this mission.
- Some of the technologies involved will be developed by organisations such as the ISRO and DRDO.

Exploration of Indian Ocean

- India has been ear-marked nearly 1.5 lakh square kilometres of area in the central Indian Ocean for exploration.
- In September 2016, India signed a 15-year contract with the International Seabed Authority (ISA) for exploration of **Poly-Metallic Sulphides (PMS)** in the Indian Ocean.

Poly-Metallic Sulphides (PMS)

- Poly-Metallic Sulphides (PMS), which contain iron, copper, zinc, silver, gold, platinum in variable constitutions, are precipitates of hot fluids from upwelling hot magma from deep interior of the oceanic crust, discharged through mineralized chimneys.
- PMS in the Ocean Ridges have attracted worldwide attention for their long term commercial as well as strategic values.

- The 15-year contract formalised India's exclusive rights for exploration of PMS in the allotted area in the Indian Ocean.
- The ISA earlier approved 10,000 sq. km for India with a 15-year PMS exploration plan along the Central Indian Ridge (CIR) and Southwest Indian Ridge (SWIR) region of the Indian Ocean.
- The ISA is an institution set up under the Convention on Law of the Sea to which India is a Party.

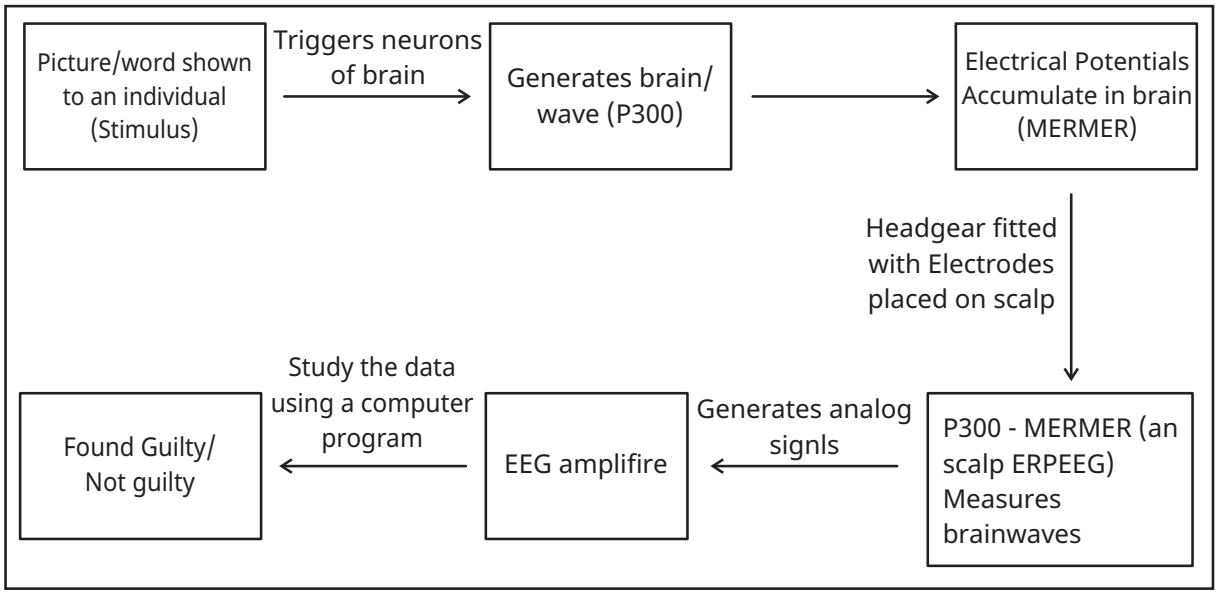
21 Brain Fingerprinting technology

Context:

The four accused in the Hathras gang rape case will undergo brain fingerprinting, the neuropsychological interrogation.

What is Brain Fingerprinting?

- In brain fingerprinting, a headset with two electrodes is put on the head of the suspect. One electrode is placed on the forehead between the eyebrows while the other is put on the back of the head where the brain stores experiential memory.
- The electrodes are connected to a laptop with brain fingerprinting software via Bluetooth.
- Details and photographs of the crime scene which are not in public domain are projected on the screen in front of the suspect.
- If the suspect is involved in the crime the moment he sees the details, his brain recognises the picture and sends a specific, measurable brain response known as a P300 to the software.
- This movement is called P 300 MERMER ("Memory and Encoding Related Multifaceted Electroencephalographic Response"), which is captured on the computer.
- The P300 is not the only brainwave used by brain fingerprinting technologies.
- In 1997, Indian neuroscientist Champadi Raman Mukundan developed a different technique called the Brain Electrical Oscillatory Signature (Beos) test, which measures the recall of memory through a smorgasbord of subtle changes in brain activity data.



