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Classroom Study Material

(May 2018 to February 2019)

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SCIENCE AND TECHNOLOGY

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1. BIOTECHNOLOGY

1.1. DNA TECHNOLOGY (USE AND APPLICATION) REGULATION BILL

Why in news?

Lok Sabha recently passed DNA Technology (Use and Application) Regulation Bill, 2019.

More on news

- The Bill regulates the use of DNA technology for establishing the identity of persons in respect of criminal matters and civil matters such as parentage disputes, transplantation of human organs etc.
- **The bill also provides for:** establishment of a DNA Regulatory Board; accreditation of DNA laboratories undertaking DNA testing, analysing, etc.; establishment of the National and Regional DNA Data Banks.
- **Written consent by individuals** is required to collect DNA samples from them. Consent is not required for offences with punishment of more than seven years of imprisonment or death.

DNA or deoxyribonucleic acid

- It is the **hereditary material** in humans and almost all other organisms.
- Most DNA is **located in the cell nucleus** (where it is called nuclear DNA), but a small amount of DNA can also be found in the mitochondria (where it is called mitochondrial DNA or mtDNA).
- DNA is made up of **molecules called nucleotides**. Each nucleotide contains a phosphate group, a sugar group & a nitrogen base**. The four types of nitrogen bases are adenine(A), thymine(T), guanine(G) & cytosine (C).**
- DNA is a **double helix formed** by base pairs attached to a sugar-phosphate backbone.
- **Application:**
  - It can almost **accurately ascertain the identity** of a person, establish biological relationships between individuals etc. Thus, useful in investigations of crime, identification of unidentified bodies, or in determining parentage.
  - It can also **reveal person** looks, eye colour, skin colour as well as more intrusive information like their allergies or susceptibility to diseases.
  - It can be **used in biometric identification** in addition to Iris scanning, Retinal scanning and Voice recognition.

1.2. HUMAN MICROBIOME

Why in news?

Indian Human Microbiome Initiative, led by The National Centre for Microbial Resource (NCMR) - National Centre for Cell Science (NCCS) has been put up for approval.

More on news

- The project will include collection of saliva, stool and skin swabs of 20,000 Indians across various ethnic groups from different geographical regions.
- Scientists have found that **Indian population, particularly tribals, have distinct gut microbiota**. Such tribal populations are **largely unaffected by "modern" diet** and **have lower prevalence of lifestyle diseases**.

What is Microbiome?

- The **collective genome of all micro-organisms** contained within the human body, residing inside tissues & bio-fluids is called **Human Microbiome**. It includes bacteria, archaea, fungi, protists and viruses.
- Most of them have either **commensal** (co-exist without harming humans) or **mutualistic** (each benefit from the other) relation.
- The composition of microbiome is shaped by factors such as genetics, dietary habits, age, geographic location and ethnicity.
- Human microbiome makes up around 2% of the body mass of the adult. There are 10 times as many outside organisms as there are human cells in human body.

Importance of the Human Microbiome

- Microbial communities play a key role in many aspects of host physiology:
  - Metabolism of otherwise complex indigestible carbohydrates and fats
  - Production of essential vitamins
  - Maintaining immune systems
  - Acting as a first line of defense against pathogens.
  - Determines how one responds to a particular drug treatment

About Human Microbiome Project (HMP)

- It is a research initiative of **US's National Institute of Health** with the mission to generate the resources and expertise needed

to characterize the human microbiome and analyze its role in health and disease.

- Launched in 2007, it is focused on identifying and characterizing human microbial fauna and elucidating their roles in health and diseases.
- Some methodologies used in HMP are:
  - **Metagenomics,** a sequence-based approach that allows the genetic material from the complete collection of microbes to be analyzed in their natural environment without needing to cultivate the microorganisms.
  - **Whole Genome Sequencing (WGS)** to provide a "deep" genetic perspective on aspects of a given microbial community, *i.e.* individual bacterial species.

Related news
SALSA

- Recently, an international team of scientists began a research named **SALSA (SUBGLACIAL ANTARCTIC LAKES SCIENTIFIC ACCESS)** for study of **microbes and living specimens** in a **Subglacial Lake Mercer of Antarctica.**
- This project could add to understanding of the **evolution of life** in these extreme environments on earth and other celestial bodies such as **habitats deep inside Mars** or on the **ice-covered moons** of Jupiter and Saturn.
- A subglacial lake is a body of liquid water located in between an ice sheet and the continental land mass. The water remains liquid because the ice sheet above the water acts as an insulator and traps geothermal heat from the Earth's crust.

1.3. GENE EDITING

Why in news?

Recently a Chinese scientist claimed that he helped make the world's first **"genetically-edited" babies** in whom a gene linked to HIV was remove using CRISPR technique.

What is gene editing?

- Genome editing (also called gene editing) is a group of technologies that give scientists the ability to change an organism's DNA.
- These technologies allow genetic material to be added, removed, or altered at particular locations in the genome.
- A recent approach to genome editing is known as CRISPR-Cas9, which is short for clustered regularly interspaced short palindromic repeats and CRISPR-associated protein 9.
  - It was adapted from a naturally occurring genome editing system in bacteria.
  - It is faster, cheaper, more accurate, and more efficient than other existing genome editing methods
  - **CRISPR is the DNA-targeting part** of the system which consists of an RNA molecule, or 'guide', designed to bind to specific DNA bases through complementary base-pairing.
  - **Cas9** is the nuclease part that cuts the DNA.

Related information

- **Gene:** A gene is the **basic physical and functional unit of heredity.** Genes are **made up of DNA.**
  - Some genes act as instructions to make molecules called proteins.
  - Every person has two copies of each gene, one inherited from each parent.
  - Alleles are forms of the same gene with small differences in their sequence of DNA bases.
  - These small differences contribute to each person's unique physical features.

1.4. EARTH BIOGENOME PROJECT

Why in News?

International biologists have launched an ambitious **Earth BioGenome Project** at an estimated cost of $4.7bn.

About Earth BioGenome Project

- It aims to **sequence, catalog and characterize the genomes of all of Earth's eukaryotic biodiversity** over a period of ten years.
- It involves projects by various countries:
  - **US-led project** to sequence the genetic code of tens of thousands of vertebrates.
  - **Chinese project** to sequence 10,000 plant genomes.
  - **The Global Ant Genomes Alliance**, which aims to sequence around 200 ant genomes.
  - **UK participants, led by the Wellcome Sanger Institute,** will also sequence the genetic codes of all 66,000 species inhabiting Britain in a national effort called **the Darwin Tree of Life.**
- The initiative would produce a **database of biological information** (shared online for free), that provides a platform for scientific research and supports environmental and conservation initiatives.
- The participating institutions would **raise their own funding** as far as possible. However, the project has the **backing of the World Economic Forum.**

Related Information

- **Genome**: It is an organism's complete set of DNA, including all of its genes. In humans, it is contained in all cells that have a nucleus.

What is Genome sequencing?

- It is figuring out the order of DNA nucleotides, or bases, in a genome.
- It may provide new information on the genetic basis of poorly understood diseases, with the potential to provide new therapies.

Eukaryotes

- These are organisms whose cells have a nucleus enclosed by membranes.
- These are animals, plants, fungi and protozoa, which encompass all of life except simple microbes (bacteria and archaea, which are prokaryotes).

Human Genome Project (HGP):

HGP-Read:

- This was an international and multi-institutional effort that took 13 years [1990-2003] to produce a blueprint of the human genome.
- The HGP has revealed that there are probably about 20,500 human genes composed of over 3 billion base pairs.
- **India did not participate in HGP-read.**

HGP-Write:

- This project was launched in 2016 to write or build an artificial human genome from scratch with sophisticated bioengineering tools.
- Potential applications include growing transplantable human organs, engineering immunity to viruses in cell lines, engineering cancer resistance into new therapeutic cell lines, and accelerating high-productivity, cost-efficient vaccine etc.

Genome India Project

- It was launched in 2017 by the Centre for Brain Research at the **Indian Institute of Science** (IISc) in collaboration with Institute of Bioresources and Sustainable Development (a national institute of the **Department of Biotechnology**).
- It seeks to carry out Whole Genome Sequencing (WGS) of over 2,000 individuals spanning different ethnic, linguistic and socio-cultural sections of the northeastern states.
- It would help in understanding the genetic origins of the different ethnic groups and also an increased understanding of the genetic disease burden which would help in the **development of personalised medicine**.

100k GenomeAsia Project: A group of Indian scientists and companies are involved with a **100k GenomeAsia project**, led out of the Nanyang Technological University (NTU), Singapore, to sequence the whole genomes of 100k Asians, including 50,000 Indians.

2. SPACE TECHNOLOGY

2.1. ISRO

2.1.1. GAGANYAAN MISSION

Why in News?

Prime Minister in his Independence Day speech announced **that ISRO** will be sending its first human spaceflight mission into the space **by 2022.**

Background

- In 2004, the manned space mission was first endorsed by the **ISRO Policy Planning Committee.**
- ISRO has successfully demonstrated some of the technologies required for the mission such as **Space Capsule Recovery Experiment (SRE-2007), Crew module Atmospheric Reentry Experiment (CARE-2014), GSLV Mk-III (2014), Reusable Launch Vehicle- Technology Demonstrator (RLV-TD), Crew Escape System (2018)** and **Pad Abort Test (2018).**
- ISRO also recently unveiled a **space capsule** (crew module) and **Space suit prototype.**
- ISRO has also finalized the layout and design of **Environmental Control & Life Support System (ECLSS).**
- A successful implementation of the mission could provide with multiple benefits such as: development of newer technologies, increased understanding of functioning of human body, understanding of effects of microgravity and cosmic radiation on bio-organisms ranging from bacteria and plants to large mammals etc.

Specifications

- **Launch Vehicle:** GSLV Mk-III launch vehicle will be used to launch Gaganyaan. Two unmanned Gaganyaan missions will be undertaken prior to sending humans, with first unmanned flight within 30 months.
- **Cost:** It's expected to be less than Rs. 10,000 Crores.
- **Aim:** To send a three-member crew to space for a period of five to seven days. The spacecraft will be placed in a low earth orbit of 300-400km.
- This will be the **first human mission indigenously developed by ISRO.**
- It will comprise of a crew module and service module that constitute an **orbital module.** The crew will do microgravity experiment during the mission.
- **ISRO Human Space Flight Centre (HSFC) at Bengaluru** will be responsible for implementation of GAGANYAAN Project.

Indian Space Research Organization (ISRO), 1969.

- It's the **pioneer space exploration agency** of the GoI, with headquarters at Bengaluru.
- **Vision:** To develop and harness space technology in national development, while pursuing planetary exploration and space science research.
- ISRO replaced its predecessor, **INCOSPAR (Indian National Committee for Space Research**), established in 1962 by India's first Prime Minister Pt. Jawaharlal Nehru and scientist Vikram Sarabhai.
- It operates through a countrywide network of centre such as Vikram Sarabhai Space Centre in Thiruvananthapuram, ISRO Satellite Centre in Bangalore, Satish Dhawan Space Centre on Sriharikota Island, near Chennai, Space Applications Centre in Ahmedabad, National Remote Sensing Centre in Hyderabad etc.
- ISRO's commercial arm is Antrix Corporation, which has its headquarters in Bangalore.

2.1.2. GSAT-11

Why in News?

GSAT-11, the **heaviest satellite** built by ISRO was launched from **French Guiana** by Ariane-V Rocket of Arianespace (a joint venture of Airbus and Safran).

About GSAT-11

- It weighs around 5855 Kg, **double** the size of biggest satellite built by ISRO till now. ISRO's most powerful launcher **GSLV-Mk III** can launch satellite weighing up to 4000 kg only.
- It is part of ISRO's **high-throughout communication satellite (HTS)** fleet that will drive the country's **Internet Broadband** from space to untouched areas. It is built to provide throughput data rate of **16 gbps.**
- It carries 40 transponders in **Ku (32)/ Ka (8) Band.** For the First time use of **Ka-Band** is introduced in India through GSAT-11.
- It will be placed in a **circular geo-stationary orbit** almost **36,000 Km** away and settle at **74° E** in India.
- It has a lifespan of 15 years.

GSAT

- A GSAT is a series of geosynchronous satellite placed in **geosynchronous orbit**, with an orbital period same as the Earth's rotation period.
- Such a satellite returns to the same position in the sky after each day.
- A special case of geosynchronous satellite is the geostationary satellite, which has a **geostationary orbit – a circular orbit directly above the Earth's equator.**

- **Geosynchronous satellites** have the advantage of remaining permanently in the same area of the sky, as viewed from a particular location on Earth.
- **Geostationary satellites** have the special property of remaining permanently fixed in exactly the same position in the sky, meaning that ground-based antennas do not need to track them but can remain fixed in one direction. Such satellites are often used for communication purposes. This orbit is present at an altitude of approx. 35,786 km in the equatorial plane.

Related information

Sun Synchronous Orbits (or Low Earth Orbit): These orbits allows a satellite to pass over a section of the Earth at the same time of day. These satellites orbit at an altitude between 700 to 800 km.

Geostationary Transfer Orbit (GTO) is an elliptical orbit, with an apogee (high point) of 35,784 kilometers and an inclination roughly equal to the latitude of the launch site, into which a spacecraft is initially placed before being transferred to a geosynchronous or geostationary orbit.

Ku vs Ka Band

- Ku band ranges between 12-18 GHz while Ka Band ranges from 26.5-40 GHz.
- Most satellites today use Ku Band Transponders because it is difficult to build hardware and software for Ka Band Transponders.

2.1.3. HYPERSPECTRAL IMAGING SATELLITE (HYSIS)

Why in News?

PSLV C43 recently launched **India's first Hyperspectral Imaging Satellite (HysIS)** from Satish Dhawan Space Centre, Sriharikota.

More on news

- HysIS is an **earth observation satellite** built around **ISRO's Mini Satellite-2 (IMS-2) bus**.
- It was placed into **polar sun synchronous orbit** and has mission lifespan of 5 years.
- One micro and 29 nano satellites from eight different countries including USA, Australia and Canada were also launched along Hysis by PSLV- C43.

About the Hyperspectral Imaging Technology

- It combines the power of **digital imaging and spectroscopy** to attain both spatial and spectral information from an object.
- This result can be then used to identify, measure and **locate different materials and their chemical and physical properties.** Every pixel in the image contains a continuous spectrum (in radiance or reflectance) and can be used to characterize the objects in the scene with **great precision and detail.**
- Hyperspectral images provide much more detailed information about the scene by dividing the spectrum into **many more bands than a normal color camera,** which only acquires three different spectral channels corresponding to the visual primary colors red, green and blue.
- It was first tried by ISRO in an experimental satellite in May 2008 and later on Chandrayaan-1 mission for mapping lunar mineral resources.
- **Application:** Hyperspectral remote sensing is used for a range of applications like agriculture, forestry, soil survey, geology, coastal zones, inland water studies, environmental studies, detection of pollution from industries and the military for surveillance or anti-terror operations.

Related Information

Spectral Imaging

- It is imaging that uses multiple bands across the electromagnetic spectrum like using infrared, the visible spectrum, the ultraviolet, x-rays, or some combination of the above.

Hyperspectal imaging vs multi spectral imaging

- The main difference between multispectral and hyperspectral is **the number of bands and how narrow the bands are**.
- Hyperspectral imaging (HSI) uses **continuous and contiguous ranges of wavelengths** (e.g. 400 - 1100 nm in steps of 0.1 nm) whilst multispectral imaging (MSI) uses a **subset of targeted wavelengths at chosen locations** (e.g. 400 - 1100 nm in steps of 20 nm).
- Hyperspectral imagery consists of much **narrower bands (10-20 nm)**. A hyperspectral image could have hundreds or thousands of bands. In general, it comes from an imaging spectrometer.

Related news

- The Indian Air Force (IAF) has commissioned the development of a Hyper Spectral Programme for **monitoring suspicious moments along the international border and some parts within the country**.
- This hyper spectral programme, a first for the nation, will help detect or identify the presence of a human below trees, dense foliage, shrubs or inside a structure, whether it is day or night.
- It can detect human presence from air even if there is clouds cover, dense fog or snow cover.

2.1.4. SATELLITE LAUNCH VEHICLES BY ISRO

Why in news?

- Recently, ISRO launched satellite-**GSAT-29** through the launcher **GSLV-Mk III D2**.

- Recently, **India's Polar Satellite Launch Vehicle (PSLV-C44)** successfully injected Microsat-R and Kalamsat-V2 satellites into their designated orbits.

More on news

- With a lift-off mass of 3423 kg, GSAT 29 is a multi-beam, multiband communication satellite of India and **is the heaviest satellite launched from India.** It will bridge the digital divide of users including those in Jammu & Kashmir and North Eastern regions of India.
- **PS4 in PSLV C-44:** Normally, the last stage of a PSLV rocket after releasing the primary satellite in space becomes dead and categorised **as debris**. However, in PSLV-C44, the fourth stage (PS4) of the vehicle would be moved to higher circular orbit so as to establish an **orbital platform for carrying out experiments.**
    - **Payload: Kalamsat (Nano-satellite),** a student payload will be the first to use PS4 as orbital platform. **Microsat-R** is a military imaging satellite.

Satellite-Launch Vehicles Developed By ISRO

PSLV (Polar Satellite Launch Vehicle): It is designed mainly to deliver the "earth-observation" or "remote-sensing" satellites with lift-off mass of up to about 1750 Kg to Sun-Synchronous circular polar orbits of 600-900 Km altitude.

- PSLV is a four-staged launch vehicle with **alternating solid and liquid stages.**
- PSLV is classified into its various versions like corealone version (PSLV-CA), PSLV-G or PSLV-XL variants depending on the number of these strapon boosters
- PSLV is also used to launch the satellites of lower lift-off mass of up to about 1400 Kg to the elliptical Geosynchronous Transfer Orbit (GTO).

GSLV (Geosynchronous Satellite Launch Vehicle): GSLV is designed mainly to deliver the communication satellites to the highly elliptical (typically 250 x 36000 Km) **Geosynchronous Transfer Orbit** (GTO). Two versions of the GSLV:

- **GSLV Mk-II:** is a three stage vehicle with four liquid strap-ons. First stage using solid rocket motor, second stage using Liquid fuel and Cryogenic Upper Stage (CUS) forms the third stage of GSLV Mk II. has the capability to launch satellites of lift-off mass of up to 2,500 kg to the GTO and satellites of up to 5,000 kg lift-off mass to the LEO (low earth orbit).
- **GSLV MK-III:** It is a three stage vehicle with an indigenous cryogenic upper stage engine (C25) with two solid fuel strap-on engines in the first stage, a liquid propellant core as second stage. It has been designed to carry heavier communication satellites weighing up to 4000 kg into the Geosynchronous Transfer Orbit or satellites weighing about 10,000 kg to a Low Earth Orbit (LEO).
    - The indigenous cryogenic C25 engine helps to **keep fuel loads on the rocket relatively low.** India is among six nations — apart from the US, Russia, France, Japan and China — to possess cryogenic engine technology.

2.1.5. YOUNG SCIENTIST PROGRAMME (YUVIKA)

Why in News?

Indian Space Research Organization (ISRO) has recently launched Young Scientist Programme/ **YUva VIgyani KAryakram (Yuvika)** for school students.