What is the BEOSP test?

- According to the National Center for Biotechnology Information (NCBI), the BEOSP (or the BEOS) is an electroencephalogram (EEG) technique by which a suspect's participation in a crime is detected by eliciting electrophysiological impulses.
- The technique, also referred to as 'brain fingerprinting', has been categorised as "non-invasive" and a legitimate neuro-psychological method of interrogation.
- The methodology was developed by CR Mukundan, a neuroscientist at the National Institute of Mental Health and Neurosciences at Bangalore.

Other important tests

- These tests, which are often used as aid during investigations by probe agencies, are different from each other, but are all aimed at collecting vital information.
- **Narco-analysis** is a controlled administration of intravenous hypnotic medications called truth drugs on a suspect to procure vital information.
- A **polygraph**, popularly referred to as a lie detector, is an instrument that measures and records several physiological indices such as blood pressure, pulse, respiration and breathing rhythms and skin conductivity while a suspect is asked a series of questions.
- Deceptive answers are said to produce physiological responses that can be differentiated from those associated with non-deceptive answers.

Application of the technique

- Brain fingerprinting can help in addressing the following critical elements in the fight against terrorism:
  - Aid in determining who has participated in terrorist acts, directly or indirectly.
  - Aid in identifying trained terrorists with the potential to commit future terrorist acts, even if they are in a "sleeper" cell and have not been active for years.
  - Help to identify people who have knowledge or training in banking, finance or communications and who are associated with terrorist teams and acts.
  - Help to determine if an individual is in a leadership role within a terrorist organization.

Is it admissible in Court?

- The results of the brain fingerprinting test may not be admissible in the Indian courts, but the technique helps investigative agencies find clues in complicated cases.

SC on Forensics

- In May 2010, the Supreme Court held that forcing suspects and witnesses to take these tests without their consent was unconstitutional and amounted to violation of their right to privacy.
- A three-judge bench had held that "the compulsory administration of the impugned techniques violates the right against self-incrimination."
- The court noted that the compulsory administration of the techniques violated "the right against self-incrimination ... unjustified intrusion into mental privacy, and amount[ed] to cruel, inhuman or degrading treatment".
- However, the Supreme Court did not question the relevance of the techniques themselves, and permitted their use if the accused consented to be tested.

How is it different from the 'lie detector' or the polygraph test?

- A BEOSP procedure ideally requires no question-answer session to be conducted during the test, as opposed to the polygraph "lie detector" test that maps physiological outputs of the individual in question - like perspiration, blood pressure, pulse rate, and pupil response.
- In the BEOSP test, the individual is simply presented with the crime events/scenarios, following which the subject's brain is analysed to verify if the encoded information is stored as experiential knowledge, which would mean that the subjects had experienced the sequence of events first-hand and not absorbed them as a secondary source during the recounting.
- This way, experts say, the results are more credible since it is difficult to tamper with neuroscientific mappings as opposed to physiological responses which can be controlled and even potentially be faked with enough training of the mind.

Does it violate human rights?

- Brain fingerprinting being a non invasive forensic technique uses electroencephalography (EEG) to determine whether information about the crime is stored in the subject's brain, it does not violate human rights as the suspect takes the test in the comfort of an air-conditioned room sitting in front of a computer where no third degree is ever necessary.
- Brain fingerprinting is a cool tool which can go a long way in enhancing police image by diminishing police brutality and torture during the investigation with a concomitant reduction in custodial deaths.
- Tamil Nadu is yet to acquire brain fingerprinting technology. States like Karnataka, Maharashtra, Gujarat etc. have installed brain fingerprinting technology for police investigation purposes.

What are the limitations of the technology?

- Brain fingerprinting detects information-processing brain responses that reveal what information is stored in the subject's brain. It does not detect how that information got there, be it a witness or a perpetrator.
- Brain fingerprinting detects only information, and not intent.
- Brain fingerprinting is not applicable for general screening.
- Brain fingerprinting does not detect lies. It simply detects information.
- Just as all witness testimony depends on the memory of the witness, brain fingerprinting depends on the memory of the subject.

- Like all forensic science techniques, brain fingerprinting depends on the evidence-gathering process which lies outside the realm of science to provide the evidence to be scientifically tested.
- Brain fingerprinting is not a substitute for effective investigation on the part of the investigator or for common sense and good judgment on the part of the judge and jury.

22 DNA Technology (Use and Application) Regulation Bill, 2019

Context:

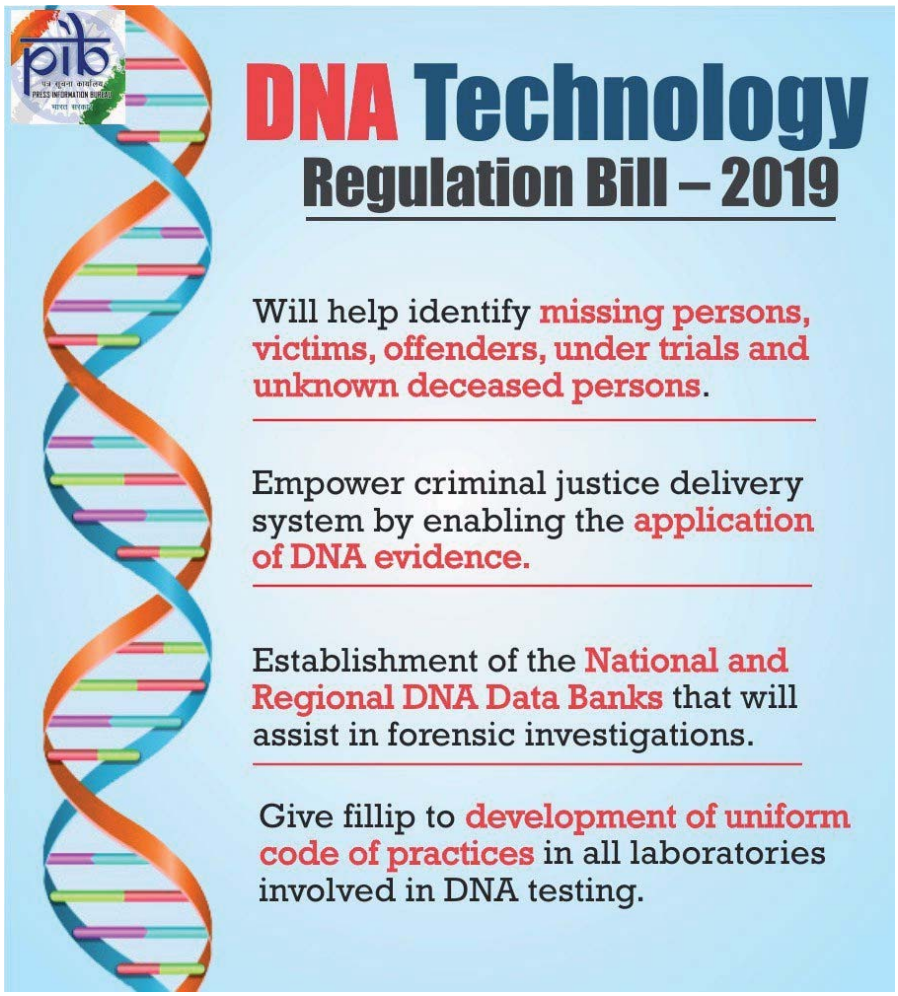
The law goes well beyond criminal matters and regulates civilian and medical use of DNA.

Features of the DNA Technology (Use and Application) Regulation Bill, 2019

The DNA Technology (Use and Application) Regulation Bill, 2019 provides for the regulation of use of DNA technology for establishing the identity of certain persons.