About the Young Scientist Programme

- It aims to inculcate and nurture space research fervor in young minds
- Under this 1-month program, 3 students from each of the 29 States and 7 UTs will be selected.
- Students mostly from class VIII will be given lectures and access to R&D labs and practical experience of building a small satellite.
- **Eligibility:** Students who have just finished 9th standard (in the academic year 2018-19) and waiting to join 10th standard (or those who have started 10th Std just now).
- All the expenses of travelling and boarding will be **funded entirely by ISRO.**
- Under this, **six incubation centres** will be established in various parts of the country - North, South, East, West, Centre and North-East, and the **first such centre has been established in Agartala in Tripura.**

2.2. NASA MISSIONS IN NEWS

Mission	Details
Parker Solar Probe	• It is **first to fly direct into the Sun's atmosphere** known as corona. The Sun's unstable corona produces: solar winds, flares, magnetic and plasma explosions. • It will take measurements of the Sun's electric fields and waves.
InSight Mars Lander	• First **spacecraft designed to explore the deep interior of the red planet.** • **The landing site** is **Elysium Planitia,** close to Mars' equator.
Opportunity Rover	• It has been recently declared as complete. It **confirmed that water once flowed on the Mars.**
Cassini-Huygens	• It was launched through collaboration between NASA, ESA

Mission	and the Italian space agency to study Saturn and its system of rings and moons (Saturn's largest moon is Titan) • It was first spacecraft to orbit Saturn.
Voyager 1 and 2	• Voyager 2 has become the second human-made object in history to enter the interstellar space after crossing the heliopause (region where the tenuous, hot solar wind meets the cold, dense interstellar medium). • Voyager 1 was the first spacecraft to have entered interstellar space
New Horizons probe	• It recently completed the flyby of the Kuiper Belt object nicknamed Ultima Thule and set the record for the most distant object ever visited by a spacecraft. • It is the **first mission to the Pluto System and the Kuiper belt**. • The farthest ever trajectory correction maneuvers (TCM) or course correction has been performed on this spacecraft. • **Ultima Thule is** a **contact binary** i.e it's a single object, with two lobes, but the lobes are gently in contact. NASA dubbed the **larger lobe Ultima**, and the other, which is about three times **smaller, Thule.** • **Kuiper Belt** is **a donut-shaped region of icy bodies beyond the orbit of Neptune.** o The icy objects of the Kuiper Belt are remnants left over from the formation of the solar system. o Many Kuiper Belt objects have remained unchanged for billions of years, and could provide clues to the history of the Solar System, and possibly the conditions that led to the evolution of a habitable world like Earth. o **Pluto also lies in the Kuiper belt.**
Dawn mission	• Only mission ever to orbit two extraterrestrial targets - **giant asteroid Vesta and the dwarf planet Ceres.** • Ceres is the **largest body in the asteroid belt between Mars and Jupiter**. It is **only dwarf planet located in the inner circle of the solar system**, rest all are located on the outer edges.
OSIRIS-REx	• It is a space probe launched for a near earth asteroid **Bennu in 2016**. • These first images of Bennu present a remarkable similarity with the ones recently obtained by the **JAXA Hayabusa2 mission** (Japanese mission) of another primitive asteroid, **Ryugu**.
Lucy Mission	• To be launched in 2021, it will be the **first space mission to study the Jupiter's Trojan Asteroids** and will fly by six Trojans and one Main Belt asteroid. • Trojan Asteroids are any one of a number of asteroids that occupy a stable Lagrangian point in a planet's orbit around the Sun.
Interstellar Mapping and Acceleration Probe (IMAP) mission	• It aims to learn more about the generation of cosmic rays in the heliosphere. It is too be launched by 2024.
Kepler Mission	• Kepler is a **space observatory** launched by NASA to discover Earth-size planets orbiting other stars. It was recently retired. • The Kepler telescope detects the presence of planets by registering minuscule drops in a star's brightness that occurs when a planet crosses in front of it, a movement known as a transit. • **Transiting Exoplanet Survey Satellite (TESS)** is its successor.
Chandra X-ray Observatory	It entered protective "safe mode" due to a malfunction. It is one of NASA's original "Great Observatories" projects along with Hubble, the Compton Gamma-Ray Observatory and the Spitzer Space Telescope.
Hubble Telescope	• It is a **joint venture between NASA and the European Space Agency** (ESA) — was launched in its orbit 552 km above Earth. • It is the first major optical telescope to be placed in space. • It has the ability to see in multiple wavelengths — near infrared, visible light and near ultraviolet.
James Webb Space	• It is a **joint project of the NASA, the European Space Agency and the Canadian Space Agency**. • It will be the **successor of Hubble Space Telescope** and 100 times powerful than it.
Spectro-Photometer for the History of the Universe, Epoch of	• It is space telescope scheduled to be launched in 2023. It is part of **NASA's Explorer Program** and is planned as a two-year mission with a **twofold aim:** to understand the **evolution of the universe** and **how common the ingredients for life**

Reionization and Ices Explorer (SPHEREx)	**are** in our galaxy. • It will survey the entire sky every 6 months from **low-Earth polar orbit,** in **optical as well as near-infrared** light, creating the first spectral all-sky survey at infrared wavelengths. • The mission will create a map of the entire sky in **96 different colour bands**, far exceeding the colour resolution of previous all-sky maps.
ICESat (Ice, Cloud, and land Elevation Satellite)-2	• It is a recently launched benchmark **Earth Observing System mission** for measuring ice sheet mass balance, cloud and aerosol heights, as well as land topography and vegetation characteristics.
Gravity Recovery and Climate Experiment Follow-On (GRACE-FO)	• It's a **joint mission** by NASA and the German Research Centre for Geosciences (GFZ) **to map Earth's gravitational fields and study changes Earth's gravitational pull due to moving water.** • It is a successor to the original GRACE Mission (2002-2017). It was the first mission to measure the amount of ice being lost from the Greenland and Antarctic ice sheets.
Visualizing Ion Outflow via Neutral Atom Sensing-2 (VISIONS-2) Mission	• It is a **sounding rocket mission** to get a **closer look at the how the Earth's atmosphere is slowly leaking** into space. ○ A sounding or probe rocket **makes brief, targeted flights into space** before falling back to Earth just a few minutes later and is designed to **probe atmospheric conditions and structure** at heights (80–160 km). • The **aurora borealis** is of keen interest to the VISIONS-2 team as they are fundamental drivers in the process of **atmospheric escape.** ○ The auroras are formed when **energetic electrons, accelerated in the electric and magnetic fields from sun in near-Earth space,** crash into and excite atmospheric gases, which emit bright hues of red, green, and yellow as they relax back to a lower energy state. ○ The lights are seen **above the magnetic poles of the northern and southern** hemispheres. They are known as 'Aurora borealis' in the north and **'Aurora Australis'** in the south. • It is the first of nine sounding rockets to be launched over the next 14 months as part of the **Grand Challenge Initiative (GCI),** an international collaboration to explore the unusual portal between Earth and space.

2.3. OTHER SPACE MISSIONS IN NEWS

Mission	Details
BepiColombo Mission	• It is Europe's first mission to Mercury, set off in 2018 and reach there in 2025. • It is a **joint mission between** ESA and the Japan Aerospace Exploration Agency (JAXA). • Mercury is the smallest planet in our Solar System. Till now only NASA's Mariner 10 and US Space Agency's Messenger have flown past the planet.
Aeolus satellite	• It's an European Space Agency's Earth Explorer satellite and **world's first space mission to map the Earth's wind on a global scale.** • It is part of the **ESA's Living Planet Programme** which include various missions like: ○ Gravity field and steady-state Ocean Circulation Explorer (GOCE) ○ Soil Moisture and Ocean Salinity ○ CryoSat mission ○ Swarm magnetic field mission
European Southern Observatory	• European Southern Observatory (ESO) recently sighted **hyperion** the largest ever galaxy proto-supercluster sighted till date. • ESO is an **intergovernmental organisation** with 16 Member States along with the host state of Chile and with Australia as a strategic partner.
Chang'e-4 spacecraft	• It is part of the second phase of China's lunar programme. • It is the first mission to land on the far side of the Moon. It landed at the **South Pole-Aitken Basin.** • Far side is the hemisphere of the Moon that always faces

	away from Earth. • From Earth, only **59%** of the moon is visible over a period of time due to: ○ **Tidal locking:** Moon takes nearly same time i.e. 27 days, to come one orbit around the Earth and also to rotate once on its own axis. Thus, same side of the moon is visible from Earth while the farther remains dark. ○ **Lunar vibrations:** due to tidal locking, ideally 50% of the moon should be visible but we see 59% because of north-south rocking and east-west wobbling of moon – called as lunar vibrations. • There are more impact craters on the far side of the Moon than the near side as near side has much thinner crust which has allowed volcanoes to erupt and fill in ancient large basins. • The Earth partially shields the near side of the Moon from incoming asteroids.
Tiangong	• Recently China presented replica of its first permanently crewed space station. • Tiangong ('Heavenly Palace') is a space station program of China to place the **Chinese large modular space station** in Low Earth orbit by 2022. • International Space Station (ISS) is expected to be de-commissioned in 2024 and **CSS** will fill the vacuum in Space Station based research**.** ○ ISS is a habitable artificial satellite in low earth orbit operational since 1998. It is collaborative effort between space agencies of the United States, Russia, Canada, Europe and Japan.
Soyuz	• The Soyuz is a **Russian spacecraft** which carries people and supplies to and from the space station. • Currently only this Russian spacecraft carry people to ISS after USA retired its space shuttle in 2011.
Ibuki-2/ Greenhouse gases Observing SATellite-2	• Recently Japan launched greenhouse gas observation satellite Ibuki-2. • Japan also launched the **United Arab Emirates' first locally made satellite, the KhalifaSat** Earth observation satellite. • **Other Environmental Satellite** ○ **Orbiting Carbon Observatory-2, or OCO-2** by NASA, is designed to monitor carbon dioxide in our planet's atmosphere. ○ **Geostationary Carbon Observatory (GeoCarb),** will build on the success of OCO-2 by NASA, will map concentrations of key carbon gases above the Americas from geostationary orbit. ○ **Gaofen 5** environmental monitoring satellite **by China,** to survey global land and water resources, air pollutants, greenhouse gases and other environmental parameters. ○ **Venus Satellite:** It's Israel first environmental research satellite, jointly built by Israel and France.
X-Calibur	• Recently, Washington University launched **telescope named X-Calibur, from Antarctica**. • It intends to measure the **polarization of X-rays** arriving from distant neutron stars, black holes, etc. • The observations will also test two of the most important theories in modern physics under extreme conditions: **quantum electrodynamics and general relativity.** • **Quantum electrodynamics - is** a quantum field theory of the electromagnetic force. Taking the example of the force between two electrons, the classical theory of electromagnetism would describe it as arising from the electric field produced by each electron at the position

	of the other. The force can be calculated from Coulomb's law. ○ The quantum field theory approach visualizes the force between the electrons as an exchange force arising from the exchange of virtual photons. • **General Relativity** - it explains that what we perceive as the force of gravity in fact arises from the curvature of space and time.

2.4. PLAN TO PREVENT ASTEROID ATTACK

Why in news?

NASA has released a document, titled **"National Near-Earth Object (NEO) Preparedness Strategy and Action Plan"**.

More on news

- It is a 10-year plan, to enhance NEO Detection, Tracking, and Characterization Capabilities and develop Technologies for NEO Deflection and Disruption Missions.
  - **Near-Earth Objects** (NEOs) are comets and asteroids that have been nudged by the gravitational attraction of nearby planets into orbits that allow them to enter the Earth's neighborhood.
- It calls for increased international cooperation to prepare for potential global impact threats.

Related information

Asteroid Impact and Deflection Assessment (AIDA) Mission

- It a proposed first-ever mission that will **deflect a near-Earth asteroid** to protect the planet.
- It is an **international collaboration** among the European Space Agency (ESA), NASA and others.
- AIDA involves two independent spacecraft: NASA's **Double Asteroid Redirection Test (DART) Mission** and **ESA's Asteroid Impact Mission (AIM)**.
- Its target is the binary near- Earth **asteroid Didymos.**
- NASA has also designed a spacecraft named **HAMMER (Hypervelocity Asteroid Mitigation Mission for Emergency Response),** which could deflect a asteroids.

Asteroids, Meteoroid, Meteors, Meteorites and Comet:

- **Asteroids** are small bodies of rocks which revolve around the sun. The Asteroid belt in our Solar System is found between the Mars and Jupiter.
- **Meteoroids** – When asteroids smash into each other, small fragments break off. These fragments are called Meteoroids.
- **Meteors** – When these meteoroids come closer to Earth and enter its atmosphere they vaporize with a streak of light in the sky (meteor shower). They are then called Meteors or shooting stars.
- **Meteorites** – When the meteors do not vaporise completely after entering the Earth's atmosphere, they are called Meteorites.
- **Comet** – A chunk of ice and rock originating from the outer solar system, often accompanied by a coma and tail.

Related news

Scientist found an asteroid known as **2015 BZ509** which is supposed to be the **first interstellar body** to stay in our solar system.

- Its orbit is **"retrograde,"** i.e. 2015 BZ509 **moves around the sun in the opposite direction (clockwise if seen from Sun's imaginary North Pole)** of Jupiter, Earth and most other bodies in the solar system.
- The **orbit of the asteroid almost coincides with the Jupiter.**

2.5. OTHER SPACE RELATED DEVELOPMENT IN INDIA

2.5.1. INDIA-BASED NEUTRINO OBSERVATORY

Why in News?

The National Green Tribunal (NGT) upheld the environmental **clearance granted to the India-based Neutrino Observatory (INO).**

What is INO?

- The project includes:
  - Construction of an **underground laboratory** at Pottipuram **in Bodi West hills** of Theni District of Tamil Nadu.
  - Construction of an **Iron Calorimeter (ICAL) detector** for studying neutrinos, which will include the world's largest magnet.
  - Setting up of **National Centre for High Energy Physics at Madurai**, for the operation and maintenance of the underground laboratory, human resource development and detector R&D along with its applications.
- It is located within 5 km of **Madhikettan Shola National Park in Idukki district of Kerala** and hence also requires **specific approval by the National Board for Wild Life.**

What are Neutrinos?

- The neutrinos are **second most abound particles in the universe.**
- They interact very little with anything and pass through everything that's why it's **hard to detect** them**.**
- They carry **no electrical charge and nearly massless.**
- It occurs in **3 different types/flavors**, separated

based on mass (electron-neutrino, muon-neutrino, tau-neutrino).
- It is **produced in the core of the sun** & millions of them roam around in the solar system.
- Neutrinos **can also be made artificially**. They are produced in radioactive decays and in nuclear reactors.
- Benefits: understanding the particle, understanding the evolution of the universe, understanding of dark matter (as they interact with it), role in nuclear non-proliferation through remote monitoring, study of Geoneutrinos might help creating an earthquake warning system, **map natural resources inside the earth.**
- They are least harmful of elementary particles, as they hardly interact with matter. In fact, trillions of solar neutrinos pass through our body every second without doing any harm to us.

About Anti-neutrinos
- They are antiparticles of neutrinos and are produced in the negative beta decay.
- Antineutrinos (as neutrinos) are very penetrating subatomic particles, capable of passing through Earth without any interaction.
- Neutrinos and antineutrinos belong to the family of leptons, which means they do not interact via strong nuclear force.

Related news

The **IceCube observatory** at the South Pole has discovered that **a "blazar"**, a galaxy with a supermassive black hole at its centre, also produces neutrinos.
- It is a cubic kilometre in size and uses deep antarctic ice as a target for the neutrinos.
- Neutrinos can produce a charged particle when they occasionally do interact with the fundamental particles that make up ice.

Other neutrino study projects
- LAGUNA (Large Apparatus studying Grand Unification & Neutrino Astrophysics) in Europe.
- Hyper Kamiokande Detector at Kamioka Observatory in Hida (Japan).
- DUNE (Deep Underground Neutrino) project in South Dakota (US).
- China proposed Neutrino Observatory in Jianmeng Province

2.5.2. LASER INTERFEROMETER GRAVITATIONAL-WAVE OBSERVATORY

Why in News?

LIGO-India (INDIGO) Observatory is scheduled to be **operational in 2024.**

Details
- It is a planned advanced gravitational-wave observatory to be located in India as part of the worldwide network.
- It is planned as **a collaborative project** between a **consortium of Indian research institutions and the LIGO Laboratory in the USA**, along with its international partners Australia, Germany and the UK.
- The LIGO project operates three gravitational-wave (GW) detectors. Two are at Hanford and Livingston in USA.
- The proposed LIGO-India project aims to move one Advanced LIGO detector from Hanford to India. It would be stationed at a perpendicular direction to the detectors in USA.
- LIGO-India is funded by the **Department of Atomic Energy (DAE) & Department of Science and Technology (DST).**
- It proposed to be built in **Maharashtra's Hingoli District.**

What are Gravitational Waves?
- Gravitational waves are distortions or 'ripples' in the fabric of spacetime caused by some of the most violent and energetic processes in the Universe such as such as the explosion of giant stars, the collision of ultradense dead ones, and the coming together of black holes.
- Albert Einstein predicted the existence of gravitational waves in 1916 in his general theory of relativity.
- The effect is very weak, however, and only the biggest masses, moving under the greatest accelerations, are expected to warp their surroundings to any appreciable degree.
- The LIGO detectors discovered the first gravitational waves produced by two giant merging blackholes in 2017.
- Nobel Prize for Physics, 2017 was awarded to Scientists Rainer Weiss, Barry Barish and Kip Thorne for contributions to the LIGO detector and the observation of gravitational waves.

2.5.3. COSMIC MICROWAVE BACKGROUND RADIATION (CMBR)

Why in news?

Scientists from the Raman Research Institute in Bengaluru have conducted an experiment for detection of Cosmic Microwave back ground radiation in **Timbaktu in Andhra Pradesh**.

More about news
- Timbaktu was chosen as it is described as **Radio Quiet** — an area where there is virtually no interference from signals produced by modern technology like mobile, TV etc. which makes it most suitable place to detect even faint electromagnetic signals from the sky.

Cosmic Microwave Background Radiation (CMBR)

- It is **an all-pervasive, but weak, electromagnetic radiation** from the early universe**, about 3,80,000 years after the Big Bang when matter was still to be formed.** Most cosmologists consider this radiation to be **the best evidence for the hot big bang model of the universe.**
- This radiation **does not come from any of the objects that we see in the universe, like stars or galaxies** but from a time **when matter and radiation were in thermodynamic equilibrium**.
- The spectrum produced by **CMBR is very smooth**. It does, however, contain **small wiggles, or deformities**, in its shape.
- **Each of these wiggles has valuable encoded information** about specific events that took place as the first stars were born.

2.5.4. INDIA'S FIRST ROBOTIC TELESCOPE

Why in news?

Recently, India's first robotic telescope – **Global Relay of Observatories Watching Transients Happen (GROWTH)-India**, began its operation at the Indian Astronomical Observatory (IAO) in Hanle in Ladakh.

GROWTH-India

- It is a joint project of Indian Institute of Astrophysics, Bangalore and the Indian Institute of Technology Bombay (**IITB).**
- It is fully funded by the Science and Engineering Board **(SERB)** of the **Department of Science and Technology**, under the **PIRE project**, administered by the Indo-US Science and Technology Forum.
- It is a 70cm telescope and the primary objective of the project is the **time domain astronomy**.
- It is mainly an **imaging telescope.**
- The first targets for the telescope were chosen from the **Messier catalogue** (a catalogue of nearby, bright astronomical sources accessible from the northern hemisphere).

About GROWTH Initiative

- It is a part of **multi-country collaborative** initiative to **observe transient events in the universe.**
- The initiative focus on **three scientific themes** in the field of time-domain astronomy – cosmic explosions (supernova), small near-earth asteroids and the electromagnetic identification of gravitational wave sources.
- It is a **fully robotic optical research telescope** which has been designed to capture cosmic events occurring in timescales much shorter than light years like years, days and even hours.
- **Partners:** Universities and research institutes from the US, the UK, Japan, India, Germany, Taiwan and Israel are part of the initiative.

What are transient events?

- These are short lived burst of energy in a system caused by a sudden change of state.
- The events are caused due to several factors such as relatively benign flares of stars, accretion of matter on compact objects, stellar merger and explosions.
- All these result in a flash in the sky for a period and then slowly fade away.
- Through these electromagnetic signatures, astronomers try to gain an insight into the cosmic objects as well as physical processes that govern their evolution.

What is Time Domain Astronomy?

It is the study of how astronomical objects change with time. Changes may be due to movement or physical changes in the object itself. Examples include pulsar variability, and the variability of accreting black holes, variable stars, and the Sun.

Himalayan Chandra Telescope

- It is a 2-m Telescope at IAO, Hanule, ladakh.
- It is remotely operated using dedicated satellite communication link from the Centre of Research & Education in Science and Technology.

2.5.5. SUNSPOT CYCLE

Why in news?

Recently, scientists from Indian Institute of Science Education and Research have developed a way of predicting the intensity of activity in the next solar cycle (approximately from 2020 to 2031).

What is Sun-spot Cycle?

- The amount of magnetic flux that rises up to the Sun's surface varies with time in a cycle called the solar cycle. This cycle which lasts 11 years on average is referred to as the sunspot cycle.
- Sun spots are darker, magnetically strong, cooler areas on the surface of the sun in a region called the photosphere.
- It will help in understanding of the long-term variations of the Sun and its impact on earth climate which is one of the objectives of India's first solar probe – 'Aditya L-1 Mission'.

About Aditya L1

- It will be placed in a **halo orbit** around a vantage point in space known as **L1 Lagrange point**.
  - Halo Orbit is periodic, three-dimensional orbit near the L1, L2 and L3 lagrange point (unstable) in a three body system.
  - Lagrange Point is the point where the combined gravitational force of two large bodies is equal to the centrifugal force that is felt by a third body which is relatively smaller. There are about 5 such points in a two body system.
  - The point L1 has the major advantage of viewing the sun without any occultation/ eclipses.
- The mission will carry seven payloads including the main payload the Visible Emission Line Coronagraph (VLEC).
- Aditya L1 is to be the first satellite to study the magnetic field of the sun's corona.
- It is expected to help study that why the photosphere, the deeper layer of the sun is at much lower temperature than the corona.
- It will also study aspects that affect space weather, the origin of solar wind ions, their reaction to coronal mass ejections, the distribution of these in the heliosphere- the space around the sun that extends up to Pluto.

2.5.6. EXOPLANET DISCOVERED BY INDIA

Why in news?

Recently Indian scientists discovered a sub-Saturn or super-Neptune sized exoplanet.

More about the news

- The discovery was made by measuring the mass of the planet using the indigenously designed **PARAS (PRL Advance Radial-velocity Abu-Sky Search)** spectrograph integrated with a 1.2m telescope at **Gurushikar Observatory in Mount Abu**.
- The name of the host star is EPIC 211945201 or K2-236 and the planet will be known as **EPIC 211945201b or K2-236b.**

About Exoplanet

- An exoplanet or extrasolar planet is a planet outside our solar system around a different host star than sun.
- Around 3500 exoplanets have been discovered. Some of the exoplanetary system are Trappist-1 planetary system, kepler-11 planetary system, TrES-4.
- Kepler 90 is the first star system to have as many planets as our solar system.

2.5.7. PARTICLE DECAY

Why in News?

Recently, Scientist at CERN observed the Higgs boson decaying to fundamental particles known as bottom quarks.

More on news

- Higgs bosons decay into pairs of the following particles in the following percentages: bottom quarks (58 percent), W bosons (21 percent), Z bosons (6 percent), tau leptons (2.6 percent) and photons (0.2 percent).
- **Significance:** It validates the theory of Standard Physics which states that about 60% of the time a Higgs boson will decay to a pair of bottom quarks.
  - **Standard Model:** It's built upon the idea that the Higgs field endows quarks and other fundamental particles with mass.
  - Standard Model **doesn't include dark matter** that makes up 85 percent of mass in the universe—or a description of how gravity works at the quantum level.
- A quark **is one of the fundamental particles** in physics. They **join to form hadrons, such as protons and neutrons**.
- The study of quarks and the interactions between them through the strong force is called **particle physics.**
- The antiparticle of a quark is the antiquark**. Quarks and antiquarks are the only two fundamental particles that interact through all four fundamental forces of physics**: gravitation, electromagnetism, and the strong interaction and weak interactions.
- A quark **exhibits confinement**, which means that the quarks are not observed independently but always in combination with other quarks. This makes determining the **properties (mass, spin, and parity) impossible to measure directly**.
- There are **six flavors of quarks**: up, down, strange, charm, bottom, and top. The flavor of the quark determines its properties.

About Higgs Boson

- It is popularly known as the **God particle** and is responsible for giving mass to fundamental subatomic particles.
- It was discovered by **Large Hadron Collider (LHC)** at CERN, the European Organization for Nuclear Research.
- CERN is the world's largest nuclear and particle physics laboratory. At CERN, scientists and engineers are probing the fundamental structure of the Universe.

- LHC accelerator hosts two large-particle physics detectors capable of observing Higgs bosons — the **Compact Muon Solenoid (CMS)** and **A Toroidal LHC Apparatus (ATLAS).**

2.5.8. EARTH'S TWO EXTRA HIDDEN 'MOONS'

Why in news?