- **Use of DNA Data**: Under the Bill, DNA testing is allowed only in respect of matters listed in the Schedule to the Bill. These include offences under the Indian Penal Code, 1860, and for civil matters such as paternity suits. Further, the Schedule includes DNA testing for matters related to establishment of individual identity.
- **Collection of DNA**: While preparing a DNA profile, bodily substances of persons may be collected by the investigating authorities. Authorities are required to obtain consent for collection in certain situations. For arrested persons, authorities are required to obtain written consent if the offence carries a punishment of up to seven years.
  - If the offence carries more than seven years of imprisonment or death, consent is not required. Further, if the person is a victim, or relative of a missing person, or a minor or disabled person, the authorities are required to obtain the written consent of such victim, or relative, or parent or guardian of the minor or disabled person. If consent is not given in these cases, the authorities can approach a Magistrate who may order the taking of bodily substances of such persons.
- **DNA Data Bank:** The Bill provides for the establishment of a National DNA Data Bank and Regional DNA Data Banks, for every state, or two or more states. DNA laboratories are required to share DNA data prepared by them with the National and Regional DNA Data Banks. Every Data Bank will be required to maintain indices for the following categories of data: (i) a crime scene index, (ii) a suspects' or under trials' index, (iii) an offenders' index, (iv) a missing persons' index, and (v) an unknown deceased persons' index.
- **Removal of DNA profiles:** The Bill states that the criteria for entry, retention, or removal of the DNA profile will be specified by regulations. However, the Bill provides for removal of the DNA profiles of the following persons: (i) of a suspect if a police report is filed or court order given, (ii) of an undertrial if a court order is given, and (iii) on written request, for persons who are not a suspect, offender or under trial, from the crime scene or missing persons' index.
- **DNA Regulatory Board**: The Bill provides for the establishment of a DNA Regulatory Board, which will supervise the DNA Data Banks and DNA laboratories. The Secretary, Department of Biotechnology, will be the ex officio Chairperson of the Board. The Board will comprise additional members including: (i) experts in the field of biological sciences, and (ii) Director General of the National Investigation Agency and the Director of the Central Bureau of Investigation.

- **Functions of the Board:** The functions of the Board include: (i) advising governments on all issues related to establishing DNA laboratories or Data Banks, and (ii) granting accreditation to DNA laboratories. Further, the Board is required to ensure that all information relating to DNA profiles with the Data Banks, laboratories, and other persons are kept confidential.
- **Offences:** The Bill specifies penalties for various offences, including: (i) for disclosure of DNA information, or (ii) using DNA sample without authorization. For instance, disclosure of DNA information will be punishable with imprisonment of up to three years and fine of up to one lakh rupees.



Concerns regarding New DNA Bill

- In criminal cases, the law specifies the requirement of written consent before DNA samples are collected for testing from criminal suspects or under trials, offenders, victims of a crime, and missing or unidentified deceased persons.
- Once these samples are analysed by a DNA laboratory, they will be stored in a national DNA data bank under various categories depending on whether the DNA has been collected from a crime scene, suspects or offenders, or unidentified deceased persons. For such criminal cases, safeguards are specified on limiting access to the DNA data bank and conditions under which DNA information can be deleted.
- However, the new law goes well beyond criminal matters and regulates civilian and medical use of DNA. This is where major concerns arise and affect issues as diverse as parentage disputes, medical negligence, and any matter related to establishing an individual's identity. On these issues, the new law does not prescribe any safeguards.

- For example, the law does not require the consent of an individual while giving DNA samples in civil matters such as a paternity suit. The ethic behind the need for consent is that a person's bodily substances include DNA, which not only identifies the person, but also reveals her genetic information such as physical and medical traits. Such information may affect her privacy, and so consent offers a safeguard against DNA misuse.
- Or consider the provision related to the national DNA database that is being created under the law. As the name suggests, the database is a central repository of DNA information of individuals covered by the law. While the database will have information related to criminal offences, the law is unclear on whether DNA collected for civil cases will be stored in this database.
- This is because the law requires all DNA laboratories to share DNA test results with the data bank. Therefore, were a DNA laboratory to analyse a DNA sample in the course of a private dispute between parties (say, an in vitro fertilization clinic and a pregnant woman), would it share this information with the data bank?
- The Bill in question does not state that DNA information related to civil matters will not be stored in it. Note that the Combined DNA Index System (CODIS) in the US and the National Criminal Intelligence DNA Database in the UK are national DNA data banks with information related only to criminal investigations.
- Further, if DNA information related to civil matters is stored in the data bank, it may violate the fundamental right to privacy as laid down by the Supreme Court. The Court has stated that the right to privacy may be infringed only through the enactment of a law, and that law must achieve a public purpose that's proportionate to the infringement of privacy. Since the storage of DNA profiles for civil matters (such as paternity suits and medical diagnoses) may not serve a public purpose, it may violate the right to privacy.
- A more fundamental issue is ambiguity on whether the law intends to regulate DNA tests conducted in medical and diagnostic settings. For instance, many laboratories across the country offer such tests to determine a person's predisposition to cancer, diabetes and other diseases.

23 Space Security

Context:

- **While the terrestrial, maritime and aerial warfare are much talked about, it is outer space which is the new arena for competition and rivalry. It is important to focus on space security.**
- **In this regard, the British's recently proposed policy emphasizes a bottom-up approach and stresses trust-building. It's a critical first step.**

Background

- From Sputnik I to SpaceX Falcon, space as a frontier has come a long way.
- Until recent past, space was seen as an 'exclusive playground' of the superpowers.
- However, with growth in the number of spacefaring nations, continuous advancements in technological and operational capabilities, and the potential for space mining, the space domain is becoming more complex, congested, competitive and contested.
- More the players on this new playground, greater the competition for resources.
- Hence there is the greater need for common objectives, fair rules of the road, and shared decision-making processes.

- Therefore, it is desirable that the competitive space environment becomes simultaneously more collaborative.
- Now, the world needs new rules of the road.

Analysis

■ What are the current space regulations?

- Space law emerged soon after Sputnik 1 was launched into outer space in 1957.
- Several legally binding international instruments(treaties) governing the use of outer space for peaceful purposes have been adopted within the framework of the United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS), with the 1967 Outer Space Treaty (OST) at its core.

■ UNCOPUOS (1958):

- The UNCOPUOS was established in 1958 as an ad hoc committee of the UN (later made permanent in 1959) with UN Office for Outer Space Affairs (UNOOSA) as its secretariat.
- UNCOPUOS oversees the implementation of five UN treaties related to the outer space activities, namely,
  - Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies of 1967 (Outer Space Treaty)
  - Agreement on the Rescue of Astronauts
  - the Return of Astronauts and the Return of Objects Launched into Outer Space of 1968 (Rescue Agreement),
  - Convention on International Liability for Damage Caused by Space Objects of 1972 (Liability Convention),
  - Convention on Registration of Objects Launched into Outer Space of 1976 (Registration Convention)
  - the Agreement Governing the Activities of States on the Moon and Other Celestial Bodies of 1979 (Moon Treaty)
- It also oversees other related international agreements like the:
  - Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space, and Under Water (NTB) of 1963
  - the Brussels Convention Relating to the Distribution of Programme–Carrying Signals Transmitted by Satellite (BRS) of 1979

■ Outer Space Treaty

- The OST contains the basic rules that define the behaviour of States in conducting activities in outer space, and has resulted in more than sixty years of peaceful cooperation in space that benefits humankind as a whole.
- The Treaty declares outer space **"the province of mankind".**
- This means that its exploration and use shall benefit all countries, be without discrimination, and ensure free access to planets and other celestial bodies.

What is the present scenario of space security?

- Space security issues have potentially serious consequences. The consequences of either a deliberate or even an accidental conflict in space are too horrible to contemplate.

- A day without the utility provided by outer space is difficult to even conceive and yet the actions of states might lead the world in that direction sooner than later.
- Unless states take measures to restrain some kinds of activities in space, access to space will not be safe, secure, or guaranteed.
- Because of the highly competitive and contested nature of major power relations today, even peaceful applications and technological developments such as On-Orbit Satellite Servicing or technologies to tackle space debris are viewed with much suspicion.
- There are also more specific space security threats – the return of anti-satellite (ASAT) testing, and cyber and electronic warfare in space, for example.
- Any satellite service disruption or damage will have a wide-ranging impact, one that cannot be contained to the security or economic sectors alone, and one that cannot be limited geographically either given the significant global dependence on space.
- Space is truly a global commons.

What are the major threats to the space?

- Space security threats are growing. The major threats to the space are as follow:
  - increasing cyber threats to space assets (through hacking and other satellite interference)
  - heightened collision probability due to congestion
  - proliferation of space debris
  - entry of new players merely to ensure deterrence
  - visible early trends of weaponization of space
  - Space is becoming more accessible
  - threat of overwhelming radiofrequency waves spectrum by large satellite constellations

What are the recent efforts made by the countries?

There have been recent efforts including the:

- **2010:** the 2010 EU-initiated International Code of Conduct for Outer Space Activities (ICoC)
- **2013:** the U.N. Group of Governmental Experts (GGE) on transparency and confidence building measures (TCBMs)
- **2014:** Russia-China sponsored draft Treaty on the Prevention of the Placement of Weapons in Outer Space, the Threat or Use of Force against Outer Space Objects (PPWT),
- **2018-19:** The GGE on further practical measures for the prevention of an arms race in outer space (PAROS)

None of these have led to a favorable conclusion.

Why outer space matters to humankind?