Recently, a group of Hungarian scientists confirmed a long-standing astronomical speculation—the **Earth has three natural satellites or moons.**

- The new moons are entirely made up of **extremely tiny dust particles of less than one millimetre size** and reflect light rather faintly making them difficult to observe and study even when they are located at around the same distance as the Moon from the Earth—400,000 kilometres.
- They were observed for the first time in 1961 by Kazimierz Kordylewski, a Polish scientist and they were later named after him as **Kordylewski Dust Clouds** (KDCs).
- These were found close **to Lagrange point L5 o**f the Earth-Moon gravitational system.

Related news

China is planning to launch its own '**artificial moon**' by 2020 to **replace streetlamps** and lower electricity costs in urban areas.

- It is essentially an **illuminated satellite** which will bear a reflective coating to cast sunlight back to Earth at night.
- It would **orbit at about 500km around the Earth,** compared to the moon's 380,000 km.
- It would be **eight times brighter than the Earth's moon.**
- The satellites' brightness and service time are both adjustable, and the accuracy of the lighting can be controlled.
- However, China is **not the first country** to try beaming sunlight back to Earth. In the 1990s, Russian scientists used giant mirrors to reflect light from space.

The International Astronomical Union (IAU) has assigned the name Hippocamp to Neptune's smallest moon S/2004 N1 discovered in 2013 through Hubble Space Telescope.

- IAU is an International Association of Professional astronomers active in professional research and education in astronomy.
- With the exception of Earth, all of the planets in our solar system have names from Greek or Roman mythology.
- Similarly, the natural satellites of planets are mostly given names based on Greek or Roman mythology. Satellites of Uranus are an exception as they are named after literary characters and not mythological characters.

3. DEFENCE TECHNOLOGY

3.1. INTEGRATED GUIDED MISSILE DEVELOPMENT PLAN (IGDMP)

Why in news?

Recently several missiles, such as **Agni V, Dhanush, Prithvi-II and Nag,** being developed under IGDMP were successfully test fired at various locations.

Integrated Guided Missile Development Plan

- It was envisioned in 1983 by former President **Dr. A P J Abdul Kalam** to help India attain self-sufficiency in the field of missile technology.
- Five missile systems have been developed **under this programme** namely **Agni, Akash, Trishul, Prithvi and Nag**.
- In 2008 DRDO announced the successful completion of the program.

Defence Research & Development Organisation (DRDO)

- It was **formed in 1958 by the merger** of the Technical Development Establishment and the Directorate of Technical Development & Production with the Defence Science Organisation.
- It is under the administrative control of the **Ministry of Defence**.
- It works for **enhancing self-reliance** in defence systems and **production of world class weapon** systems and equipment in accordance with the expressed needs and the qualitative requirements laid down by the three services.

3.1.1. AGNI

- It is an **intercontinental surface-to-surface, nuclear capable ballistic missile**.
- At present, US, China, Russia, UK, France and Israel are known to have ICBMs.
- It has been equipped with very high accuracy **Ring Laser Gyro based Inertial Navigation System (RINS)** and **Micro Navigation System (MINS).**
- India has reportedly also been working on **multiple independently targetable reentry vehicles (MIRV)** for the Agni-V in order to ensure a credible second strike capability or credible minimum deterrence**.**

Missile	Details
Agni-I	• Single-stage engine powered by solid fuel • Short-range ballistic missile. • Coverage: 700 km
Agni-II	• Two stage solid propellant engine. • Medium-range ballistic missile • Coverage: 2000 km
Agni-III	• Two-stage solid propellant engine • Intermediate range ballistic missile • Coverage: 3000 km
Agni-IV	• Two-stage solid propellant engine • Intermediate range ballistic missile • Coverage: 4000 km
Agni-V	• Powered by 3 stage solid, all composite rocket motors • It is an Intercontinental Ballistic Missile (ICBM) • Coverage: 5000 km • Maximim speed: 24 times speed of sound • Canister-launch for quick-response, higher reliability, longer shelf-life, less maintenance and enhanced road mobility

3.1.2. PRITHVI

- Both Prithvi-I and Prithvi-II are **short range surface-to-surface ballistic missile**.
- While Prithvi I has a **range of 150km** (used by Army), Prithvi II has **a range of 350 km** (used by Airforce).
- **Dhanush** (also known as Prithvi III), **a naval variant** of this Prithvi missile, has a range of 350 km.

3.1.3. NAG

- It is a **third generation "fire and forget"** anti-tank guided missile.
- It can be launched from **land and air-based platforms**.
- The helicopter-launched configuration, designated as **helicopter-launched NAG (HELINA)**, can be fired from Dhruv advanced light helicopter (ALH) and HAL Rudra attack helicopter.
- The **land based version (NAMICA)** has maximum range of 4 km while air based version has a maximum range of 7 km.

3.1.4. AKASH MISSILE

- It is a **supersonic surface-to-air missile.**
- It has a strike range of about 30 km and can carry a 55- kg fragmentation warhead.
- It's designed to neutralise multiple aerial targets attacking from several directions simultaneously.
- The system is autonomous and its operation is fully automated.

3.1.5. TRISHUL MISSILE

- It is a **Quick Reaction Surface to Air Missile.**
- It can be used as an anti-sea skimmer from a ship against low flying attacking missiles.

- It employs dual thrust propulsion stage using high-energy solid propellant.

Related information
Types of missile

- **Cruise Missile**: A cruise missile is an unmanned self-propelled guided vehicle that sustains flight through aerodynamic lift for most of its flight path. They fly within the Earth's atmosphere and use jet engine technology. **Classification on the basis of speed**
  - **Subsonic cruise missile** flies at a speed lesser than that of sound. It travels at a speed of around 0.8 Mach.
  - **Supersonic cruise missile** travels at a speed of around 2-3 Mach. The combination of supersonic speed and warhead mass provides high kinetic energy ensuring tremendous lethal effect.
  - **Hypersonic cruise missile** travels at a speed of more than 5 Mach. Many countries are working to develop hypersonic cruise missiles.
- **Ballistic Missile**: A ballistic missile is a missile that has a ballistic trajectory over most of its flight path, regardless of whether or not it is a weapon-delivery vehicle.

3.2. INS ARIHANT

Why in news?

The **indigenous INS Arihant,** India's first nuclear-powered submarine successfully completed its **first deterrence patrol.** With the completion of the patrol, **India have finally achieved the longstanding ambition to have a nuclear triad.**

About INS Arihant

- INS Arihant is a **part of Indian Navy's secretive Advanced Technology Vessel (ATV) project** operated under the supervision of the Prime Minister's Office and closely monitored by agencies such as the Department of Atomic Energy and the Submarine Design Group of the Directorate of Naval Design.
- The INS Arihant was **built at the Ship Building Centre at Visakhapatnam**.
- It is **capable of carrying nuclear-tipped ballistic missiles**.
- The vessel will be able to carry 12 Sagarika K 15 submarine launched ballistic missiles that have a range of 750 km. It can also be armed with four K-4 submarine launched ballistic missile with a range of 3,500 km.
- There is **also provision to launch non-nuclear tipped BrahMos** supersonic cruise missile as well as the 1,000-km sub-sonic cruise missile **Nirbhay**, which can be configured for both nuclear and non-nuclear warheads.

Nuclear Triad

- A nuclear triad refers to the **three components of atomic weapons delivery:** strategic bombers, intercontinental ballistic missiles (ICBMs) and submarine launched ballistic missiles (SLBMs).
- A nuclear triad gives a country the ability to launch nukes from land, air and sea. India's nuclear triad consists of multiple deterrants such as Agni and Prithivi missiles for Army, Sukhoi-30MKI and Mirage-2000 for Airforce, INS Arighat for Navy.

3.3. PROJECT 75(I)

Why in news?

Recently the Defence Acquisition Council approved indigenous construction of **Six Project 75(I) submarines** under strategic partnership model.

More on news

- Project 75 India (P-75I) is follow-on of the Project 75 Kalvari-class submarines for the Indian Navy.
- Under this project, the Indian Navy intends to acquire six **diesel-electric submarines**, which will also feature advanced Air-independent propulsion (AIP) systems to enable them to stay submerged for longer duration and substantially increase their operational range.
- Six Scorpene-class submarines are currently being built under 'Project 75' of the Indian Navy.
  - The submarines, designed by French firm Naval Group are being built by Mazagon Dock Limited in Mumbai.
  - The first of these, INS Kalvari was commissioned in Dec 2017 and INS Khanderi and INS Karanj are undergoing sea trials.
- The P75I project is part of a 30-year submarine building plan that ends in 2030. According to this, India has to build 24 submarines — 18 conventional submarines and six nuclear-powered submarines (SSNs).

Strategic Partnership (SP) Model

- Under this policy **an Indian private company would be selected in each segment** which would tie up with shortlisted **global Original Equipment Manufacturer** (OEM) to manufacture the platforms in India under technology transfer.
- The SP model has **four segments** — submarines, single engine fighter aircraft, helicopters and armoured carriers/main battle tanks — which would be specifically opened up for the private sector.
- It was first suggested in 2015 by **Dhirendra Singh Committee** and was introduced by Defence Procurement Procedure 2016.

- A **49 per cent FDI cap** has been kept for setting up ventures under this for the production of defence platforms and the companies have to be in control of Indian entities.

3.4. SMART BORDER FENCE

Why in news?

Recently Union Home Minister inaugurated the smart border fencing pilot projects under the **Comprehensive Integrated Border Management System (CIBMS) programme.**

What is CIBMS?

- It is a robust and integrated system that is capable of addressing the gaps in the present system of border security by seamlessly integrating human resources, weapons, and high-tech surveillance equipment.
- It has three main components: new high-tech surveillance devices, an efficient and dedicated communication network and a command and control centre.

Related news

BOLD-QIT

- Government inaugurated **BOLD-QIT (Border Electronically Dominated QRT Interception Technique)** under CIBMS on India-Bangladesh border in Dhubri District of Assam.
- It enables BSF to equip Indo-Bangla borders with different kind of sensors in unfenced riverine area of Brahmaputra and its tributaries.

Project Network for Spectrum (NFS)

The Cabinet Committee on Infrastructure approved substantial hike in the budget for the Network for Spectrum (NFS) project.

- It was launched to establish the **alternative communication network for exclusive use by defence services** to boost the communication capabilities of defence forces.
- The project is result of an agreement reached in 2010 between Defence ministry and Dept. of Telecom (DoT) in which DoT agreed to vacate 25 MHz of 3G spectrum and 20 MHz of 2G spectrum in phases solely for defence communication purpose
- The project is being implemented by state-run **Bharat Sanchar Nigam Limited (BSNL).**

3.5. DRONE REGULATIONS IN INDIA

Why in News?

Ministry of Civil Aviation (DGCA) has for the first time released a set of rules regulating the civil use of drones in India which will be effective from 1st December, 2018.

What are drones?

- **Drones or unmanned aerial vehicles (UAVs)** have been defined as "Powered, aerial vehicles that do not carry a human operator, use aerodynamic forces to provide vehicle lift, can fly autonomously or be piloted remotely, can be expendable or recoverable, and can carry a lethal or nonlethal payload".
- **They can be used for:** damage assessment in areas affected with natural calamities, surveillance and crowd management, **monitoring of wildlife** etc.

Various Defence UAV developed by DRDO

- **Nishant:** It was designed for battlefield surveillance and reconnaissance.
- **Panchi:** It wheeled version of UAV Nishant.
- **Lakshya:** It is a surface/ship launched reusable aerial target system.
- **Rustom-2:** It's used by all three services of Indian armed forces, primarily for intelligence, surveillance and reconnaissance (ISR) operations.
  - It can fly missions on manual as well as autonomous modes.

Key features of the Regulations for Civil Use of Remotely Piloted Aircraft System (RPAS)

- **The Digital Sky Platform** is the first-of-its-kind **national unmanned traffic management (UTM) platform** that implements "**no permission, no takeoff**".
- All civil RPA, shall require to obtain **Unique Identification Number** (UIN) from DGCA.
- As per the regulation, there are 5 categories of Remotely Piloted Aircraft System (RPAS) categorized by weight.
- Operators of civil drones will **need to get an Unmanned Aircraft Operator Permit (UAOP) from the DGCA** with certain exceptions.
- RPAS shall be flown only by someone **over 18 years of age, having passed 10th exam in English**, and undergone ground/ practical training as approved by DGCA.
- DGCA has also clarified that **no remote pilot can operate more than one RPA at any time**.
- The basic operating procedure will **restrict drone flights to the daytime only** and that too within "Visual Line of Sight (VLOS)".
- An **insurance will be mandatory** to cover third-party damage.
- **Restrictions placed such as:**
  - RPAS cannot be flown within 5km of the perimeters of the airports in Mumbai, Delhi, Chennai, Kolkata, Bengaluru and Hyderabad and within 3km from the perimeter of any other airport.
  - It cannot fly within "permanent or temporary Prohibited, Restricted and

Danger Areas" and within 25km from international border which includes the Line of Control (LoC), Line of Actual Control (LAC) and Actual Ground Position Line (AGPL).
    - It cannot fly beyond 500 m into sea from the coast line and within 3 km from perimeter of military installations.
    - It also cannot be operated from a mobile platform such as a moving vehicle, ship or aircraft.
    - Eco-sensitive zones around National Parks and Wildlife Sanctuaries are off-limits without prior permission.

Related news

- Government has setup the **Drone Task Force under the chairmanship Jayant Sinha** which will provide draft recommendations for Drone Regulations 2.0.

3.6. OTHER DEFENCE PROJECTS IN NEWS

3.6.1. SOLID FUEL DUCTED RAMJET (SFDR)

- Recently, DRDO successfully flight tested the second indigenously developed **'Solid Fuel Ducted Ramjet (SFDR)'** propulsion-based missile system.
- Started in 2013, it's an **Indo-Russian R&D project** which has been established to develop a long-range air-to-air missile and a surface-to-air missile system in near future.
- SFDR technology, based on the **ramjet propulsion system** depends only on its forward motion at supersonic speed to compress intake air
- Unlike solid rocket propellant whose formulation is approximately 20% fuel and 80% oxidizer, the solid ramjet fuel is **100% fuel and obtains oxidizer from air,** with the result being approximately **four times the specific impulse** (the product of thrust and time divided by propellant weight) as compared to solid rocket propellant.
- Hence, this **air breathing ramjet propulsion technology** helps propel the missile at high supersonic speeds (above Mach 2) for engaging targets at long ranges.
- Consequently, it has inherent simplicity, reliability, lightweight, and high-speed flight capability not possible with other air-breathing engines.

3.6.2. MISSILE PRAHAAR

- India recently successfully test-fired missile Prahaar off Odisha coast.
- It is a surface-to-surface short-range tactical ballistic missile developed by DRDO with a strike range is **150 km.**
- It can carry warhead up to 200 kg. It uses **solid propellant** and travels at a speed of Mach 2.

3.6.3. MILAN-2T ANTI-TANK MISSILES

- The **Defence Acquisition Council** gave approval for acquisition of 5,000 Milan 2T **anti-tank guided missiles** (ATGM) with a **range of 2 Km.**
- Milan-2 is a **French 2nd-generation** man-portable ATGM which is produced in India by **Bharat Dynamics Limited** in partnership with a French firm.
- Some of the **indigenous anti-tank missiles** include: NAG, HELINA, SANT (Stand-off Anti-Tank) Missile, Cannon-launched Laser Guided Missile (CLGM), SAMHO, AMOGHA-1, AMOGHA-2, AMOGHA-3.

3.6.4. BARAK-8 MISSILE

- The Barak 8 missile defence system will be procured by the Israeli Navy to protect its economic zones and strategic facilities.
- **Barak 8 (the Hebrew word for Lightning**), jointly developed by **India and Israel,** is a **long-range surface-to-air missile (LRSAM).**
- It is designed to defend against any type of airborne threat including aircraft, helicopters, anti-ship missiles, and UAVs as well as cruise missiles and combat jets.
- Its main features include**:**
    - Capability to take down an **incoming missile as close as 500 meters** away;
    - Maximum speed – **Mach 2**
    - Operational range - 70 Km (which has been increased to **100 Km**)
    - **Simultaneous Engagements on multiple targets** in **all weather** conditions.

3.6.5. NATIONAL ADVANCE SURFACE TO AIR MISSILE SYSTEM-II (NASAMS)

- Recently, Defence Acquisitions Council (DAC) approved the acquisition of National Advance Surface to Air Missile System-II (NASAMA) for the security of Delhi.
- NASAMS was developed by Raytheon in partnership with KONGSBERG Defence and Aerospace of Norway.

- It quickly detects, tracks & shoots down multiple airborne threats such as cruise missiles, aircraft and drones.
- It consists of a radar, short and medium range missile launchers and fire distribution centres,
- It is deployed in US, Israel, Russia and various NATO countries.

3.6.6. AVANGARD HYPERSONIC SYSTEM

- Recently, Russia successfully test fired Avangard Missile.
- It's liquid-fueled **intercontinental-range ballistic missile (ICBM)**, with the ability to fly as fast as Mach 20 (more than 15,000 miles per hour), and can carry nuclear and conventional warheads.
- Avangard deployment by 2019 will make it **the first operational hypersonic glide vehicle system** deployed anywhere in world.

3.6.7. PINAKA ROCKET

- An upgraded version of Pinaka rocket was recently successfully test-fired from Chandipur in Odisha.
- The **upgraded Pinaka system, Pinaka mark-II,** is a guided one unlike the earlier version and has navigation, guidance and control kit.
- The range of new version is more than **70 kilometre** which was earlier only 40km.
- It is a multi-barrel rocket launcher which can fire a salvo of 12 rockets in 44 seconds.

3.6.8. LCA TEJAS

- Recently, India's **Light Combat Aircraft** (LCA) Tejas has received the final operational clearance for induction into the Indian Air Force (IAF) as **a weaponised fighter jet**.
- It is **indigenously** built fighter aircraft and has been designed by **Aeronautical Development Agency (ADA)** and produced by **Hindustan Aeronautics Limited (HAL)**.
- It is **single-seat** multi-role jet fighter, powered by **single engine** and can also carry out mid-air refueling. It is pegged as **world's smallest and lightest supersonic fighter aircraft** in its class.
- It has limited reach of little **over 400-km** and will be mainly used for **close air-to-ground operations** (unlike Russian-origin Sukhoi-30MKIs or Rafale which have deep strike capability into enemy territory due to their long range).
- It is equipped with state-of-the-art **Satellite aided Inertial Navigation System**.
- It is **not the first indigenous fighter** to be inducted into the IAF. In April 1967, IAF had formed the first operational squadron with the indigenous HF-24 Marut fighter.

3.6.9. CHINOOK HELICOPTERS

- India received Boeing Co.'s Chinook helicopters that are expected to **bolster the heavy-lift capabilities of its air force** and further strengthen the fast-expanding defence ties with the US.
- It is a multi-role, vertical-lift platform, which is used for **transporting troops, artillery, equipment and fuel.** It is also used for **humanitarian and disaster relief operations** and in missions such as transportation of relief supplies and mass evacuation of refugees.
- It is also expected to give a **significant boost to infrastructure development along India's borders** given the Chinook has the **capability to ferry heavy cargo like road construction equipment** over difficult terrain.

3.6.10. ARTILLERY GUN 'DHANUSH'

- It is the **first long-range artillery** gun to be produced in India.
- It is an **upgraded version**, based on the original design of the **Swedish 155-mm Bofors howitzers,** which India procured in the mid-1980s.
- It is the product of joint efforts by the Ordinance Factory Board and the Army with contributions from the DRDO, DGQA etc. and several private enterprises.

4. IT & COMPUTER

4.1. DATA PROTECTION

Why in news?

Recently, B. N. Srikrishna committee submitted its report on a Data Protection Framework and also a draft bill on data protection.

Key features of Data protection framework as provided by Sri Krishna Committee

- **Fiduciary relationship**: The relationship between the individual and the service provider must be viewed as a fiduciary relationship.
- **Defined personal data**: as data from which an individual may be identified or identifiable, either directly or indirectly.
- **Consent-based data processing except in certain cases.**
- **Ownership of personal data:** Through rights such as right to access, confirm & correct data, right to object data processing and **right to be forgotten.**
- **Regulatory authority:** to inquire into and take action against any violations of the data protection regime.
- **Amendments to other laws:** Minimum data protection standards should be adhered to for all data processing in the country authorized under various laws such as Information Technology Act, Census Act etc.
- **The Draft Personal Data Protection Bill 2018** follows the recommendation of the committee and also provides for establishment of a data protection authority, **mandates data localization**, offences and penalties, **recognition of privacy as a fundamental right etc.**

Data Protection in India

- India **does not have any dedicated legal framework** for data protection. Presently some acts cover the data protection in general
  - **Sec 43 A of Information technology act 2000** protects user data from misuse but it is applicable to **only corporate entities and not on government agency**. Also the rules are restricted to sensitive personal data only — **medical history, biometric information among other** things.
  - Other acts like **consumer protection Act 2015, copyrights act 1957** among others also attempt to protect the personal information.

Related news

Recently European Union has adopted **General Data Protection Regulation 2018** which mandates that every EU citizen's data be stored within the EU. GDPR also regulates exportation of this data outside the EU.

4.2. NET NEUTRALITY

Why in News?

The Telecom Commission, the highest decision-making body in the Department of Telecom has recently approved the principles of net neutrality recommended by TRAI last year.

What is Net Neutrality?

- The basic principles of net neutrality is that nobody owns the internet and it is free and open to all and that Internet Service Providers (ISPs) must treat all internet traffic equally without any regard to the type, origin or destination of the content or the means of its transmission.
- According to TRAI net neutrality principles, **any form of discrimination or interference** in the treatment of content, including practices like blocking, degrading, slowing down or granting preferential speeds or treatment to any content is **prohibited.**
- **Other recommendations include:**
  - **Specialised Service**: are exempted from neutrality framework such as tele-surgery, Voice over Internet Protocol (VoIP) and IPTV services etc.
  - **Content delivery Network (CDN) platform**: should not be included within the scope of any restrictions on non-discriminatory treatment.
  - **Regulatory Body:** TRAI suggested DoT may establish a multi-stakeholder body with framework for collaborative mechanism among the stakeholders for monitoring the net-neutrality.

Related news

Inclusive Internet Index 2019

- Recently, India ranked 47th in **Inclusive Internet Index 2019.**
- It is the third edition of Inclusive Internet Index, prepared by **The Economist Intelligence Unit**.
- It covers 100 countries, representing 94 per cent of the world's population and 96 per cent of global GDP. Sweden has topped the ranking and Congo is on the last spot.
- It measures inclusiveness based on four categories: **Accessibility** (network coverage), **Affordability** (pricing), **Relevance** (availability of local-language content) and **Readiness** (capability to access internet).

4.3. 5G

Why in news?

The Steering Committee, headed by **AJ Paulraj**, for identifying the 5G deployment roadmap for India recently submitted report titled 'Making India 5G Ready'.

What is 5G?

- 5G is a wireless communication technology using **radio waves** or radio frequency (RF) energy to transmit and receive data.
- 5G technologies will enter services gradually, beginning in 2019 and advance to a full range of services by 2024.
- The final standard for 5G will be set up by the **International Telecommunications Union (ITU).**
- Technical specification for 5G –
  - **high data rates**: While 4G tops out at a theoretical 100 megabits per second (Mbps), 5G tops out at 10 gigabits per second (Gbps).
  - **massive connectivity** of 1 million connections per square kilometer (4G- 100 thousand conncetions/km^2).
  - **ultra-low latency** of 1 millisecond (4G has a latency of 10 ms).
  - **high reliability** (99.999% for mission critical 'ultra-reliable' communications), and
  - **Mobility at high speeds** (up to 500 km/h i.e. high-speed trains).
  - **30 Ghz of available spectrum in comparison to 3Ghz of 4G.**

Related information

- The Government has launched a program titled **'Building an End-to-End 5G Test Bed'**. The program envisages close collaboration between the universities and small technology companies to build broadly compliant with the third generation partnership projects (3GPP) standards.
- Ericsson has installed the first public access 5G test bed at IIT Delhi.

5G in World

- South Korea has become the world's first country to launch 5th-Generation (5G) networks.
- Shanghai Becomes World's First City With 5G Network Coverage.

4.4. DIGITAL INITIATIVES

4.4.1. NATIONAL DIGITAL LITERACY MISSION

Why in News?

Recently a report on review of **National Digital Literacy Mission** was laid in Parliament by the Parliamentary Standing Committee on Information Technology.

Background of Government Initiatives

- **National Digital Literacy Mission** (NDLM) was launched to realize the **vision of 'Digital India'**, which aims for transforming India into a digitally empowered society and economy.
- **Under the mission**, beneficiaries undergo a 20-hour training programme in using computers and other digital devices, browsing the Internet and sending and receiving emails.
- The original deadline for the NDLM was 18 months but it was extended to 27 months before it was scrapped in June 2016. While the programme was still running, the government introduced the **Digital Saksharta Abhiyan, or DISHA**, in January 2015.
- In 2017, the government launched the **Pradhan Mantri Gramin Digital Saksharta Abhiyan** by improving upon previous two schemes.

Related Information

Pradhan Mantri Gramin Digital Saksharta Abhiyan' (PMGDISHA)

- It was launched in 2017 to **make 6 crore rural households digitally literate by March 2019.**
- It is expected to be **one of the largest Digital Literacy Programmes** in the world.
- Under the scheme, 25 lakh candidates will be trained in the FY 2016-17; 275 lakh in the FY 2017-18; and 300 lakh in the FY 2018-19.
- To ensure equitable geographical reach, **each of the 250,000 Gram Panchayats would be expected to register an average of 200-300 candidates.**

4.4.2. DIGITAL VILLAGE PROGRAMME

Why in news?

Recently, it has been decided to expand **Common Service Centres (CSC)** to 2.50 lakh gram panchayats.

More on news

- The CSC model has adopted six villages in the country in the pilot phase to be developed as Digital Villages.
  - Common Service Centres (CSC) scheme is one of the **mission mode projects** under the **Digital India Programme.**
  - CSCs are the access points for delivery of **essential public utility services, social welfare schemes, healthcare, financial, education and agriculture services, apart from host of B2C services** to citizens in rural and remote areas of the country.
- **DigiGaon or Digital Village** is conceptualized as a connected place in a rural and remote

part of the country where citizens can avail various e-Services of the Central Government, state Governments and private players.

- **Aim:** Promoting rural entrepreneurship and building rural capacities and livelihoods through community participation and collective action.
- The digital villages have been equipped with solar lighting facility in their community center, LED assembly unit, sanitary napkin unit (with active participation on Asha and Anganwadi workers) and Wi-fi choupal.

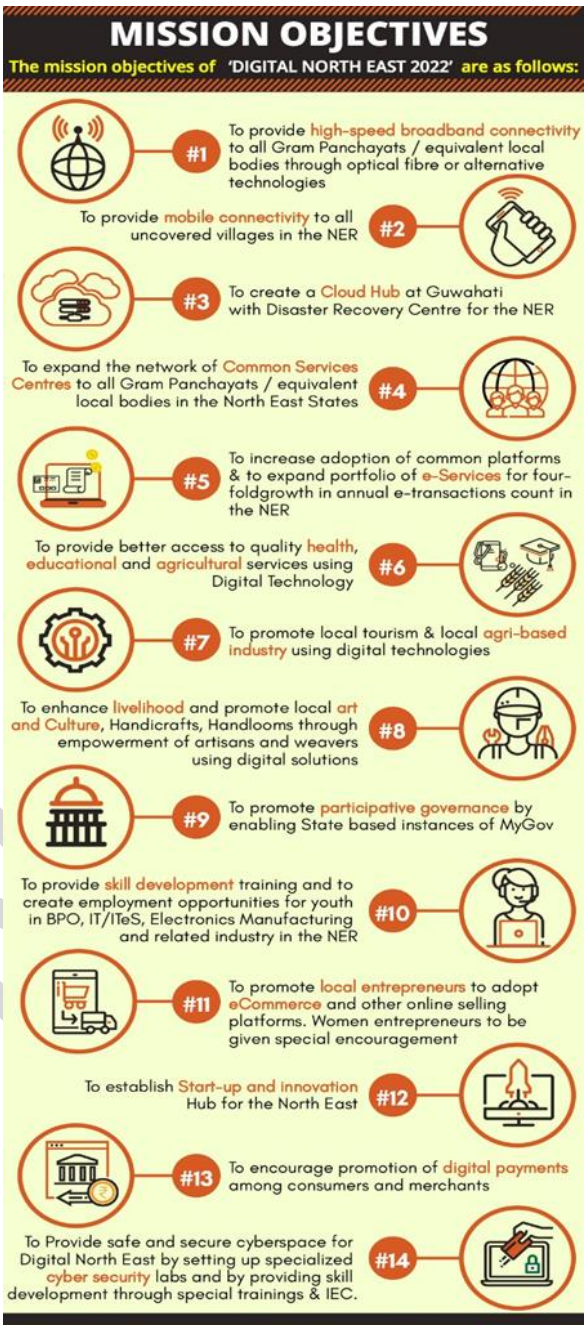
4.4.3. DIGITAL NORTH-EAST VISION 2022

Why in News?

Recently government released **'Digital North East: Vision 2022'**, that aims to leverage digital technologies to transform lives of people of the northeastern states and enhance the ease of living.

More on news

- The Vision document aims to consolidate all the disparate digital initiatives with a view to restructure, refocus, and fast track implementation in a synchronised manner.
- **Launched under the Digital India programme** it will be coordinated by the **Ministry of Electronics and Information Technology** and will be implemented by various central government ministries and governments of north eastern states,
- The document identifies **eight digital thrust areas** -digital infrastructure, digital services, digital empowerment, promotion of electronics manufacturing, promotion of IT and IT enabled services including BPOs, digital payments, innovation & startups, and cyber security.



4.4.4. DIGITAL PAYMENT

Why in news?

NITI Aayog recently pointed out that the digital payments market in India is set to become a trillion-dollar industry in the next five years, led by growth in mobile payments which are slated to rise to $190 billion by 2023 from $10 billion in 2017-18.

About Digital Payment in India

- **The Payment and Settlement Act, 2007 defines Digital Payments/electronic funds transfer** as any transfer of funds which is initiated by a person by way of instruction, authorization or order to a bank to debit or credit an account maintained with that bank

through electronic means and includes point of sale transfers; automated teller machine transactions, direct deposits or withdrawal of funds, transfers initiated by telephone, internet and, card payment.

- The payment system can be bifurcated into **two main segments**:
  - The first segment consists of instruments which are covered under **Systemically Important Financial Market Infrastructure (SIFMIs)** and the second segment consist of **Retail Payments.**
  - **Financial Market Infrastructure (FMI)** is defined as a multilateral system among participating institutions, including the operator of the system, used for the purposes of clearing, settling, or recording payments, securities, derivatives, or other financial transactions. Under this segment there are four instruments of payments: Real Time Gross Settlement (RTGS), Collateralized Borrowing and Lending Obligation, Forex Clearing and Government Securities.
  - Under the **Retail Payments segment** which has a large user base, there are three broad categories of instruments. They are Paper Clearing, Retail Electronic Clearing and Card Payments which includes Cheque Truncation System (CTS), National Electronic Funds Transfer, Unified Payments Interface, Immediate Payment Service etc.

Benefits

- It **reduces cost of transactions:** Digital payment is **faster, easier, more convenient** and **enables financial participation** and inclusion.
- It **promotes more transparency and accountability as it** helps to keep black money under control and **increases tax compliance.**
- It hinders the terror financing network and circulation of counterfeit notes.

Challenges

- **Low internet penetration and Low levels of digital literacy leads to unbanked population:** About 19 percent of the Indian population is still **outside the banking net.**
- **Cyber threats:** It cost the global economy 1% of annual GDP.

Initiatives taken to promote digital payments:

- **The National Payments Corporation of India (NPCI)** was established in 2008 to spearheading the development of the retail payments system.
- **Initiatives by the NPCI:** Launching of grid-wise operations of CTS, RuPay (a domestic card payment network), Aadhaar Payments Bridge System and Aadhaar Enabled Payment System, National Unified USSD Platform (NUUP), UPI and the BHIM application.
- Settlement at half-hourly intervals was introduced in the National Electronic Funds Transfer (NEFT) system.
- **Rationalisation of Merchant Discount Rate** (Rate charged to a merchant for payment processing services on debit and credit card transactions) was undertaken to provide a boost to digital payments.
- Furthermore, **non-bank entities have been introduced in the issuance of pre-paid instruments** (PPI), including mobile and digital wallets.
- **DigiShala:** Free Doordarshan DTH educational channel for creating awareness regarding various forms of electronic payment.
- **Vittiya Saksharta Abhiyan** of **Ministry of Human Resource Development** aims to actively engage the youth/ students of Higher Education Institutions to encourage and motivate all payers and payees to use a digitally enabled cashless economic system for transfer of funds.

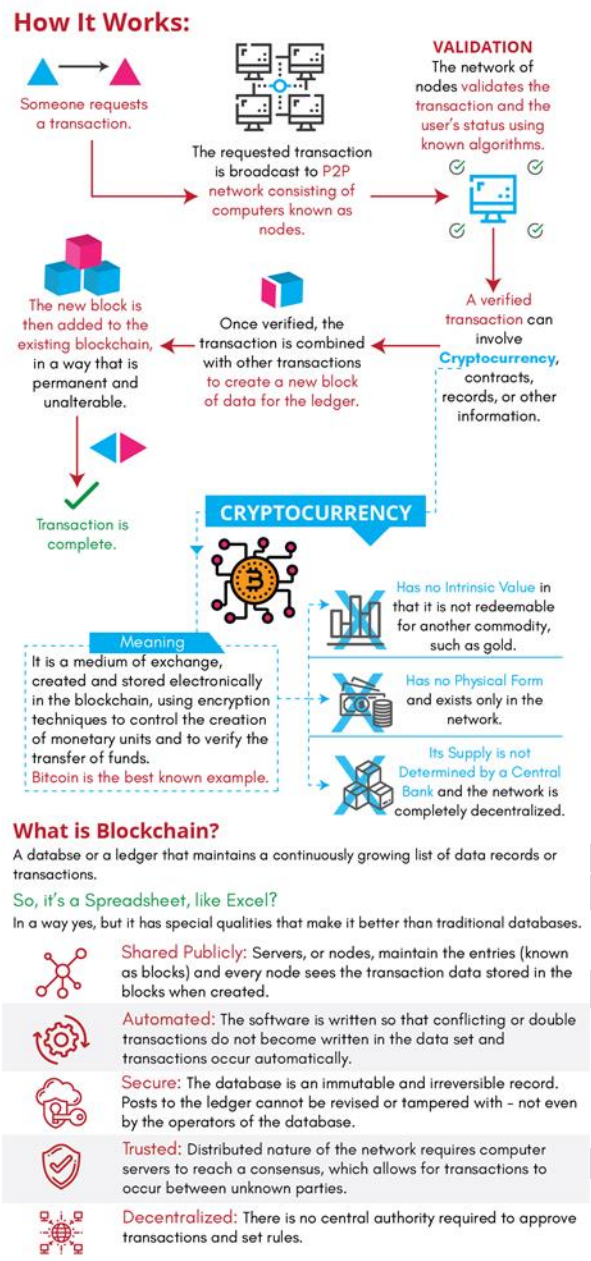
4.5. CRYPTOCURRENCY

Why in news?

The Reserve Bank of India released a statement directing all regulated entities, including banks, to stop dealing with individuals and businesses involved in virtual currencies**.**

What is Cryptocurrency?

- Cryptocurrency is a type of digital currency that uses cryptography for security and anti-counterfeiting measures.
- It is normally **not issued by any central authority**, making it immune to government interference or manipulation.
- The control of each cryptocurrency works through distributed ledger technology called **blockchain.**
- Examples include Bitcoin, Ethereum, Ripple etc.



Use of blockchain beyond cryptocurrency

It has the power to transform business processes and applications across sectors — from financial services to agriculture, from healthcare to education, among others. Some examples include:

- **Blockchain-powered smart contracts** where every piece of information is recorded in a traceable and irreversible manner would enhance ease of doing business, augment the credibility, accuracy and efficiency of a contract and reduce the risk of frauds substantially.
- **Property deals** which are still carried out on paper making them prone to disputes, can be benefitted through in-built transparency, traceability and efficiency in this system
- **Financial services:** For example, Yes Bank adopted this technology to fully digitise vendor financing for one of its clients which enables timely processing of vendor payments without physical documents and manual intervention while tracking the status of transactions in real time. Even NITI Aayog is reportedly building a platform called 'IndiaChain' — a shared, India-specific blockchain infrastructure to leverage the trinity of Jan-Dhan-Yojana, Aadhaar and the mobile.
- **Healthcare and pharmaceuticals:** It involves a lot of sensitive clinical data which demands a secure and reliable system.
- **Insurance sector:** It may play a crucial part in health or agriculture insurance claims management by reducing the risk of insurance claim frauds.
- **Education sector** to ensure time-stamped repository of pass-outs and job records of students to enable easier verification of candidates by the employees.

4.6. ARTIFICIAL INTELLIGENCE

Why in News?

Recently NITI Aayog released a 'national strategy for artificial intelligence', to suggest ways to promote adoption of machine learning in key areas of the economy.

Artificial Intelligence (AI)

- It refers to the ability of machines to perform cognitive tasks like thinking, perceiving, learning, problem solving and decision making.
- It enables computer system to carry out task on their own that otherwise requires human intelligence.

Importance of AI

- AI has the potential to overcome the physical limitations of capital and labour and open up new sources of value and growth.
- AI has the potential to drive growth by enabling:
  - **Intelligent automation** i.e. ability to automate complex physical world tasks. For e.g.: A recent study found that a Google neural network correctly identified cancerous skin lesions more often than expert dermatologists did.
  - **Labour and capital augmentation:** enabling humans to focus on parts of their role that add the most value, complementing human capabilities and improving capital efficiency.
  - **Innovation diffusion** i.e. propelling innovations through the economy.
- **Role in social development and inclusive growth:** access to quality health facilities, addressing location barriers, providing real-time advisory to farmers and help in increasing productivity, building smart and

efficient cities and infrastructure to meet the demands of rapidly urbanising population are some of the examples that can be effectively solved through AI.

2-Tier Research Architecture proposed by NITI Aayog to address India's AI Aspirations

It is focused on developing better understanding of existing core research and pushing technology frontiers through **creation of new knowledge.**	It is entrusted with a mandate of developing and deploying **application-based research. Private sector collaboration** is envisioned to be a key aspect of ICTAIs.

Also, it has proposed setting up **AIRAWAT (AI Research, Analytics and knowledge Assimilation platform)** to be utilised effectively to support advancement of AI-based developments.

Related News

National Informatics Centre's (NIC) Command & Control Centre (CCC) and Center of Excellence in Artificial Intelligence (CoE in AI)

- The Government of India has setup Command and Control Centre (CCC) at NIC with the aim to provide single window solution for monitoring, troubleshooting and technical support for Cloud and Data Centre Infrastructure.
- In addition, Centre of Excellence in Artificial Intelligence (CoE in AI) by NIC, was inaugurated.
- CoE in AI by NIC has been established with the motto of **'Inclusive AI'** for responsive governance, to work towards improving Government service delivery to citizens.
- CoE in AI will be a **platform for innovative new solutions in AI space.**

Rashmi

- Recently an Indian version of humanoid robot Sophia (Hong Kong) was made and is named as Rashmi.
- Rashmi can **speak Hindi, Bhojpuri and Marathi along with English**.
- It is claimed to be as world's first Hindi speaking realistic humanoid robot and India's first lip-synching robot.
- Rashmi uses linguistic interpretation (LI), artificial intelligence (AI), visual data and facial recognition systems.

4.7. SUPERCOMPUTER

Why in News?

Recently PARAM Shivay, the first super computer designed & built under **the National Supercomputing Mission by C-DAC** (Center for Development of Advanced Computing) at IIT-BHU was launched.

About National Supercomputing Mission

- The Mission, launched in 2015, envisages empowering our national academic and R&D institutions spread over the country by installing a vast supercomputing grid comprising of more than **70 high-performance computing facilities.**
- These supercomputers will also be networked on the **National Supercomputing grid** over the National Knowledge Network (NKN).
- The Mission would be implemented jointly by the **Department of Science and Technology (DST) and Department of Electronics and Information Technology (DeitY)** for over a period of seven years, through the **C-DAC and Indian Institute of Science (IISc), Bengaluru**.
- The Mission also includes development of **highly professional High Performance Computing (HPC) aware human resource** for meeting challenges of development of these applications.
  - **PARAM Shavak** has been deployed to provide training.
- **Application areas:** Climate Modelling, Computational Biology, Atomic Energy Simulations, National Security/ Defence Applications, Disaster Simulations and Management, Computational Material Science and Nanomaterials, Cyber Physical Systems, Big Data Analytics etc.

Related Information

Top-500 Project

- Started in 1993, it ranks **the 500 most powerful non-distributed computers** in the world.
- It publishes an updated list of the supercomputers twice a year.
- Currently, **China dominates** the list with 229

supercomputers, leading the second place (United States) by a record margin of 121.

- Since June 2018, the **American "Summit"** is the world's most powerful supercomputer, based on the **LINPACK benchmarks**.
- LINPACK benchmark are a measure of a system's floating point computer power. It measures how far a computer solves a system of linear equations.
- **India has 4 supercomputers** in the Top-500 list of the world's top 500 supercomputers with **Pratyush and Mihir** being the fastest supercomputers in India.

About C-DAC

- It is the premier R&D organization of the Ministry of Electronics and Information Technology (MeitY) for carrying out R&D in IT, Electronics and associated areas.
- **PARAM 8000**, first supercomputer of India, was built by CDAC.
- **C-DAC has also signed an agreement with ATOS (France based Company)** for designing, building and installing BullSequana – the supercomputer in India.
    - ATOS will supply BullSequana XH200 super computer to India to create a **network of over 70 high-performance supercomputing** facilities with a cumulative computing power of **more than 10 petaflops,** for various academic and research institutions across India.
    - BullSequana will be set up in India under the **National Supercomputing Mission** (NSM).

Related news

- **Spiking Neural Network Architecture Machine**
    - Recently **world's largest brain like supercomputer called Spiking Neural Network Architecture (SpiNNaker)** was turned on for the first time.
    - SpiNNaker **mimics the working of human brain** with the help of about thousand interconnected circuit boards.
    - It has computational capability of more than 200 million actions per second. **However even at this rate it has achieved only 1 percent of scale of human brain and that too with lots of simplifications.**
- **Shakti Microprocessor**
    - It's India's first microprocessor developed by IIT Madras.
    - Shakti is **an open-source initiative** by the Reconfigurable Intelligent Systems Engineering **(RISE) laboratory at IIT Madras** with funding by **Union Ministry of Electronics and Information Technology**.
    - Earlier, an initial batch of 300 chips named **RISECREEK** was fabricated free at Intel's facility at USA to run on the Linux System. But now fabrication also in the country has made the microprocessor **completely indigenous**.
    - The Shakti team is also almost ready with **'Parashakti'** which is an advanced microprocessor for super computers. It can be used in desktops and if 32 such microprocessors are attached together then it could be used in supercomputer.

4.8. CYBER-PHYSICAL SYSTEMS

Why in News?

Recently cabinet approved the launching of **National Mission on Interdisciplinary Cyber-Physical Systems (NM-ICPS)** which is to be implemented by **Department of Science &Technology** for a period of five years.

What is Cyber-physical system (CPS)?

- CPS is an **interdisciplinary field** that deals with the deployment of computer-based systems that do things in the physical world. It integrates sensing, computation, control and networking into physical objects and infrastructure, connecting them to the Internet and to each other.
- **Examples of cyber physical systems** are Smart Grid Networks, Smart Transportation System, Enterprise Cloud Infrastructure, Utility Service Infrastructure for Smart Cities, etc.
- **CPS and its associated technologies**, like Artificial Intelligence (AI), Internet of Things (IoT), Machine Learning (ML), Deep Learning (DP), Big Data Analytics, Robotics, Quantum Computing, Quantum Communication, Quantum encryption (Quantum Key Distribution), Data Science & Predictive analytics, Cyber Security for physical infrastructure and other infrastructure plays a transformative role in almost every field of human endeavor in all sectors.