- **Answering the fundamental questions:** Human space exploration helps to address fundamental questions about our place in the Universe and the history of our solar system.
- **Peaceful connection:** Through addressing the challenges related to human space exploration, countries expand technology, create new industries, and help to foster a peaceful connection with other nations.
- **Understanding Earth**: Experiments performed in space help us understand health problems on Earth.
- **Improving day-to-day lives:** Space technologies improve products and services used every day such as weather forecasts, and communications worldwide.

- **Enhancing safety:** Satellites data are used to predict natural disasters and to support emergency relief efforts.
- **Conservation:** Satellites provide data on climate change, measure pollution, and help protect the Earth.

What are the challenges in development of an outer space regime?

- **Lack of consensus:** The biggest challenge facing the development of an outer space regime is a lack of consensus among major powers.
- **Political impediments:** These are essentially political impediments and therefore that much harder to overcome than practical issues.
- **Lack of trust and confidence:** Major power relations are characterized by a serious lack of trust and confidence in each other.

24 Sending Humans to Mars

Context:

From Elon Musk's vision to build a human city on Mars to the recent pioneering space flight by Jeff Bezos and Richard Branson. It appears to be setting the stage for the future of space tourism. All these developments raise concerns about the ethics of sending a human to Mars.

Analysis

Space exploration has resulted in many extraordinary discoveries, but it has also led inevitable exploitation of natural as well as human resources. Why are we so much inclined towards going to Mars? There are many answers to it, a few of them are mentioned below:

- To conquer an uncharted territory.
- We have exhausted the resources that Earth has to offer, so we need more.
- Quest to look for the possibility of finding life.

Keeping the reasons aside, what come forefront is the Ethical question of sending humans to Mars. The space environment is not viable to support human life, so new ethical issues concerning the value of human life may appear. We need to look into the possible ethical challenges and issues, which may appear during a human mission to Mars and moreover the ethics of sending humans to Mars at the first instance.

Claim for Ownership:

- The whole exercise of sending humans to Mars surfaces the issues about the ownership claims. Does the first country that puts its foot on the surface of another world get to claim ownership? All of this shall not do any better for the future of space exploration than it had for human history on Earth. If we want to settle on another planet, it is probably going to be an outcome of multinational efforts in harmony, else it may lead to a conflict among the competing nations who are striving to make it a reality.
- Capitalism and consumerism have adversely turned our species into a parasitic one. Increased consumption has increased the area of our landfills while the ethical standards that we expect from businesses are declining. The cocktail of Industry and mindless consumerism has created our current state. Thoughtful consumerism can possibly save us from the race of capturing other planets to fulfil our ever-growing needs.

Possible Harm to Martian life forms

- One of the strongest ethical arguments that are not in resonance with the idea of sending humans to Mars and colonizing it, is the possibility of causing a potential to harm any indigenous life forms that might be existing there.
- Surely anything can't be said firmly about such life forms at the moment. The discovery of liquid water (and evidence that indicates that Mars may once have had it in relative abundance) strengthen the possibility of Mars having life forms on it in the past.
- The possibilities of processes happening right now through which life on Mars could emerge cannot be ruled out. Sending humans would disrupt these processes. Our sense of moral community is inclusive and extends to life forms that sufficiently resemble Earth life forms and otherwise.

Potential harmful impacts on Earth

- It is not a narrative but a fact that space travel uses depleting natural resources and generates waste products. It can't be denied that it shifts funds away from other projects or purposes. **The ethical issue here is not confined to the amplitude of the costs involved for sending human missions relative to the benefits. It also raises a question, how those costs and benefits are distributed — of whether the people who bear the costs will also be experiencing the benefits.**
- We must also weigh the impacts of shifting scientific and engineering human resources to the task of sending humans to Mars instead of addressing other human aspirations and needs, few of them are quite pressing. For example, to address diseases, climate change, war, social and economic inequality.

Potential long-term impacts on Human life

- We are wonderfully fit for Earth, but the same is not true with other planets. They are cold, empty, without or with a thin atmosphere. Especially the exposure to radiation, for which space suits and ships provide little protection are few of exhaustive list of threats.
- Earth's magnetic fields and atmosphere shelter us from the ionizing radiation from outer space. On the surface of Mars (which lacks a magnetic field or much atmosphere) or aboard a spaceship, exposure to cosmic radiation would kill cells and make them malfunction. The affected cells cause heart disease or might result in cognitive decline. DNA damage is even worse, leading to mutations that cause cancer and heritable diseases.