About National Mission on Interdisciplinary Cyber-Physical Systems

- It is a comprehensive mission which would address technology development, application development, human resource development, skill enhancement, entrepreneurship and start-up development in CPS and associated technologies.

Implementation:

- It aims at establishment of **Technology Innovation Hubs**, Application Innovation Hubs and **Technology Translation Research Parks (TTRP).**
- These **Hubs & TTRPs will connect to Academics, Industry, Central Ministries and State Government** in developing solutions at reputed academic, R&D and other organizations across the country in a hub and spoke model.
- They mainly **focus on four areas:** Technology Development, HRD & Skill Development, Innovation, Entrepreneurship & Start-ups Ecosystem Development and International Collaborations.

CPS	Internet of things
• They are physical and engineered systems whose operations are monitored, coordinated, controlled and integrated by a computing and communication core. • CPS engineering has a strong emphasis on the relationship between computation and the physical world. • They are not necessarily connected with internet. **Ex:** It may be individual system which integrates the physical and cyber technology like smart electricity meters.	• It is the network of devices such as vehicles, and home appliances that contain electronics, software, actuators, and connectivity which allows these things to connect, interact and exchange data. • IoT has a strong emphasis on uniquely identifiable and internet-connected devices and embedded systems. • They are connected to internet. • IoT forms a foundation for the cyber-physical systems revolution. **Ex:** Smart Home in which all appliances are connected to each other through internet like TV is connected to mobile, lights are connected to mobile etc.

4.9. PARIS CALL

Why in news?

At UNESCO Internet Governance Forum (IGF) meeting convened in Paris, **"The Paris Call for Trust and Security in Cyberspace"** was commenced, aimed at developing common principles for securing cyberspace.

Details

- **Participants:** More than 190 signatures were obtained on the Paris Call, including 130 from private sector and more than 50 member nations. Prominent countries like India, US, China, Russia did not sign the agreement.

Prominent Models of Internet Governance

- **Multi-stakeholder Model (supported by western nations like US)**
  - Decentralized governance institutions where non-state actors like corporates, NGOs & civil society have a say in making globally acceptable norms regulating cyberspace.
  - Gives recognition to technical expertise of corporates.
- **Multilateral Model (supported by Russia and China)**
  - Governance model based on agreements between multiple governments with limited involvement of non-state actors.
  - Holds sovereignty of nation state in managing cyberspace and provides the scope for the exercise of inherent right of self-defense and the law of state responsibility, including countermeasures in the cyberspace.

4.10. GRAVITYRAT MALWARE

Why in news?

Maharashtra Cybercrime department has reported the malware **"**GravityRAT**"**.

Background

- The 'RAT' in the name stands for **Remote Access Trojan**, which is a program capable of being controlled remotely and thus difficult to trace.
- It was first detected by Indian **Computer Emergency Response Team (CERT-In)** in 2017.
- **Malware, or malicious software,** is any program or file that is harmful to a computer user. It includes computer viruses, worms, Trojan horses and spyware.
- These malicious programs can perform a variety of functions, including stealing, encrypting or deleting sensitive data, altering or hijacking core computing functions and monitoring users' computer activity without their permission.

CERT-In

- It is the **national nodal agency** under Ministry of Electronics and Information Technology (**MeitY**) for responding to computer security incidents as and when they occur, operational since January 2004.
- In the **IT Amendment Act 2008**, it has been designated to serve following functions-
  - Collection, analysis and dissemination of information on cyber incidents.
  - Forecast and alerts of cyber security incidents.
  - Emergency measures for handling cyber security incidents.
  - Coordination of cyber incident response activities.
  - Issue guidelines, advisories, vulnerability notes and whitepapers relating to information security practices, procedures, prevention, response and reporting of cyber incidents.

Additional Information

- **Bot:** Bots are software programs created to automatically perform specific operations. While some bots are created for relatively harmless

purposes (video gaming, internet auctions, online contests, etc), it is becoming increasingly common to see bots being used maliciously.

- **Ransomware:** It is a form of malware that essentially holds a computer system captive while demanding a ransom. The malware restricts user access to the computer either by encrypting files on the hard drive or locking down the system and displaying messages that are intended to force the user to pay the malware creator to remove the restrictions and regain access to their computer.
- **Spyware:** Spyware is a type of malware that functions by spying on user activity without their knowledge. Spyware spreads by exploiting software vulnerabilities, bundling itself with legitimate software, or in Trojans.
- **Trojan Horse:** A Trojan horse, is a type of malware that disguises itself as a normal file or program to trick users into downloading and installing malware. A Trojan can give a malicious party remote access to an infected computer.
- **Virus:** A virus is a form of malware that is capable of copying itself and spreading to other computers. Viruses can be used to steal information, harm host computers and networks, create botnets, steal money, render advertisements, and more.
- **Worm:** Computer worms are among the most common types of malware. They spread over computer networks by exploiting operating system vulnerabilities. Worms typically cause harm to their host networks by consuming bandwidth and overloading web servers. Worms often spread by sending mass emails with infected attachments to users' contacts.

5. HEALTH

5.1. FOOD AND HEALTH

5.1.1. FOOD FORTIFICATION

Why in news?

The Food Safety and Standards Authority of India (FSSAI) has recently released a report on food fortification.

What is food fortification?

- Food fortification is the **deliberate addition of one or more micronutrients to food** so as to correct or prevent a deficiency (**Hidden Hunger**: Deficiency of Micronutrients).
- Food fortification is a **"complementary strategy"** and not a replacement of a balanced & diversified diet to address malnutrition.

Food Safety and Standards Authority of India (FSSAI)

- FSSAI, under the **Ministry of Health & Family Welfare**, has been established under Food Safety and Standards Act, 2006.
- It has responsibility of laying down scientific standards for articles of food and to regulate their manufacture, storage, distribution, sale and import to ensure availability of safe and wholesome food for human consumption.

Food Fortification in India

- Fortification is being promoted through both open market and government schemes like ICDS, MDMS, PDS,etc.
- In National Nutrition Strategy (Kuposhan Mukt Bharat), food fortification has been given a major thrust.
- FSSAI has operationalised standards for fortification of:
  - wheat- flour-rice (with iron, Vitamin B12 and folic acid)
  - milk & edible oil (with Vitamins A and D)
  - double-fortified salt (with iodine and iron).
- It has also introduced the **+F logo** to identify fortified foods.
- It has also launched **the Food Fortification Resource Centre (FFRC)** to promote large-scale fortification of food across India.
- **Indian Food Laboratory Network system (INFoLNET):** It's an initiative with bringing all the stakeholders to a common platform for the establishment of a transparent food testing network by FSSAI.

Food Safety and Standards (Fortification of Foods) Regulations, 2018

- It has prescribed **standards** for fortification of various food products such as All fortified foods must not fall below the minimum level of micro nutrients.
- **Quality assurance:**
  - Every manufacturer and packer of fortified food shall give an undertaking on quality assurance
  - random testing of fortificants and fortified food
- Every package of fortified food shall **carry name of the fortificant** and the **logo** to indicate.
- The Food Authority shall take steps to **encourage the production, manufacture, distribution, sale, and consumption** of fortified food.

5.1.2. EAT RIGHT INDIA MOVEMENT

Why in News?

The Food Safety and Standards Authority of India (FSSAI) recently organised the Swasth Bharat Yatra, a key element of the 'Eat Right India Movement'.

Eat Right India movement

- It is multi-sectoral effort with primary focus on daily intake of salt, sugar, fat, phasing-out trans-fats from diets and promoting healthier food options.
- It is built on two broad pillars of Eat Healthy and Eat Safe.
- It brings together three ongoing initiatives of FSSAI that target citizens:
  - **The Safe and Nutritious Food (SNF) Initiative**, focused on social and behavioral change around food safety and nutrition at home, school, workplace and on-the-go.
  - **The Eat Healthy Campaign** focused on daily intake of salt, sugar, fat, phasing-out trans-fats.
  - **Food fortification,** focused on promoting five staple foods- wheat flour, rice, oil, milk and salt, with key vitamins and minerals added to improve their nutritional content.
- Under the movement, "Aaj se thoda kam campaign" was launched to encourage citizens to adopt healthy food habits through social media and mass media.

5.1.3. REPURPOSE USED COOKING OIL (RUCO)

Why in news?

Recently, FSSAI launched Repurpose Used cooking Oil (RUCO) initiative.

About RUCO Initiative

- **Aim:** To enable collection and conversion of used cooking oil to bio-diesel.
- Under this around 64 companies at 101 locations have been identified to enable collection of used cooking oil.
- **Significance:**
  - India has the potential to recover 220 crore litres of used cooking oil for the production of biodiesel by 2022 if co-ordinated actions are taken.
  - It **is environment friendly** because as of now cooking oil is either not discarded or disposed in an environmentally hazardous manner, thereby, choking drains and sewerage systems.
  - It would promote public health as the initiative would prevent diversion of UCO to smaller restaurants, dhaabas and street-vendors.

About Used Cooking Oil (UCO) standards

- According to FSSAI regulations, the maximum permissible limits for **Total Polar Compounds** (TPC) in cooking oil have been set at **25 per cent**.
- TPC is formed due to **repeated frying** and usage of edible oil which changes its physiochemical and nutrition properties making it unfit for human consumption.
- TPCs above the set level cause hypertension, atherosclerosis, Alzheimer's disease, liver disease etc.
- **FSSAI** is working in partnership with **Biodiesel Association of India** (BDAI) and the food industry to ensure effective compliance of UCO standards.
- FSSAI is also implementing a **'Triple E strategy'** - **Education, Enforcement and Ecosystem** to divert UCO from the food value chain and curb current illegal practices.

Related information

- Cooking oil may have saturated fatty acids (palm oil) or unsaturated fatty acids (soyabean).
- The saturated fatty acids such as in palm oil are more stable that the unsaturated fatty acids which decompose easily at high temperature forming **polar compounds**.
- Thus, it makes oils with saturated fatty acids fit for frying. However, oils with unsaturated fatty acids are healthier provided they are used just once for frying.

5.1.4. TRANS FAT

Why in News?

World Health Organization has urged developing nations to eliminate man-made trans fatty acids from their food supplies.

About Trans-Fat

- Also known as Trans Fatty Acids (TFA), they are of 2 types-
  - **Natural Trans-Fat**- Occur naturally in the dairy and some meat products.
  - **Artificial Trans-Fat**- They are created when the oil goes through hydrogenation, which involves adding hydrogen to the liquid oil to make it more solid.
- They help to increase the shelf life of oils and foods and stabilise their flavours.
- In India, Vanaspati, desi ghee, butter and margarine are the main sources of trans fat. Vanaspati is favoured by the industry as it prolongs a food product's shelf life and is cheap.
- The current **permitted level of trans fat** is 5 per cent (by weight) in India. FSSAI has further proposed to limit the maximum amount of trans fat in vegetable oils, vegetable fat and hydrogenated vegetable oil to 2 per cent to make India **trans-fat free by 2022,** a year ahead of the global target by the WHO for complete elimination of trans fat.

Health Hazards due to Trans-Fat

- According to various studies, a 2% increase in energy intake from trans-fat has been associated with a 23 % increase in the **risk of heart disease** and according to another estimate by WHO.
  - Its consumption increases the risk of heart disease by raising the level of **low-density lipoprotein (LDL)**, also known as the "bad" cholesterol and at the same time it reduces the level of **high-density lipoprotein (HDL)** which is the "good" cholesterol.
- They are supposed to be the **main cause of Type-2 Diabetes** and linked to insulin resistance, that is why WHO recommends that no more than one per cent of a person's calories come from trans fats.

"REPLACE" by WHO

- WHO has released a step by step guide for the industry to eliminate trans fats from the food by 2023.
- The guide, called REPLACE, has **six actions**, which include
  - Review of dietary sources of trans fats,
  - Promoting replacement with healthier fats,
  - Legislation and Setting up a regulatory framework,
  - Assessing and monitoring trans fats content in food,
  - Creating awareness and
  - Enforcing regulation.

Related News

- **Heart Attack Rewind: It's a mass media campaign by FSSAI, calling for the elimination of industrially-produced trans fat in the food supply.**
- **Denmark was the first country** to restrict industrially-produced trans fats in food and it has witnessed a sharp decline in deaths due to cardiovascular diseases.

5.2. PHARMACEUTICALS

5.2.1. ANTIMICROBIAL RESISTANCE

Why in news?

Government has proposed a ban on the use of antibiotic colistin that is widely for non-therapeutic purposes such as growth promotion and disease prevention in poultry, farming and aquaculture in India which increases antibiotic resistance in humans.

Details

- Colistin belongs to a group of antibiotics called polymixins which are termed "**critically important by WHO.** It is used when no other antibiotic works
- Other countries that do not permit the use of the antibiotic, both for therapeutic and growth promotion in animals are European Union (banned colistin in 2006), while Malaysia and China banned it in 2018.

Antimicrobial Resistance (AMR)

- It occurs **when microorganisms such as bacteria, viruses, fungi and parasites** change in ways that render the medications **used to cure the infections and causing them ineffective**.
- It is the broader term for resistance in different types of microorganisms and encompasses resistance to antibacterial, antiviral, antiparasitic and antifungal drugs. It occurs naturally but is also facilitated by the inappropriate use of medicines.
- Microorganisms that become resistant to most antimicrobials are often referred to as **"superbugs".**
- It affects the, medical procedures such as organ transplantation, cancer chemotherapy, major surgeries etc. making them very risky.

Factors responsible for antibiotic resistance in India

- Self-medication (to avoid financial burden)
- Access to antibiotics without prescription
- Use of pharmacies and informal healthcare providers as sources of healthcare.
- Inadequate public sector diagnostic laboratory and Unaffordability of private labs
- Mass bathing as part of religious occasions
- Antibiotics as growth promoters in food animals and poultry
- Effluents from the antibiotic manufacturing units leading to contamination of rivers and lakes
- Disposal of untreated sewage into water bodies
- Prevalence of various Hospital Associated Infections (also called nosocomial infections).

Policy/Initiatives of Government

- **National Policy for Containment of AMR 2011** provided regulations for use of antibiotics for humans as also for veterinary use along with a hospital based surveillance system for monitoring antibiotic resistance.
- Indian Council of Medical Research (ICMR) has set up a **National Anti-Microbial Resistance Research and Surveillance Network (AMRRSN)** to enable compilation of National Data of AMR at different levels of Health Care.
- FSSAI has set certain **guidelines limiting the antibiotics** in food products such as fish and honey.
- Ministry Of Health has notified an **amendment to the Food Safety & Standards (Contaminants, Toxins & Residues) Regulations, 2011,** to set maximum permissible limits for the presence of antibiotics and other drugs in meat and meat products, including chicken.
- **Red Line Campaign on Antibiotics 2016**, was launched to create awareness regarding rational usage and limiting the practice of self-medication of antibiotics among the general public.
- **National Health Policy 2017** envisions a holistic framework against AMR.
- The **National Action Plan on Antimicrobial Resistance (NAP-AMR) 2017** has assigned coordinated tasks to multiple government agencies involving health, education, environment, and livestock to change prescription practices and consumer behaviour and to scale up infection control and antimicrobial surveillance.
    - The strategic objectives of NAP-AMR are aligned with the WHO's Global Action Plan on AMR (GAP-AMR).

WHO "Global action plan on antimicrobial resistance" 2015: it has 5 strategic objectives:

- To improve awareness and understanding of antimicrobial resistance.

- To strengthen surveillance and research.
- To reduce the incidence of infection.
- To optimize the use of antimicrobial medicines.
- To ensure sustainable investment in countering antimicrobial resistance.

5.2.2. FIXED DOSE COMBINATIONS (FDCS)

Why in news?

Recently, the **Ministry of Health and Family Welfare (MoHFW)** in exercise of powers conferred by the **Drugs and Cosmetics Act, 1940** has prohibited the manufacture for sale, sale or distribution for human use of 328 FDCs and restricted the manufacture, sale or distribution of six FDCs subject to certain conditions.

About FDC

- An FDC is a combination of two or more therapeutic drugs packed in a single dose. Several cough syrups, painkillers and dermatological drugs in India are FDCs.
- **Benefits**: They are known to offer specific advantages over the single entity preparations, such as increased efficacy, and/or a reduced incidence of adverse effects, possibly reduced cost and simpler logistics of distribution relevant to situations of limited resources
- **Cheaper for consumer**: Patient can buy just one FDC medicine to treat multiple illness symptoms.

Brief Background

- In 2016, the health ministry had banned 349 FDCs, claiming they were **"unsafe" and "irrational"** for consumption on the recommendation of **Chandrakant Kokate committee (2015)**.
- Later, **Drugs Technical Advisory Board (DTAB)** on a direction from Supreme Court, formed **Nilima Shirsagar committee** to review the safety, efficacy and therapeutic justification of 344 fixed dose combination (FDC) drugs. The committee also recommended the continuation of the ban along with other observations such as:
  - FDCs were formulated without due diligence, with dosing mismatches that could result in toxicity.
  - Over the years, India has become a **"dumping ground" for irrational FDCs** that are not approved in other countries for consumption.

Drug regime in India

- Drugs are regulated by the **Drugs and Cosmetics Act, 1940** and **Drugs and Cosmetic Rules, 1945.**
- **Central Drugs Standard Control Organization (CDSCO),** under the **MoHFW**, is the authority that approves new drugs for manufacture and import.
- State Drug Authorities are the licensing authorities for marketing drugs.
- **Drugs Technical Advisory Body (DTAB):** It is the highest statutory decision-making body under the Union Health ministry on technical matters related to drugs. It is constituted as per the **Drugs and Cosmetics Act, 1940.**

5.2.3. NATIONAL MEDICAL DEVICES PROMOTION COUNCIL

Why in News?

To give a fillip to the medical device sector, a **National Medical Devices Promotion Council** will be set up under the Department for Promotion of Industry and Internal Trade (DPIIT).

About National Medical Devices Promotion Council

- The Council will be headed by **Secretary, DPIIT** and will have **representatives from** concerned departments, **health care industry and quality control institutions**.
- It will act as a facilitating and promotion & developmental body for the Indian Medical Devices Industry (MDI). It will give a **boost to domestic manufacturing and for exports.**
- It will identify redundant processes and render **technical assistance to the agencies and departments concerned to simplify the approval processes** involved in medical device industry.

5.2.4. ANIMAL-FREE TESTING FOR DRUGS

Why in News?

Indian Pharmacopoeia Commission (IPC) has approved modern, animal-free tests for drug manufacturers.

New Guidelines

- In the **2018 edition of Indian Pharmacopoeia**, the IPC has **replaced the pyrogen test** carried out on rabbits and the abnormal toxicity test carried out on guinea pigs and mice.
- Pyrogen test will be replaced by a **bacterial endotoxin test or a monocyte activation test** which can be carried out in test tubes.
- **Abnormal toxicity test** can be waived by getting a compliance certificate from the National Control Laboratory.

Pyrogen Test

- A **pyrogen is a foreign substance** that causes a fever (temperature elevation) in an animal's body. Vaccines and other injectable drugs must be confirmed to be pyrogen free according to regulatory requirements.
- For the test, the drug is **injected into a rabbit** (Food and water is withheld to rabbit overnight) and the animal is **closely observed for feverish symptoms.**

Abnormal Toxicity Test

- This test is carried out to check potential hazardous biological contamination in vaccine formulations i.e. the degree to which a substance can damage living or non-living entity.
- The scientists observe if there is death of any animal during the tests.

Indian Pharmacopoeia Commission (IPC)

- It is an **autonomous institution of the Ministry of Health and Family Welfare.**
- It is created **to set standards of drugs** in the country.
- It **publishes official documents** for improving Quality of Medicines by way of adding new and updating existing articles in the form of Indian Pharmacopoeia (IP).
- It also **promotes rational use** of generic medicines by publishing National Formulary of India.

Indian Pharmacopoeia (IP)

- It **contains a collection** of authoritative procedures of analysis and specifications for Drugs.
- It has **got legal status** under the Second Schedule of the Drugs & Cosmetics Act, 1940.

5.3. VIRAL DISEASES

5.3.1. NIPAH VIRUS

Why in news?

Recently, there were several cases of deaths due to 'Nipah' (NiV) virus in Kerala.

Nipah virus

- Nipah virus was first identified in Kampung Sungai **Nipah**, Malaysia in 1998.
- The first outbreak in India was reported from Siliguri, West Bengal in 2001.
- The natural host of the virus is the fruit bat but it can also infect pigs or **any domesticated animals.**
- The virus is present in bat urine, faeces, saliva, and birthing fluids which then transmits it to Humans climbing trees or drinking raw palm sap covered in it.
- Transmission of Nipah virus also takes place through **direct contact** with other NiV-infected people.

Related Information

What are Zoonotic diseases?

- A zoonotic disease is a disease that spreads between animals and people.
- They can be caused by **viruses, bacteria, parasites, and fungi**.
- Important Zoonotic diseases in India are: Nipah virus, avian influenza, rabies, Japanese encephalitis, leptospirosis, Hanta virus, SARS, cysticercosis, anthrax, plague, echinococcosis and schistosomosis, Kyasanur forest disease (KFD) etc.

Why is there an increase in Zoonotic diseases?

- Due to dramatic **increase in population, mobility** and the associated social and environmental changes like habitat destruction in the past 70 years.

Way forward: We need to adopt **"one health"** approach particularly to fight zoonotic diseases. The One Health Initiative defines One Health as 'the collaborative efforts of **multiple disciplines** working locally, nationally and globally to attain optimal health for **people, animals, plants and our environment'.**

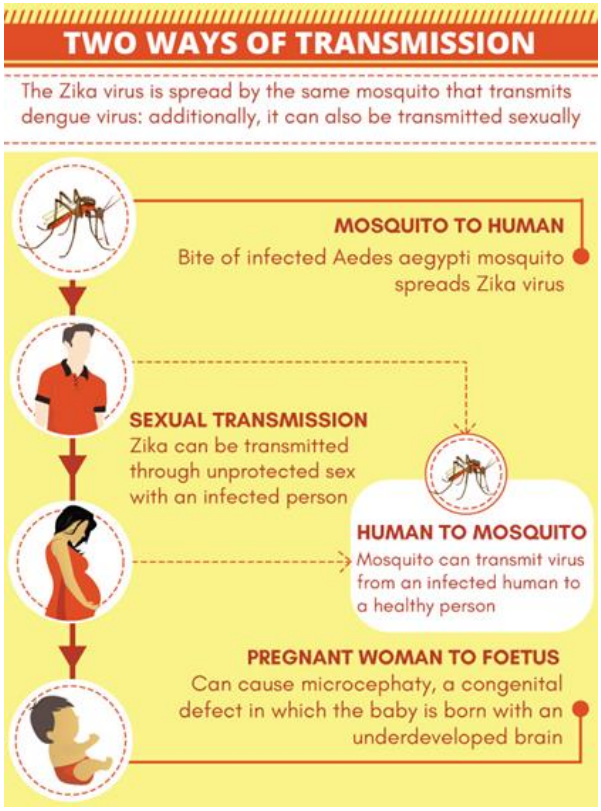
5.3.2. ZIKA VIRUS

Why in News?

Few cases of Zika virus disease have been reported in Bihar.

About Zika

- **First identified in Uganda** in 1947 in monkeys, Zika was detected in humans five years later. Sporadic cases have been reported throughout the world since the 1960s, but the first outbreak happened in 2007 in the Island of Yap in the Pacific.
- In 2015, a **major outbreak in Brazil** led to the revelation that Zika can be associated with **microcephaly**, a condition in which **babies are born with small and underdeveloped brain**.
- Some countries that have had a Zika outbreak, including Brazil, reported a steep increase in **Guillain-Barré syndrome** — a **neurological disorder** that could lead to paralysis and death, according to WHO.
- In India, the **first outbreak** was reported in Ahmedabad in January 2017 and second outbreak in July, 2017 from Krishnagiri District in Tamilnadu.
- Vulnerability of India to Zika due to:
  - Poor health facilities.
  - Lack of effective vaccination against Zika virus.
  - Lack of awareness.
  - Lack of after care in case of microcephaly occurrence.



5.3.3. POLIO VIRUS

Why in news?

Recently, the Union Health Ministry has ordered an inquiry into the type-2 polio virus contamination detected in the vials used for immunisation in Uttar Pradesh, Maharashtra and Telangana.

Polio

- Polio (or Poliomyelitis) is a **highly-infectious viral disease** which mainly affects young children and can result in permanent paralysis.
- The virus is transmitted by person-to-person spread mainly through the faecal-oral route or, less frequently, by a common vehicle (e.g. contaminated water or food) and multiplies in the intestine, from where it can invade the nervous system and can cause paralysis.
- There is no cure and it can only be prevented through immunisation.
- Types: Of the **3 strains** of wild poliovirus (type 1, type 2, and type 3), wild poliovirus type 2 was eradicated in 1999 and no case of wild poliovirus type 3 has been found since 2012.
- **Difference between Oral Polio Vaccine (OPV) and IPV:** OPV is made up of attenuated or weakened poliovirus and there is a risk of vaccine derived polio. IPV is made up of inactivated (killed) polio virus and will provide immunity from all three strains of polio.
- **India status**: India was officially declared Polio free by WHO in **2014**.
- However, samples from some states showed the presence of Type 2 **vaccine derived polio virus (VDVP)**, which had undergone ten nucleotide changes.
- If six or more nucleotide changes happen then it is called vaccine-derived poliovirus (VDVP).
- VDVP is extremely rare and found in children with immune-deficiency and among populations with low immunity levels.

5.3.4. MEASLES-RUBELLA

Why in news?

Recently, Global Measles and Rubella Update stated that India had 56,399 confirmed measles cases and 1,066 confirmed rubella cases in 2018.

About Measles-Rubella

- Measles and Rubella are **highly contagious viral diseases** that are spread by contact with an infected person **through coughing and sneezing**.
  - Measles **weakens the immune system** and opens the door to secondary health problems, such as pneumonia, blindness, diarrhoea etc. This virus is an exclusive human pathogen and has **no animal reservoirs or vectors**. It occurs only in humans.
  - **Rubella**, also known as **German Measles,** is generally a mild disease but can have serious consequences for pregnant women and their children as it may cause **congenital rubella syndrome** in the foetus.
- **Measles-rubella (MR) vaccine** is given at 9-12 months and 16-24 months of age for preventing both measles and rubella diseases in the child as no specific treatment is available for the disease.
- To eliminate measles and control rubella, over 95% immunisation of children or strengthening **of Herd Immunity** is required.
- It is a form of immunity that occurs when the vaccination of a significant portion of a population (or herd) provides a measure of protection for individuals who have not developed immunity.

5.3.5. NATIONAL ACTION PLAN FOR VIRAL HEPATITIS CONTROL

Why in News?

Recently, Ministry of Health and Family Welfare launched National Action Plan for Viral Hepatitis.

About National Action Plan for Viral Hepatitis

- The Plan provides a strategic framework, based on which **National Viral Hepatitis Control Program** was launched in 2018 under **National Health Mission.**

About Hepatitis

- It is an **inflammation of the liver** often **cause by virus** and other **infections, toxic substances** (e.g. alcohol, certain drugs).
- There are **5 main hepatitis viruses**, referred to as types A, B, C, D and E.
  - Viral **hepatitis types B and C** can cause **chronic** hepatitis and are responsible for 96% of overall hepatitis mortality while **Hepatitis A and E** usually cause **acute hepatitis**.
  - **Hepatitis A and E** are typically caused by ingestion of **contaminated food or water.**
  - **Hepatitis B, C and D** usually occur as a result of contact with **infected body fluids** such as during receiving blood, invasive medical procedures using contaminated equipment, transmission from mother to baby at birth, sexual contact etc.
  - Also, **Hepatitis D virus** (HDV) infections occur **only** in those who are infected with **Hepatitis B Virus**.
  - There are vaccines to prevent hepatitis A, B and E**.** However**, there is no vaccine for hepatitis C**.
- The challenge in eliminating chronic viral hepatitis is due to the **infected person being unaware of their chronic carrier status** and to the potential for them to continue to infect others for decades.

National Viral Hepatitis Control Program

- It aims to **reduce morbidity and mortality** due to viral hepatitis.
- **Goal:** Ending viral hepatitis as a public health threat by 2030 in the country
- **Key strategies** under the programme are:
  - Preventive and Promotive interventions with focus on **awareness generation.**
  - **Safe injection practices** and socio-cultural practices.
  - **Sanitation and hygiene** like safe drinking water supply, infection control and immunization.
  - Co-ordination and collaboration with different Ministries and departments.
  - **Increasing access to testing and management** of viral hepatitis.
  - Promoting diagnosis and providing treatment support for patients of hepatitis B &C through standardized testing and management protocols with focus on treatment of hepatitis B and C.

5.3.6. CHIKUNGUNYA VIRUS

Why in News?

Recently, Indian scientists have developed a **biosensor technique** to detect chikungunya virus.

About Chikungunya

- Chikungunya is a **viral disease** (genus Alphavirus) which is transmitted to humans by infected mosquitoes – including **Aedes aegypti (also transmit dengue and zika) and Aedes albopictus.**
- There is no cure for the disease. Treatment is focused on relieving the symptoms.
- **Current Detection Techniques:** It's detected through RT-PCR (Real-time polymerase chain reaction) from serum samples and by determination of serum anti-bodies which are time consuming and cumbersome.

About the Biosensor technology

- Scientist made a Molybdenum disulphide nanosheet which is absorbed onto the screen-printed **gold electrodes** and then used in the detection of **chikungunya virus DNA** using **electrochemical voltammetric techniques.**
- **Advantages:** Used to develop a **point of care device** for rapid identification of disease. It is suitable for mass production, has low cost, higher disposability and design flexibility as compared to traditional electrode materials.

5.3.7. QUADRIVALENT INFLUENZA VACCINE

Why in news?

WHO recently for the first time recommended the use of quadrivalent influenza vaccine.

More on news

- **Sanofi Pasteur's injectable influenza vaccine** (FluQuadri) has been recommended for use in the 2018-2019 northern hemisphere influenza season.
- The quadrivalent vaccine will contain four influenza virus strains (two A subtypes and two B subtypes — H1N1 and H3N2, and Victoria and Yamagata respectively), while trivalent influenza vaccine used to contain both A subtype viruses but only one of the B subtype virus.
- Quadrilateral vaccine was approved for **active immunisation** of adults of **age 18 to 64 years**

in 2017 by the **Drug Controller General of India** (DCGI).

Influenza

- Influenza (flu) is a contagious respiratory illness caused by influenza viruses, transmitted from person to person via droplets.
- It is characterized by sudden onset of high fever, aching muscles, headache and severe malaise, non-productive cough and sore throat.
- There are **four types of influenza viruses: types A, B, C and D:**
  - **Influenza A viruses** infect humans and many different animals. The emergence of a new and very different influenza A virus with the ability infect people and have sustained human to human transmission, can cause an influenza pandemic.
    - ✓ **Subtype: They are** classified according to the combinations of different virus surface **proteins Haemagglutinin (H) and Neuraminidase (N). Avian influenza virus** subtypes A(H5N1), A(H7N9), and A(H9N2) and **swine influenza virus** subtypes A(H1N1), A(H1N2) and A(H3N2).
    - ✓ **Tamiflu/ Oseltamivir Drug** to treat influenza A (including H1N1) and influenza B.
  - **Influenza B viruses** circulates among humans and cause seasonal epidemics.
  - **Influenza C viruses** can infect both humans and pigs but infections are generally mild and are rarely reported.
  - **Influenza D viruses** primarily affect cattle and are not known to infect or cause illness in people.

Vaccines

- Vaccines are substances that stimulate the body's own immune system to protect the person against subsequent infection or disease.
- Vaccines contain antigen (which generates the protective immune response) that may be a weakened or killed form of the disease-causing organism, or fragments of the organism.
- They can be **broadly classified as live or inactivated.**
  - **Live vaccines** are made using 'wild' viruses or bacteria that have been attenuated, or **weakened,** before being included in the vaccine and **create a strong and long-lasting immune response.**
  - **Inactivated vaccines** use the killed version of the germ that causes a disease and usually don't provide immunity (protection) that's as strong as live vaccines.

Related News

New Influenza Research Programme

Recently, Indian and European Union (EU) collaborated for new influenza research programme to develop Next Generation Influenza Vaccine.

About the programme

- The programme will get fund of EUR 15 million under EU funding programme for research and innovation called **'Horizon 2020'.**
- It aims at further advancing the next generation influenza vaccine with improved efficacy and safety, duration of immunity, and reactivity against an increased breadth of influenza strains.

Horizon 2020

- It is the biggest EU Research and Innovation programme with nearly €80 billion of funding available over 7 years (2014 to 2020).
- It is helping to achieve research and innovation on excellent science, industrial leadership and tackling societal challenges.

5.4. BACTERIAL DISEASES

5.4.1. WHO TB REPORT AND ROADMAP

Why in news?

Recently, World Health Organisation (WHO) released World TB Report 2018, with collaboration of UN's first high-level meeting (HLM) on TB.

Findings of the World TB report 2018

- TB is the 10th leading cause of death worldwide, and since 2011, it has been the leading cause of death from a single infectious agent, ranking above HIV/AIDS.
- India accounted for 27% of the total new infections of TB in 2017, which is the highest among the top 30 high TB burden countries in the world.
- **Concept Notes from report**
  - **Triple-Billion Goals:** It is associated with **WHO General Programme of Work 2019-2023** linked to SGDs health goals. This stressed the need of:
    - ✓ 1 billion more people are benefiting from Universal Health Coverage.
    - ✓ 1 billion more people are better protected from health emergencies.
    - ✓ 1 billion more people are enjoying better health and well-being.

Related Information

Facts about TB

- TB is **communicable infectious disease** caused by the **bacillus Mycobacterium Tuberculosis.**
- It typically affects the lungs (pulmonary TB) but can also affect other organs (extrapulmonary TB).

Drug Resistant TB

- **Multidrug Resistance TB (MDR):** It is TB that does not respond to at least **isoniazid and rifampicin** (2 of the most powerful first line drugs).
- Extensively drug-resistant tuberculosis (XDR-TB): It is resistant to at least four of the core anti-TB drugs. It involves multidrug-resistance (MDR-TB), in addition to resistance to any of the fluoroquinolones (such as levofloxacin or moxifloxacin) and to at least one of the three injectable second-line drugs (amikacin, capreomycin or kanamycin).
- Totally drug-resistant tuberculosis (TDR-TB): TB which is resistant to all the first- and second-line TB drugs.

Global Efforts for TB

- **Moscow Declaration to End TB**: It is the outcome of first global ministerial conference on ending TB, in 2017.
- **WHO- End TB Strategy:** A world free of TB with zero deaths, disease and suffering due to TB. It has three high-level, overarching indicators and related targets:
  - 95% reduction by 2035 in number of **TB deaths** compared with 2015.
  - 90% reduction by 2035 in **TB incidence** rate compared with 2015.
  - Zero the level of **catastrophic costs** for TB-affected families by 2035.

5.4.2. LEPROSY IN INDIA

Why in News?

Initial reports of Leprosy Case Detection Campaign of the **National Leprosy Eradication Programme (NLEP)** indicated an all-time high of nearly **50,000 new leprosy cases in Bihar.**

Current scenario

- India was officially **declared to have eliminated leprosy in 2005,** yet India still accounts for the largest number of leprosy affected people in the world (58 per cent).
  - According to WHO, **'elimination'** implies a prevalence rate of less than one case per 10,000; whereas 'eradication' means to reach zero level — a condition where no infection remains, and there is no possibility of further transmission.
- Indian research contributed to the development of **Multi-Drug Therapy** (MDT), now recommended by WHO, which led to the shortening of treatment and higher cure rates.

Challenges in eradicating leprosy

- **Antimicrobial resistance in leprosy:** Global data shows that a total of 8% of the Mycobacterium leprae bacterial strains studied showed **gene mutations conferring resistance towards drugs such as rifampicin, dapsone and ofloxacin.**
- **Non-adherence to drugs:** Due to various reasons a significant number of patients become irregular and default from MDT.
- **Issues with 2005 declaration of Leprosy elimination:** It led to the **diversion fund, leading to poor research** and the frontline workers stopped making household visits to identify undetected cases.
- **Stigma about leprosy:** Fear of stigma, and the resulting discrimination, discourages individuals and their families from seeking the help they need.

Leprosy

- It is a Neglected Tropical Disease, caused by **Mycobacterium leprae bacteria.**
- Affects the skin and peripheral nerves.
- Long incubation period generally 5-7 years.
- Timely diagnosis and treatment of cases, before nerve damage has occurred, is the most effective way of preventing disability.
- **Mycobacterium Indicus Pranii (MIP),** is an indigenous vaccine for leprosy.
- India has the highest burden of leprosy with about 60% of the world's new leprosy cases reported each year.

India's National Leprosy Eradication Programme

- It is a **centrally sponsored Health Scheme** of the Ministry of Health and Family Welfare which aims to eradicate leprosy from India.
- **Strategies for Leprosy elimination:**
  - **Decentralized integrated leprosy services** through General Health Care system.
  - **Early detection & complete treatment** of new leprosy cases.
  - Carrying out **house hold contact survey** in detection of Multibacillary (MB) & child cases.
  - **Early diagnosis & prompt MDT,** through routine and special efforts
  - **Involvement of Accredited Social Health Activists (ASHAs)** in the detection & complete treatment of Leprosy cases for leprosy work

What are Neglected Tropical Diseases?

- **WHO defines NTDs** as a diverse group of communicable diseases that prevail in tropical and subtropical conditions in 149 countries.
- **Vulnerability:** Populations living in poverty, without adequate sanitation and in close contact with infectious vectors and domestic animals and livestock are those worst affected.
- **Situation in India:** Diseases that are most prevalent in India include lymphatic filariasis, soil transmitted helminthiases, trachoma, visceral leishmaniasis, dengue, rabies, cysticercosis, Japanese encephalitis and intestinal worm infections (hookworms, whipworms and Ascaris worms).
- **Uniting to Combat NTDs:** Leaders of several prominent global health and development

organizations, together with industry partners, met in London in 2012 and pledged to unite in their efforts to support the achievement of **the WHO 2020 goals in respect to 10 NTDs.**
  - Pledge is known as **London Declaration on NTDs.**
- **10 NTDs are:** Guinea worm disease, lymphatic filariasis, blinding trachoma, sleeping sickness, leprosy, helminthes, schistosomiasis, river blindness, Chagas disease and visceral leishmaniasis (Kala Azar).

5.4.3. NEPAL ELIMINATES TRACHOMA

Why in news?

Recently, WHO has announced that **Nepal has eliminated Trachoma** and became the first country in South East Asia to do so.

What is Trachoma?

- It is a chronic infective eye disease caused by infection with the bacterium **Chlamydia trachomatis** which is transmitted through contact with eye and nose discharge of infected people, particularly young children who are most vulnerable to the infection.
- It is **also spread by flies** which come in contact with the infected person and is most common under poor environment, low personal hygiene and inadequate access to water.
- It is one of the causes of the avoidable blindness and one of the **18 Neglected Tropical Diseases (NTD).**
- During 1950s, India was a hyperendemic to Trachoma. About 50%-80% children from North-west India were affected by it.
- Ministry of Health and Family Welfare of India had recently National Trachoma Survey Report (2014-17) and declared **India infective Trachoma free** under **WHO GET2020 program**, however it has not been yet announced by WHO.

Criteria used by WHO for assessing a country's claim for having eliminated trachoma as a public health problem.

- less than 5% of children aged 1–9 years have signs of active trachoma which can be treated with antibiotics, in each previously-endemic district;
- less than 0.2% of people aged 15 years and older have trachomatous trichiasis, which requires eyelid surgery, in each previously-endemic district; and
- A health system which can identify and manage new cases of trachomatous trichiasis.

Global Initiatives for Trachoma

- **WHO's SAFE (Surgery, Antibodies, Facial cleanliness, Environmental improvement)** strategy (1997) and Global Elimination of Blinding Trachoma by 2020 to eliminate Trachoma.
- **GET2020**- a WHO International Alliance of interested parties who work for elimination of Trachoma also known as Alliance for Global Elimination of Trachoma by 2020.
- **Vision 2020 of WHO and IAPB** (International Agency for the Prevention of Blindness) - includes Trachoma as a priority under its disease control component.

5.5. OTHER NEWS

5.5.1. TRIPLE DRUG THERAPY FOR LYMPHATIC FILARIASIS (ELEPHANTIASIS)

Why in news?

Recently Triple Drug Therapy regime for eradication of Lymphatic Filariasis was launched.

Details

- Triple Drug Therapy involves combination of three **drugs Ivermectin, Diethylcarbamazine Citrate and Albendazol (Known as IDA).**
- Lymphatic filariasis, **a neglected tropical disease** caused by three species of thread-like nematode worms, known **as filariae** – Wuchereria bancrofti (responsible for 90% cases), Brugia malayi and Brugia timori.
- It's transmitted to humans through **mosquitoes.**
- The **larval stages of the parasite** (microfilaria) circulate in the blood and are transmitted from person to person by mosquitoes**.**
- **Manifestation of the disease after infection takes time** and can result in an altered lymphatic system, causing **abnormal enlargement** of body parts (like feet, arms, breasts, genitals) leading to severe disability and social stigmatization and poverty of those affected.

5.5.2. RARE DISEASES

Why in News?

After **withdrawing the National Policy for Treatment of Rare Diseases (NPTRD),** the Minister of Health and Family Welfare has approved a proposal for **adding a sub-component under the umbrella scheme of Rashtriya Arogya Nidhi (RAN)** for provision of **one-time financial assistance to those below threshold poverty line** for specified rare diseases which require one-time treatment.

About Rare Diseases

- There is no universally accepted definition of rare diseases and the definitions usually vary across different countries. However, generally

rare diseases are defined as a **health condition of low prevalence** that affects a small number of people compared with other prevalent diseases in the general population.

- **WHO defines rare disease** as often debilitating lifelong disease or disorder condition with a prevalence of 1 or less, per 1000 population.
- 80% of rare **diseases are genetic in origin** and hence disproportionately impact children.
- These are **also called 'orphan diseases'** because drug companies are not interested in adopting them to develop treatments due to low profitability.
- The most **common rare diseases** include Haemophilia, Thalassemia, Sickle-cell Anaemia, auto-immune diseases, etc.
- **Karnataka** is the first state to release a Rare Diseases and Orphan Drugs Policy.

5.5.3. 'P NULL' PHENOTYPE

Why in news?

A team of doctors from Mangaluru's Kasturba Medical College (KMC) has identified a rare blood group called "pp" or "P null" phenotype for the first time in India.

More about the news

- ABO and Rh are the common types of blood group systems. However, there are more than 200 minor blood group antigens known besides A, B and Rh.
- A blood type is considered rare if fewer than one in 1,000 people have it. A person is said to have rare blood group when he lacks the high frequency antigen or multiple common antigens.
- The 'P null' blood group has anti-**PP1Pk antibody** that has the potential to cause acute intravascular haemolytic reaction to incompatible blood transfusion. This antibody is also known to cause **recurrent abortions in women.**
- Finding compatible unit for such case is a near impossible task without a well-established rare donor panel, hence Rare donor registry should be maintained for managing such cases.

Blood Type	Donate Blood To	Receive Blood From
A+	A+ AB+	A+ A- O+ O-
O+	O+ A+ B+ AB+	O+ O-
B+	B+ AB+	B+ B- O+ O-
AB+	AB+	Everyone
A-	A+ A- AB+ AB-	A- O-
O-	Everyone	O-
B-	B+ B- AB+ AB-	B- O-
AB-	AB+ AB-	AB- A- B- O-

5.5.4. BACTERIA WOLBACHIA

Why in news?

Recently successful experiments were conducted in Australia, which demonstrated the positive correlation between presence of Wolbachia bacteria in mosquitoes and reduced spread of diseases such as Malaria and Dengue.

Details

- Wolbachia is a tiny bacterium that is present in up to **60% of all species of insects, including several mosquito species (except Aedes aegypti mosquito:** responsible for transmitting dengue, chikungunya and Zika).
- The **World Mosquito Program** introduces Wolbachia into Aedes aegypti mosquitoes. Once Wolbachia carrying mosquitoes are released, they breed with wild mosquitoes and over time, the majority of mosquitoes carry Wolbachia.
- This new method provides **bio-control approach** to handle these diseases.

5.5.5. WHO PUBLISHES ESSENTIAL DIAGNOSTICS LIST

Why in news?