Risks with long human space flight:

- Health hazards from space radiation; the possibility of a mission getting sabotaged by the crew itself – based on studies of isolated communities, psycho-social issues; physiological risk– including bone and muscle loss due to the near absence of gravity; and medical risk – difficulties of treating injuries and illness. Space provides the harshest possible human environment, exceeding conditions that cannot be experienced on Earth. It is important to note that, more is unknown about the physical and mental challenges of space travel than is known.
- So, what makes risk ethical? The answer has been one thing: "**consent".** The ethical considerations take a different path if we think of the crew as military personnel. We anticipate soldiers to encounter substantial risk. And think of the explorers who travelled to distant and secluded places with no thought of return. The mission if done must be done publicly for peaceful purposes, by free people, with the results considered common stock.

To answer ethical questions related to sending humans to Mars or the colonisation of Mars, we usually resort to the three important ethical theories:

- Consequentialism
- Deontology and
- Virtue ethics

- **Consequentialism Theory:** It focuses on judging the moral worth of the results of the actions. Actions are determined to be right or wrong based on consequences. The rightness or wrongness of an action is determined by its consequences.
- **Deontological Theory:** It focuses on judging the actions themselves. How we are to act in a given situation and comes bundled with the concept of duty. The rightness or wrongness of an action is determined by moral duties.
- **Virtue Ethics:** This differs from both deontology and consequentialism as it focuses on being overdoing. It tells us primarily about what kind of person we are and should be. The rightness or wrongness of an action is determined by the reasons (motives) one has for acting and these motives flow from one's character.

- **Space ethics** is no different and it is meaningful enough to find the answer to the above questions by examining how they each fit into our available ethical frameworks. The development and nurturing of **virtuous characteristics** that make us ready to act in an **ethical way** is the best approach **when the moral landscape is uncertain and unpredictable.**
- Owing to the unpredictability aspects of human activity in space, we should ask the meta-ethical question of whether these normative theories and frameworks, which were constructed to guide human action and interaction on earth, are relevant to the space outside. Or do we require new space ethics?
- The story is not complete without looking at the other side. The human expansion of space is regarded not only as an obvious phenomenon but also as a natural process of human evolution. Colonization of space objects is sometimes being seen as to become a common practice in the short term. Lately, we are experiencing the formation of a sequence of actions that, at the first stage, will lead to the colonization of Mars. And it is difficult to side with anyone possibility.

25 Synthetic Biology

Context:

The Centre is working on a national policy on synthetic biology, an emerging science that deals with engineering life forms for a wide range of applications from making designer medicines to foods.

Background

- As part of the 12th Five-Year Plan, India had set up a task force on systems biology and synthetic biology research in 2011.
- This body underlined the potential benefits from synthetic biotechnology in biofuels, bioremediation, biosensors, food and health and made a strong case for a push for the technology.
- It highlighted that India could be a world leader as a protector and supporter of "open source biological platforms".

Analysis

■ What is Synthetic Biology?

- Synthetic biology, field of research in which the main objective is to create fully operational biological systems from the smallest constituent parts possible, including DNA, proteins, and other organic molecules.

- The synthetic systems created may be used to generate products ranging from ethanol and drugs to complete synthetic organisms such as complex bacteria that can digest and neutralize toxic chemicals.
- Ideally, these customized synthetic biological systems and organisms would be much safer and less complicated than approaches based on the manipulation of naturally occurring biological entities.

Applications of synthetic biology:

- Redesigning organisms so that they produce a substance, such as a medicine or fuel, or gain a new ability, such as sensing something in the environment, are common goals of synthetic biology projects.
- Some examples of what scientists are producing with synthetic biology are:

Application in pharmaceuticals:

- For instance, researchers have been working on the synthetic manufacture of the antimalarial drug artemisinin, which is produced naturally in the sweet wormwood plant, a slow-growing species.
- Scientists have been trying to create new forms of bacteria that can destroy tumors.
- S. Department of Defense has experimented with the creation of biological computers, and other military scientists are trying to engineer proteins and gene products from scratch that will act as targeted vaccines or cures.

Application in Biofuels:

- In the area of biofuels, scientists at numerous companies are trying to create microbes that can break down dense feedstocks to produce biofuels.
- Modify the genes of microbes to secrete oil. If successfully scaled up for commercial production, these organisms could serve as valuable sources of renewable energy.

Other Applications:

- Microorganisms harnessed for bioremediation to clean pollutants from our water, soil and air.
- Rice modified to produce beta-carotene, a nutrient usually associated with carrots, that prevents vitamin A deficiency.
- Yeast engineered to produce rose oil as an eco-friendly and sustainable substitute for real roses that perfumers use to make luxury scents.