World Health Organization (WHO) published its first **Essential Diagnostics List (EDL) –** which catalogues tests to diagnose the most common conditions and a number of global priority diseases.

Details

- EDL consists of **113 products** – 58 tests for a range of common conditions and the rest 55 test for "priority" diseases such as HIV, TB, HPV, syphilis, malaria and hepatitis B and C.
- It is intended to **serve as a template** for countries to develop their own list. WHO will support the countries for its local adaptation.

5.5.6. CELIAC DISEASE

Why in news?

Recently there have been calls to raise awareness regarding celiac disease.

Details

- Celiac disease also called sprue or coeliac, is an immune reaction to eating **gluten, a protein found in wheat, barley and rye.**
- It is a kind of an **autoimmune disorder** (where the immune system mistakes healthy cells and substances for harmful ones and produces antibodies against them (antibodies usually fight off bacteria and viruses) occurring in people who are **genetically predisposed.**

- In celiac patient, eating gluten triggers an immune response in small intestine. Over time, this reaction damages small intestine's lining and prevents absorption of some nutrients (malabsorption). The **intestinal damage** often causes diarrhea, fatigue, weight loss, bloating and anemia, and can lead to serious complications.
- There's no cure for celiac disease.
- India has many **Gluten free grains grown locally- Jowar, Bajra, Makki, Ragi, Kuttu.**

6. IPR

6.1. WIPO TREATIES

Why in news?

GOI has approved **accession to the World Intellectual Property Organisation (WIPO) Copyright Treaty and WIPO Performers and Phonograms Treaty.**

About WIPO Copyright Treaty

- It is a special agreement under **the Berne Convention (for protection of literary and artistic works)** that deals with the protection of works and the rights of their authors in the digital environment.
- It grants following rights:
  - the right of distribution
  - the right of rental
  - a broader right of communication to the public
- Any Contracting Party must comply with the substantive provisions the **Protection of Literary and Artistic Works.**
- The WCT mentions two subject matters to be protected by copyright: computer programs and compilations of data which constitute intellectual creations.
- The term of protection must be at least 50 years for any kind of work.

About WIPO Performances and Phonograms Treaty

- It deals with the rights of two kinds of beneficiaries, particularly in the digital environment:
  - performers (actors, singers, musicians, etc.); and
  - producers of phonograms (persons or legal entities that take the initiative and have the responsibility for the fixation of sounds)
- It grants them these economic rights: the right of reproduction; the right of distribution; the right of rental and the right of making available.
- The term of protection must be at least 50 years.

Related Information

Copyright

- Copyright is a right given by the law to creators of literary, dramatic, musical and artistic works and producers of cinematograph films and sound recordings.
- This right allows its creator the rights of reproduction, communication to the public, adaptation and translation of the work.

World Intellectual Property Organisation (WIPO)

- It is a specialised self-funding United Nations agency which acts as global forum for intellectual property services, policy, information and cooperation.
- It was established under the WIPO Convention in 1967 and currently has 191 member states. India joined WIPO in 1975.
- The importance of IPR was first recognized in the **Paris Convention for the protection of Industrial Property (1883)** and **Berne Convention for the Protection of Literary and Artistic Works (1886)** (both administered by WIPO).
  - The **Paris Convention** covers: Inventions (patents), trademarks and industrial designs.
  - Works protected under **Berne Convention** include novels, short stories, songs, musicals and drawings, paintings and sculptures.

Other IPRs

Patent

- A patent is granted for an invention which is a new product or process that meets conditions of novelty, non-obviousness and industrial use.
- Novelty means inventive step is the feature(s) of the invention that involves technical advance as compared to existing knowledge.
- Non-obviousness means the invention is not obvious to a person skilled in the art.
- Industrial use means that the invention is capable of being made or used in an industry.
- Patents in India are governed by "The patent Act 1970" which was amended in 2005 to make it compliant with TRIPS.

Trademark

- It refers to **graphical representation of goods or services** to make it distinguishable from the others
- It can be words, symbols, sound, colours, shape of goods, graphics representation or packaging etc.
- They are governed under Trademarks Act, 1999 (amended in 2010) under aegis of DIPP.
- The **'fair usage'** of certain trademarks for the purpose of education, research etc. is not available under the Trademarks Act. Therefore the third party is required to seek permission from the owner every time.

Design

- An industrial design consists of the creation of a shape, configuration or composition of pattern or color, or combination of pattern and color in three-dimensional form containing aesthetic value.
- An industrial design can be a two- or three-dimensional pattern used to produce a product, industrial commodity or handicraft.
- Designs in India are governed by "The Designs Act 2000".

Plant Variety Protection

- It refers to the protection granted for plant varieties. These rights are given to the farmers and

plant breeders to encourage the development of new varieties of plants.
- Plant variety protection in India is governed by "The Protection of Plant Varieties and Farmers' Rights (PPV&FR) Act, 2001".

NOTE: GI has been covered in Culture booklet.

6.2. IPRISM

Why in news?

Recently, Cell for IPR Promotion and Management (CIPAM) in collaboration with ASSOCHAM and ERICSSON India, launched the second edition of **'IPrism'.**

Details

- IPrism is an Intellectual Property (IP) competition for students of schools, polytechnic institutes, colleges and universities. This competition is for **residents of India only**.

About CIPAM

- It has been created under the aegis of **Department for Promotion of Industry and Internal Trade** to take forward the implementation of the **National IPR Policy 2016.**
- It assists in simplifying and streamlining of IP processes, apart from undertaking steps for furthering IPR awareness, commercialization and enforcement.

National Intellectual Property Rights Policy

Main objectives of the policy are –
- IPR Awareness and outreach
- Stimulate the generation of IPR
- Strong legal and legislative framework
- Modernize and strengthen service-oriented IPR Administration
- Commercialisation of IPR
- Enforcement and Adjustment for combating IPR adjustment
- Human Capital Development for teaching, training, research and skill building in IPRs.

Adoption of this has led to following achievements-
- **Strengthening of Institutional Mechanism** – Except for Plant variety Protection (which is administered by Ministry of Agriculture), other IPRs are now administered by DIPP.
- **Creating Awareness** - Recently, Ministry of Commerce and Industry launched Intellectual Property Rights (IPR) Mascot - **IP Nani** to create awareness among people specially children.
- **Technology and Innovation Support Centres (TISCs)** - In conjunction with WIPO, 6 TISCs have been established in various institutions across different states.
- **Global Innovation Index (GII) -** India's rank in the GII Report issued by WIPO has improved from 81st in 2015 to 57th place in 2018.
- **IPR Enforcement Toolkit for Police** - to assist police officials in dealing with IP crimes, in particular, Trademark counterfeiting and Copyright piracy.
- **'Institution Innovation Councils' (IICs)** - set up in Higher Education Institutions (HEIs) through the Innovation Cell at AICTE under the Ministry of HRD.
- IP Process Re-engineering, clearing backlog, reducing pendency and increase in fillings.

7. ALTERNATIVE ENERGY

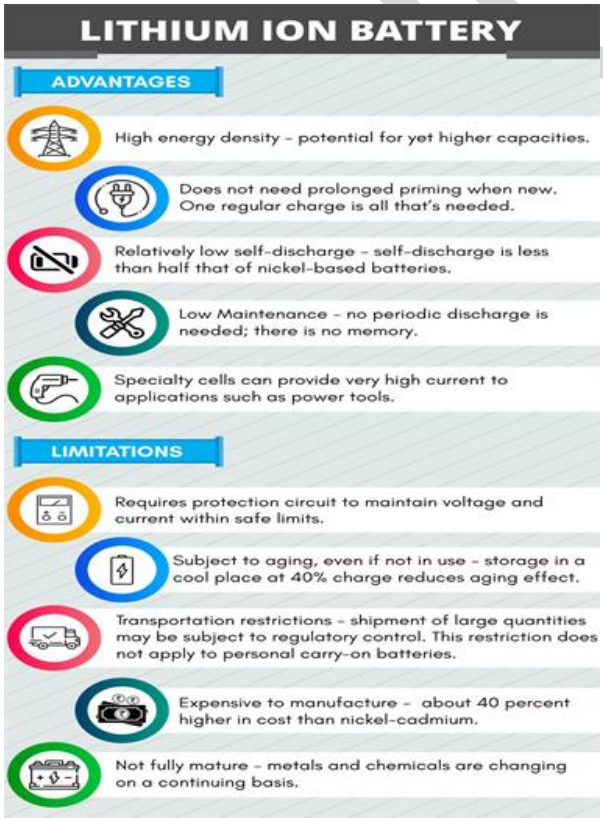
7.1. INDIA'S FIRST LITHIUM ION (LI-ION) BATTERY PROJECT

Why in News?

Recently, Central Electro Chemical Research Institute (CECRI), under Council of Scientific & Industrial Research (CSIR) and RAASI Solar Power Pvt Ltd have signed a Memorandum of Agreement for transfer of technology for India's first Lithium Ion (Li-ion) Battery project.

About Lithium Ion Battery

- These are rechargeable batteries having **high energy density** and commonly used in consumer electronics**.**
- It uses **intercalated lithium compound** instead of metallic lithium as its electrode and is able to store 150 watt-hours electricity per kg of battery.
- Rechargeable lithium-ion batteries cycle 5000 times or more compared to just 400-500 cycles in lead acid.
- When a LIB is discharging, lithium ions move from the negative electrode (anode) to the positive electrode (cathode). When a LIB is charging, lithium ions move in the opposite direction, and the negative electrode becomes the cathode, while the positive electrode becomes the anode.



Related Information
Graphene Based Supercapacitors

- It is being produced by the waste/discarded lithium ion battery.
- Graphene oxide collected form lithium ion battery showed high specific capacity at low current and it is novel energy storage system that combined high energy and power density.
- The process involves conversion of graphite into graphene oxide by oxidation and subsequent exfoliation which is then further converted into reduced graphene oxide.
- Supercapacitor are now being used explicitly, in wind turbine pitch control, rail, automobile, heavy industry, telecom system and memory backup.

7.2. THERMAL BATTERY

Why in News?

World's first-ever thermal battery plant was inaugurated in Andhra Pradesh.

Thermal Battery

- **Conventional battery technology** is based on the system of charging/discharging cycles that are driven by electricity while t**hermal batteries**, uses thermal energy to operate, i.e., the **energy created by temperature differences**.
- A thermal battery consists of **two parts: a cool zone known as sink, and a hot source called source.**
- Both these sides consist of compounds known as **phase-changing materials (PCMs)**, which can change their state of matter on the basis of a physical/chemical reaction.
- When the sink of a thermal battery receives heat, it transforms physically or chemically, thereby storing energy, while the source cools down.
- During operation, the sink is cooled down, so it releases the stored energy, while the source heats up. Depending on the nature of the battery, the system can derive heat from any source, which makes a thermal battery very versatile.

7.3. HYDROGEN-CNG

Why in News?

Delhi is set to be **India's first city to launch hydrogen-enriched CNG (HCNG) buses** in 2019.

What is HCNG?

- HCNG is a vehicle fuel which is a **blend of compressed natural gas and hydrogen**, typically 8-50% hydrogen by volume.

Advantages of HCNG

- **No retrofitment required**- It does not need any modification of the engine or retrofitment.
- **Lower pollutant emissions**- It has potential to reduce nitrous oxide (NOx), carbon dioxide (CO_2), carbon monoxide (appx 70%) and hydrocarbon emissions (appx 15%) vehicle emissions compared to traditional CNG.
  - Hydrogen addition to natural gas can **decrease engine's unburned hydrocarbons** and speed up the combustion process.
- **Improves fuel economy**- It improves the engine efficiency, lowers fuel consumption upto 5 per cent as compared to a CNG bus.
- The **thermal efficiency of both Natural gas and HCNG increases** with increase in load which makes it an ideal fuel for high load applications and heavy-duty vehicles.

7.4. WORLD'S FIRST HYDROGEN FUEL CELL TRAIN

Why in News?

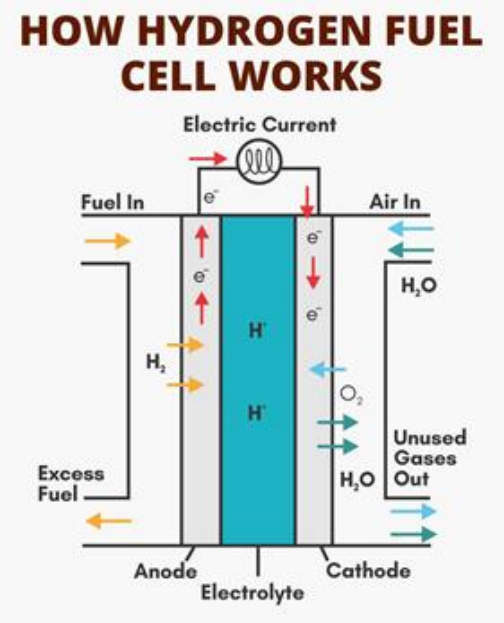
Germany has rolled out world's first hydrogen fuel cell powered trains called **Coradia iLint.**

About Hydrogen fuel cell

- It is a fuel cell that **combines hydrogen and oxygen** to produce electricity with water and steam as the only biproducts.
- The excess energy can be stored on board in ion lithium batteries.
- It is a climate friendly fuel as it **does not emit carbon dioxide or particulate matter** as the case with conventional fuels like diesel, coal etc.

How the hydrogen fuel cell works?

- A fuel cell is composed of an **anode, a cathode, and an electrolyte membrane**.
- A fuel cell works by passing **hydrogen through the anode** of a fuel cell and **oxygen through the cathode**.
- At the anode, the hydrogen molecules are split into electrons and protons.
- The **protons pass through the electrolyte membrane**, while **the electrons are forced through a circuit, generating an electric current and excess heat**.
- At the cathode, the protons, electrons, and oxygen combine to produce water molecules.
- Unlike **traditional combustion technologies that burn fuel, fuel cells undergo a chemical process** to convert hydrogen-rich fuel into electricity.
- Fuel cells **do not need to be periodically recharged like batteries**, but instead **continue to produce electricity as long as a fuel source is provided.**



7.5. APSARA-U

Why in news?

A research reactor **"Apsara-upgraded"** has become operational at Bhabha Atomic Research Centre (BARC), Trombay.

Research reactors

- Research reactors are simpler nuclear reactors used **for research, radioisotope production, education, training etc**, operating at low temperature.
- **Like power reactors, the core needs cooling** and usually a moderator is used to slow down the neutrons.
- They produce neutrons for use in industry, medicine, agriculture, forensics, etc which is their main function. Hence most research reactors also need a **reflector to reduce neutron loss from the core**.

More about Apsara-U

- It has been made indigenously.
- It is the **upgraded version of "Apsara",** the **first research reactor in Asia** which had became operational in 1956 and was shut down in 2009.

- It uses plate type dispersion fuel elements made of **Low Enriched Uranium (LEU).**
- Owing to higher neutron flux, this reactor will **increase indigenous production of radio-isotopes** for medical application by about 50%.

Related Information

Other Research reactors

- **Kamini** (Kalpakkam Mini)
  - KAMINI is the only reactor in the world operating with 233U fuel which is produced by the thorium fuel cycle harnessed by the neighboring Fast Breeder Test Reactor.
- **Dhruva** (at BARC in Trombay)
  - It is India's largest research reactor.

India's three-stage Nuclear Power Programme

- **Stage 1: Pressurised Heavy Water Reactor**
  - In this natural uranium (0.7 % fissile U-235 and the rest is U-238) fuelled pressurised heavy water reactors (PHWR) which produce electricity while generating plutonium-239 as by-product.
- **Stage 2 – Fast Breeder Reactor**
  - In the second stage, fast breeder reactors (FBRs) would use a mixed oxide (MOX) fuel made from **plutonium-239**, recovered by reprocessing spent fuel from the first stage, and **natural uranium**.
  - In FBRs, plutonium-239 undergoes fission to produce energy, while the uranium-238 present in the mixed oxide fuel transmutes to additional plutonium-239.
  - Thus, the Stage II FBRs are designed to **"breed" more fuel than they consume**.
  - Recently, India's first indigenously developed prototype FBR at Kalpakkam achieved **criticality**, which means reactor is fully operational and safe.
- **Stage 3 – Thorium Based Reactors**
  - A Stage III reactor or an advanced nuclear power system involves a self-**sustaining series of thorium-232- uranium-233 fuelled reactors**.
  - This would be a thermal breeder reactor, which in principle can be refueled after its initial fuel charge using only naturally occurring thorium.

	PHWR	FBR
Purpose	Electricity, plutonium production	Electricity, plutonium production
Coolant	Heavy water (D_2O)	Molten, liquid sodium
Moderator	Heavy water (D_2O)	Not required
Fuel	UO_2 or metal	Plutonium dioxide and UO_2 in different combinations
Enrichment level	Not-enriched	Various mixtures of P-239 and U-235

7.6. WORLD'S FIRST FLOATING NUCLEAR PLANT

Why in News?

Russia has created world's first floating nuclear plant (FNPP) named as Academik Lomonosov.

About the Plant

- It is owned by the state-run nuclear energy corporation **Rosatom,** which is also the equipment suppliers and consultants for the **Kudankulam Nuclear Power Project** in Tamil Nadu.
- Upon its connection to the Power grid, Akademik Lomonosov will become the **northernmost nuclear installation in the world** and it is expected to be put into service in early 2019.

8. RESEARCH & DEVELOPMENT

8.1. PRIME MINISTER'S SCIENCE TECHNOLOGY AND INNOVATION COUNCIL (PM-STIAC)

Why in news?

Union Government recently constituted new 21-member advisory panel on science, technology and innovation called Prime Minister's Science, Technology and Innovation Advisory Council (PM-STIAC).

More on news

- It will be chaired by the government's Principal Scientific Advisor, Dr K. Vijay Raghavan.
- It will **replace two scientific advisory committees** for the prime minister and the cabinet, and is aimed to streamline as well as cut down the number of committees and councils.
- The council includes secretaries from various departments/ministries and is expected to act as a high level advisory body to several ministries and execute mission-oriented programmes. The new panel will advise the PM on all matters related to science, technology and innovation, and would also monitor the implementation of the PM's vision.
- It will also **advise government on developing 'Clusters of Excellence'** in science including city-based R&D clusters. It will work to bring together all science and technology partners from academia and institutes to industries near such centres or cities.
- Recently, it has identified **nine national science missions** aim to address major scientific challenges to ensure India's sustainable development - Natural Language Translation, Quantum Frontiers, Artificial Intelligence (AI), National Biodiversity Mission, Electric vehicles, Bioscience for Human Health, Waste to Wealth, Deep Ocean exploration, AGNIi (Accelerating Growth of New India's Innovations)

8.2. MISSION INNOVATION

Why in News?

India recently participated in the 3rd Mission Innovation Ministerial Meeting held in Sweden.

Initiatives taken

- **Mission Innovation Champions Programme** was launched by MI countries to felicitate clean energy innovators.
- **Hydrogen Innovation Challenge** was announced to reduce costs along the value chain and further expand the deployment of hydrogen.
- India announced setting up of **First International Incubator for clean energy** in public-private partnership at a total investment of around US $ 5 million in Delhi.

Mission Innovation

- It was launched at COP21 of UNFCCC in Paris in November 2015. It is a **global platform of 23 countries and European Union** aimed at accelerating clean energy innovations through-
  - Enhanced Government funding,
  - Greater public-private sector partnership and
  - Enhanced global cooperation.
- It seeks to **double investments** in clean energy innovation over five years.
- **India** is **founding member of Mission Innovation** and part of the Steering Committee besides co-lead of innovation challenges on smart grids, off grids and sustainable bio-fuels.
- **Department of Biotechnology (DBT)** is nodal agency of this mission in India.
- The first Ministerial meeting was held in June 2016 in San Francisco. 4th MI Ministerial will be hosted by Canada, Vancouver in May 2019.

The **eight Innovation Challenges** under Mission Innovation are the following:

- Smart Grids
- Off-Grid Access to Electricity
- Carbon Capture
- Sustainable Biofuels
- Converting Sunlight
- Clean Energy Materials
- Affordable Heating and Cooling of Buildings
- Renewable and Clean Hydrogen (recently added)

8.3. ATAL TINKERING MARATHON

Why in news?

A six-month long Atal Tinkering Marathon has been organized by Atal Tinkering Lab of **Atal Innovation Mission (AIM)** of NITI Ayog.

Details of the Atal Tinkering Marathon:

- Its aim is to find out the **best student innovators** of India.
- The marathon puts nation-wide **challenge in 6 thematic areas** namely Clean Energy, Water resources, Waste management, Healthcare, Smart mobility, and Agri-tech.
- The Top 30 teams selected for their innovation, were being awarded with several prizes including **a three month-long ATL Student Innovator Program** (ATL SIP) in partnership with industry and start-up incubator.

Atal Innovation Mission

- It is a flagship initiative set up by the NITI Aayog to promote innovation and entrepreneurship across the length and breadth of the country, based on a detailed study and deliberations on innovation and entrepreneurial needs of India in the years ahead.
- It shall have **two core functions**:
  - Entrepreneurship promotion through **Self-Employment and Talent Utilization (SETU)**, wherein innovators would be supported and mentored to become successful entrepreneurs.
  - **Innovation promotion:** To provide a platform where innovative ideas are generated through-
    - ✓ Atal Tinkering Labs
    - ✓ Atal Incubation Centers
    - ✓ Scale-up support to Established Incubators

ATL Student Innovator Program

- It is an effort to institutionalize a mechanism, where **high school students can work with university incubators** to pursue their innovative and entrepreneurial ideas along with their education.

8.4. RECENT INITIATIVES RELATED TO RESEARCH

IMPRESS — Impactful Policy Research in Social Sciences

- **Aim:** To identify and fund research proposals in social sciences with maximum impact on the governance and society.
- **Eligibility:** To provide opportunity for social science researchers in any institution in the country, including all Universities (Central and State), private institutions and ICSSR funded/recognised research institutes.
- **Implementing Agency:** Indian Council of Social Science Research (ICSSR).

Identified domains under IMPRESS are:

- State and Democracy.
- Urban Transformation.
- Media, Culture and Society.
- Employment Skills and Rural Transformation.
- Governance, Innovation and Public Policy.
- Growth, Macro Trade and Economic Policy.
- Agriculture and Rural Development.
- Health and Environment.
- Science and Education.
- Social Media and Technology.
- Politics, Law and Economics.