Risk assessment of synthetic biology:

- Synthetic biology is not without its risks. However, there is some debate as to whether synthetic biology represents categorically different risks from those posed by other forms of biological research and genetic engineering.
- Both genetically engineered and synthetic organisms are capable of reproducing, mutating, evolving, and spreading through the environment, which makes them riskier than hazardous chemicals.
- There is concern over so-called emergent properties, which could arise unexpectedly when genes with no natural lineage enter the environment and interact with one another.

What are the ethical and social implications?

- Projects that propose to synthesize entire genomes raise important ethical questions about potential harms and benefits to society.
- Many of the ethical questions relevant to synthetic biology are similar to ethical discussions related to genome editing.
- Are humans crossing moral boundaries by redesigning organisms with synthetic biology techniques?
- If synthetic biology yields new treatments and cures for diseases, who in our society will have access to them?
- What are the environmental impacts of introducing modified organisms into the ecosystem?
- Such ethical questions have been the subject of research since the beginning of the Human Genome Project and will continue to be researched as technology evolves and changes.
- Most scientists, ethicists and policymakers agree that entire societies must discuss and weigh the potential harms and benefits of synthetic biology in order to answer these questions.

Way forward:

- Synthetic biology is seen as one of the top 10 **breakthrough technologies** as part of the **new industrial revolution** that are most likely to change the world.
- The regulatory challenge is how to leverage its anticipated benefits while guarding against its potential risks. The **laws and regulations** framework governing traditional tools and products of biotechnology can be applicable to this relatively nascent field in some ways, but most often it fails to fully adapt to the evolving possibilities of synthetic biology.

26 Artificial Intelligence and its Climate Cost

Context:

- **The techno-optimism towards future of AI can be seen in budget speech, where AI was described as a sunrise technology that would "assist sustainable development at scale and modernize the country."**
- **While there is an allure to national dreams of economic prosperity and global competitiveness, underwritten by AI, there is an environmental cost.**

Analysis

■ The "race" for dominance in AI is far from fair:

- Not only do a few developed economies possess certain material advantages right from the start, they also set the rules.
- They have an advantage in research and development, and possess a skilled workforce as well as wealth to invest in AI.
- North America and East Asia alone account for three-fourths of global private investment in AI, patents and publications.

■ Inequity in AI in terms of governance:

- How "tech fluent" policymakers are in developing and underdeveloped countries?

- What barriers do they face in crafting regulations and industrial policy?
- Are they sufficiently represented and empowered at the international bodies that set rules and standards on AI?
- There is an emerging challenge at the nexus of AI and climate change that could deepen this inequity.

■ The climate impact of AI comes in a few forms:

- The energy use of training and operating large AI models is one.
- In 2020, digital technologies accounted for between 1.8 per cent and 6.3 per cent of global emissions.
- AI development and adoption across sectors has skyrocketed, as has the demand for processing power associated with larger and larger AI models.
- Paired with the fact that governments of developing countries see AI as a silver bullet for solving complex socio-economic problems, we could see a growing share of AI in technology-linked emissions in the coming decades.

■ Entering mainstream debates:

- The idea of sustainability is rapidly entering mainstream debates on AI ethics and sustainable development.
- In November 2021, UNESCO adopted the Recommendation on the Ethics of Artificial Intelligence, calling on actors to "reduce the environmental impact of AI systems, including but not limited to its carbon footprint."
- Technology giants like Amazon, MicrTosoft, Alphabet and Facebook have announced "net zero" policies and initiatives. These initiatives are a good sign, but they only scratch the surface.
- Both global AI governance and climate change policy are contentious, being rooted in inequitable access to resources.

■ Developing and underdeveloped countries face a challenge on two fronts:

- AI's social and economic benefits are accruing to a few countries.
- Most of the current efforts and narratives on the relationship between AI and climate impact are being driven by the developed West.

What then is the way ahead?

- Like most nexus issues, the relationship between climate change and AI is still a whisper in the wind.
- It is understudied, because the largest companies working in this space are neither transparent nor meaningfully committed to studying, let alone acting.

Conclusion:

- Governments of developing countries, India included, should also assess their technology-led growth priorities in the context of AI's climate costs. It is argued that as developing nations are not plagued by legacy infrastructure it would be easier for them to "build up better". These countries don't have to follow the same AI-led growth paradigm as their Western counterparts.
- It may be worth thinking through what "solutions" would truly work for the unique social and economic contexts of the communities in our global village.