SPARC — Scheme for Promotion of Academic and Research Collaboration

- **Aim:** To boost joint research with global universities from 28 countries and get international expertise to solve major national problems, train Indian students in the best laboratories, deepen academic engagement and improve the international ranking of Indian Institutes.
- **Eligibility:** All Indian institutions ranked in top 100 of National Institutional Ranking Framework will be eligible for this scheme that targets PhD and postdoctoral researchers. Foreign institutions in top 100 to top 200 of global academic rankings from the 28 target countries will be eligible.
- A set of **Nodal Institutions (NI), from India,** for each participating foreign country has been identified to help, handhold and coordinate with willing Participating Indian (PI) Institutions to forge alliance with the Institutions of concerned participating foreign country, for academic and research collaboration.
- **Implementing Agency:** IIT Kharagpur will be the National Coordinating (NC) Institution.

Thrust Areas under SPARC Scheme

- **Fundamental Research:** Those which attempt to provide new knowledge and understanding or address open unsolved problems of international importance.
- **Emergent Areas of Impact:** Those which look at new and emerging areas like Artificial & Machine Learning, Cognitive Science, Human Signal Processing, Digital Humanities, etc, that can potentially bring about a major impact cutting across disciplines and domains.
- **Convergence:** Those which bring together multiple disciplines of basic, engineering, economic, social science and humanities to solve critical problems of today in a holistic integrated manner.
- **Other areas like** Action Oriented Research, Innovation-Driven and other proposal of high potential.

Augmenting Writing Skills for Articulating Research (AWSAR)

- The scheme has been initiated by **National Council of Science and Technology**

Communication (NCSTC), Department of Science & Technology (DST) to encourage, empower and endow popular science writing through newspapers, magazines, blogs, social media etc. by young PhD scholars and post-doctoral fellows during the course of their higher studies.

- Under the scheme best articles which would be selected would be provided monetary incentives.
- **Significance**:
  - Increase supply of informed science writing
  - Encourage the students to write about their work and help them secure the resources
  - tap the potential of young scholars
  - Inculcate scientific temperament in the masses.
  - Improve the future science communication and popularize science in India.

Innovation Cell at All India Council of Technical Education (AICTE)

- **Aim:** to encourage, inspire and nurture young students by exposing them to new ideas and processes resulting in innovative activities in their formative years fostered through Network of Innovation clubs in Higher Educational Institutions. Major Program under it are:

- **Atal Ranking of Institutions on Innovation Achievements (ARIIA)** - to systematically rank education institutions and universities primarily on innovation related indicators. It will primarily focus on 5 main parameters -
  - Budget expenses and revenue generated through innovation and entrepreneurship
  - Facilitating access to advance centres/facilities and entrepreneurial support system
  - Idea to entrepreneurship
  - Development of innovation ecosystems supported through teaching and learning
  - Best innovative solutions developed in-house for improving governance of your institution
- **Smart India Hackathon (SIH) 2019** - to provide students a platform to solve some of pressing problems we face in our daily lives, and thus inculcate a culture of product innovation and a mindset of problem solving.
- **National Student Startup Policy (NSSP)** - launched in 2016 to guide AICTE approved institutions to promote student driven innovations and start-ups. The policy aims at identifying the innovative and entrepreneurial potential of students and transforming them into start-up entrepreneurs. This can be done by developing an ideal entrepreneurial ecosystem and promoting strong inter-institutional partnerships among technical institutions, other ecosystem enablers, different stakeholders, programs, market and society.

IMPRINT – II

- **Impacting Research, Innovation and Technology** or **IMPRINT** is a national initiative of Ministry of Human Resource Development (MHRD) which aims to address engineering challenges in **10 technology domains** relevant to India through an inclusive and sustainable mode.
- The 10 domains include**:** (i) Health care (ii) Information and Communication Technology (iii) Energy (iv) Sustainable Habitat (v) Nano-technology Hardware (vi) Water Resources and River systems (vii) Advanced Materials (viii) Manufacturing (ix) Security and Defense (x) Environmental Science and Climate Change
- IMPRINT was launched in 2015 as a joint initiative of IITs and IISc.
- The round two of IMPRINT – **IMPRINT II**, will be jointly funded and steered by MHRD and Department of Science and Technology.
- Key features of IMPRINT-II include–
  - Principle objective is to translate knowledge into viable technology
  - MHRD and DST will be equal partners in the scheme
  - It will be open to all MHRD funded Higher Education Institute (HEI)/Centrally Funded Technical Institution (CFTI). Its scope has been extended to private institutions as well.
  - Projects with industry support will be preferred

Startup Academia Alliance Program

- It is a **unique mentorship opportunity** between academic scholars and start-ups to promote **the spirit of entrepreneurship** in the country.
- It aims to **reduce the gap** between **scientific research and its industrial application** in order to increase the efficacy of technology and widen its impact.
- It strives to implement the **third pillar on which the Startup India Action Plan** is based -

Industry Academia Partnerships and Incubation. The other two being Simplification and Handholding & Funding Support and Incentives

- It has been partnered by Regional Centre for Biotechnology, The Energy and Resources Institute (TERI), Council on Energy, Environment and Water, and TERI School of Advanced Studies to provide mentorship and guidance to relevant start-ups in the field of renewable energy, biotechnology, healthcare etc.

Ocean Services, Technology, Observations, Resources Modelling and Science (O-SMART) Scheme

- It's an **Umbrella scheme under Ministry of Earth Sciences** and encompasses a total of 16 sub-projects addressing ocean development activities such as Services, Technology, Resources, Observations and Science.
- **Key missions under O-SMART:** It encompasses a total of **16 sub-projects** addressing ocean development activities such as Services, Technology, Resources, Observations and Science. The services rendered under the O-SMART will provide economic benefits to a number of user communities in the coastal and ocean sectors, namely, fisheries, offshore industry, coastal states, Defence, Shipping, Ports etc. This scheme also provides necessary scientific and technological background required for implementation of various aspects of Blue Economy.

Stars Scheme

- Recently, Ministry of Human Resource Development launched **STARS Scheme (Scheme for Translational and Advanced Research in Science)** on National Science Day.
- Under this, 500 science projects would be funded.
- The project will be coordinated by the **Indian Institute of Science (IISc),** Bangalore.

Related Information
National Science Day

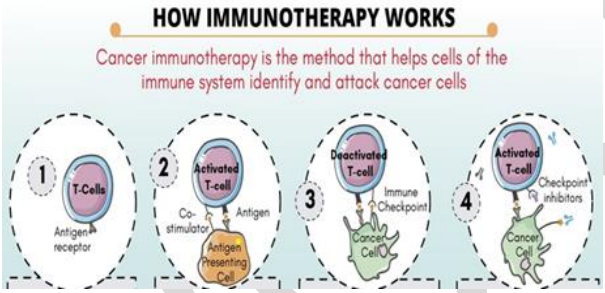
- It is celebrated every year on **February 28** to mark the **discovery of Raman Effect** by physicist Chandrasekhara Venkata Raman (honoured with **Bharat Ratna, Nobel Price and Lenin Peace Prize).**
- **Theme:** This year theme was 'Science for the People and the People for Science'.

9. AWARDS

9.1. NOBLE PRIZES 2018

9.1.1. NOBEL PRIZE IN PHYSIOLOGY OR MEDICINE

- It has been jointly awarded to **James P. Allison** and **Tasuku Honjo** for their **discovery of 'immune checkpoint therapy,'** a cancer treatment.
- **Working:** By stimulating the inherent ability of our immune system to attack tumor cells by releasing the brakes on immune cells.
- **James P. Allison** studied a known protein that functions as a **brake on the immune system.** He realized the potential of releasing the brake and thereby unleashing our immune cells to attack tumors. He then developed this concept into a brand new approach for treating patients.
- **Tasuku Honjo** discovered a protein on immune cells and, after careful exploration of its function, eventually revealed that it **also operates as a brake**, but with a different mechanism of action. Therapies based on his discovery proved to be strikingly effective in the fight against cancer.

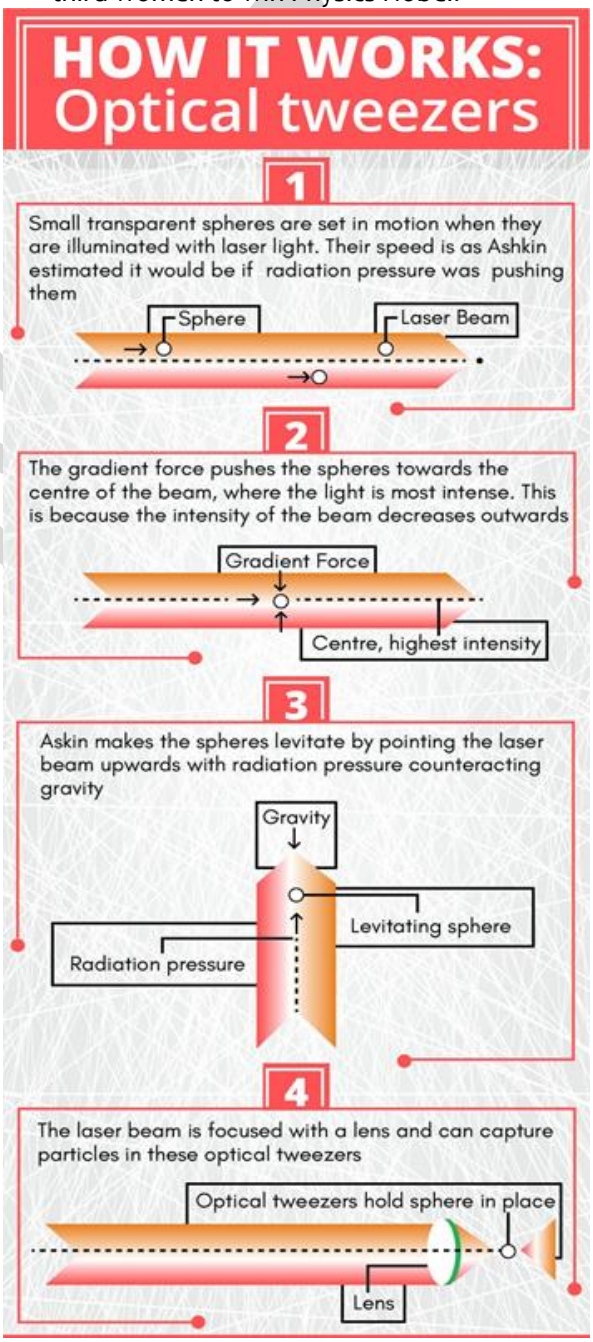


Human immune system

- The Immune system is a complex network of cells and organs that work together to defend against foreign substances (antigens-bacteria, virus etc.). Various cells associated are:
  - **B-cell** – It is a type of white blood cell that makes antibodies. Antibodies are large Y-shaped proteins which bind to specific antigens. This signals the other cells of the immune system to get rid of the invading microbes.
  - **T-cell** – These are designed to recognise the molecular signatures of particular proteins, such as those from bacteria, in order to activate an immune response.
  - **Macrophage** – It is the first cell to recognize and engulf foreign substances. It may break down these substances and present the smaller proteins to the T lymphocytes .

9.1.2. NOBEL PRIZE IN PHYSICS

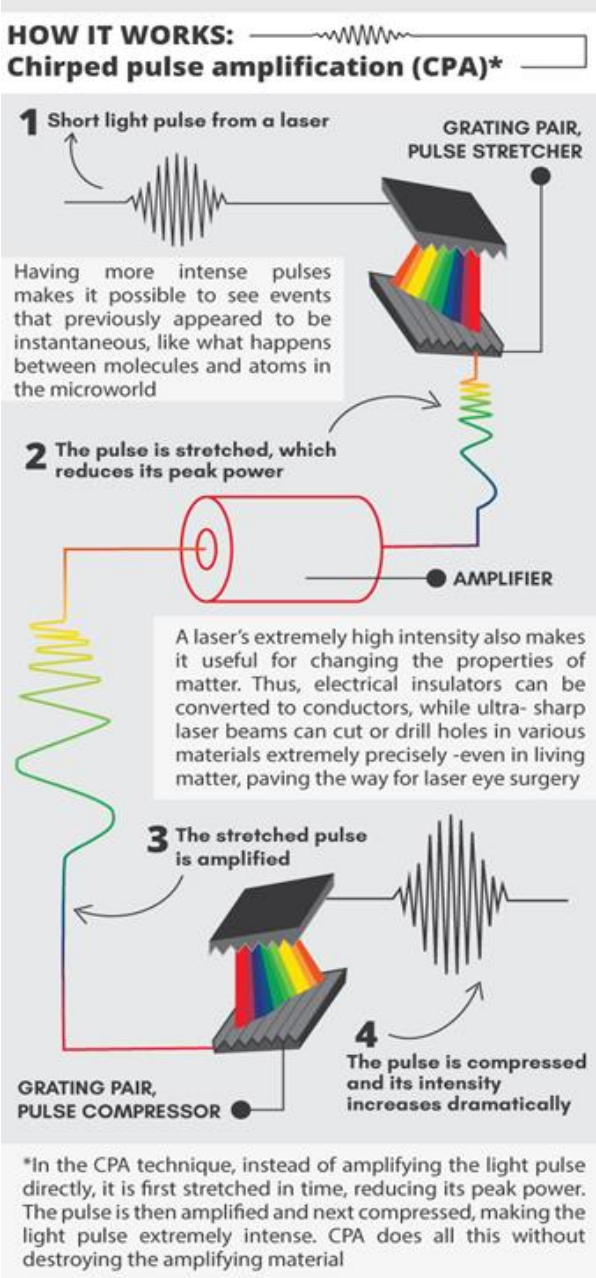
- **Nobel** Prize in Physics 2018 was awarded for groundbreaking **inventions in the field of laser physics** with one half to **Arthur Ashkin** for the **optical tweezers** and their application to biological systems, the other half jointly to **Gérard Mourou and Donna Strickland** for their method **of generating high-intensity, ultra-short optical pulses.** Donna Strickland is third women to win Physics Nobel.



- **Application:**
  - **Optical Tweezers** have been used to trap dielectric spheres, viruses, bacteria, living cells, organelles, small metal particles,

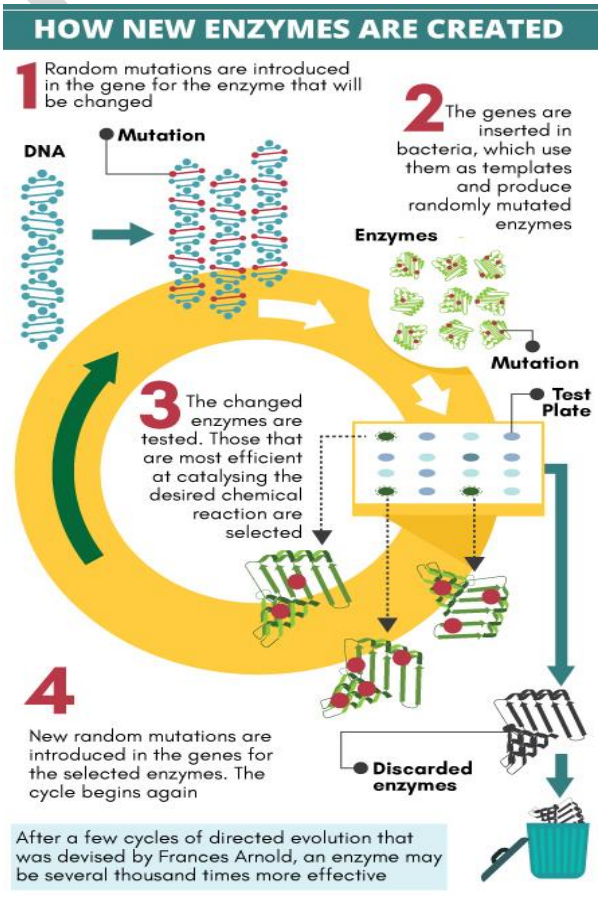
and even strands of DNA. Applications include confinement and organization (e.g. for cell sorting), tracking of movement (e.g. of bacteria), application and measurement of small forces, and altering of larger structures (such as cell membranes).

- **Chirped Pulse Amplification (CPA)** for subsequent high-intensity lasers. Its uses include the millions of corrective eye surgeries that are conducted every year using the sharpest of laser beams.



9.1.3. NOBEL PRIZE IN CHEMISTRY

- The Nobel Prize in Chemistry 2018 was divided, one half awarded to **Frances H. Arnold for the directed evolution of enzymes,** the other half jointly to **George P. Smith and Sir Gregory P. Winter** for the **Phage Display** of peptides and antibodies. Ms. Arnold, only the fifth woman to win a chemistry Nobel.
- **Application:**
  - **First directed evolution of enzymes,** which are proteins that catalyse chemical reactions, has been used in manufacturing of chemical substances, such as pharmaceuticals, and the production of renewable fuels for a greener transport sector.
  - **Phage Display,** where a **bacteriophage** – a virus that infects bacteria – can be used to evolve new proteins. It has produced anti-bodies that can neutralise toxins, counteract autoimmune diseases and cure metastatic cancer. **Adalimumab, a first protein evolved through phage display,** is used for rheumatoid arthritis, psoriasis and inflammatory bowel diseases.
    - ✓ **Phage display allows** scientists to study protein interactions on a large-scale and select proteins with the highest affinity for specific targets. It provides a means to identify target-binding proteins from a library of millions of different proteins without the need to screen each molecule individually.



9.2. FIELDS MEDAL

Why in news?

Recently, **Indian- Australian mathematician Akshay Venkatesh** was awarded Fields Medal, also known as the Nobel prize for math.

About Fields Award

- It is awarded **every four years** on the occasion of International Congress of Mathematicians to recognise the outstanding mathematical achievements for existing work to the mathematicians **under the age of 40 years.**
- The prize was inaugurated in 1932. Each winner is awarded with a cash of 15000 Canadian dollars cash prize.
- The medals and cash prizes are funded by a trust established by **John Charles Fields** at the University of Toronto, which has been supplemented periodically.
- Venkatesh was recognised for his **use of dynamics theory,** which studies the equations of moving objects to solve problems in number theory, which is the study of whole numbers, integers and prime numbers.

10. MISCELLANEOUS

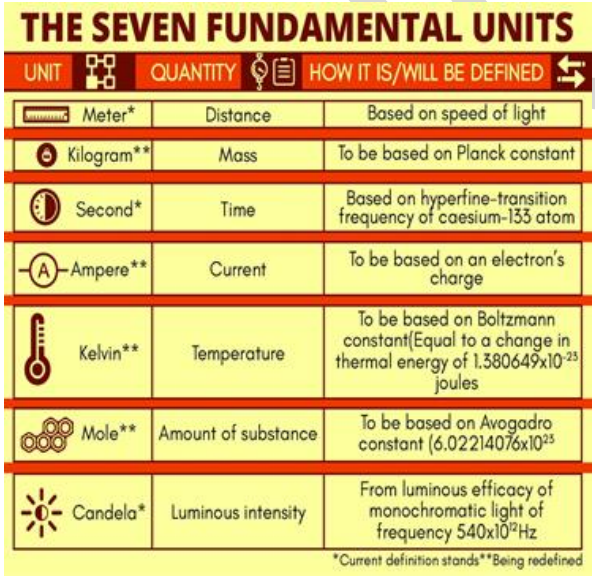
10.1. OVERHAUL OF SI UNITS

Why in News?

The 26th General Conference on Weights & Measures (CGPM) in a historic decision unanimously redefined World's standard definition of **kilogram, Ampere, Kelvin, and Mole.**

Impact of Change

- It will result in **uniform and worldwide accessible SI system** for high- technology manufacturing, basic science, etc. For example earlier the scientific definition of the "second" had helped ease communication across the world via technologies like GPS and the Internet.
- The units shall be **stable in the long term,** internally self-consistent and practically realisable being based on the present theoretical description of nature at the highest level.
- It will **not be bound by the limitations of objects in our measurement** of the world, but have universality accessible units that can pave the way to even greater accuracy and accelerate scientific advancement.
- It will **not change measurements in our day to day life** like in kitchen, trade & transport etc. Thus for most people, everyday life will carry on as normal despite the redefinitions.



General Conference on Weights and Measures (CGPM)

- CGPM is the highest international body of the world for accurate and precise measurements.
- **India became a signatory in 1957.**
- The CGPM meets usually once every four years
- The International Bureau of Weights and Measures (BIPM), the main executive body of CGPM has the responsibility of defining the International System of Units (SI).

International System of Units (SI Units)

- The SI system was adopted in 1960.
- There are seven fundamental units. Every other unit of measurement can be derived from one or more of these seven units: the unit for speed, for instance, factors in the units for distance and time.

10.2. CALL FOR TWO TIME ZONES IN INDIA

Why in news?

Council of Scientific & Industrial Research's National Physical Laboratory (CSIR-NPL), which maintains Indian Standard Time (IST), has published a research article describing the necessity of two time zones.

Need for two time zones

- At present, the country observes a single time zone based on the longitude passing through 82°30'E.
- India extends from 68°7'E to 97°25'E, with the **spread of 29°** representing **almost two hours** from the geographic perspective. Early sunrise in the easternmost parts- (as early as 4AM in June) in the Northeast - causes the loss of many daylight hours by the time offices or educational institutions open, and that early sunset (4PM in winters), for its part, leads to higher consumption of electricity.
- The researchers estimated **energy savings at 20 million kWh** if we follow two time zones. This will have ecological and environmental benefits too.
- It will have an **impact on circadian rhythm** of the body and thus would have health benefits due to better leisure time and sleep. This, in turn, would enhance the **productivity of people**.

Proposal for new time zone

- The proposed **line of demarcation is at 89°52'E,** the narrow border between Assam and West Bengal. States west of the line would continue to follow IST (to be called IST-I). States east of the line — Assam, Meghalaya, Nagaland, Arunanchal Pradesh, Manipur, Mizoram, Tripura, Andaman & Nicobar Islands —would follow IST-II.

Related Facts

- Since independence in 1947, the IST has been the official time for the whole country.
- **India's time zones were first established in 1884.** Pre-independence India had two time zones. In the East, **Calcutta Time** was 5:30:21 hours ahead of GMT, while **Bombay Time** in the West was 4:51:00 hours ahead of GMT.
- Calcutta Time was abandoned in 1948 and Bombay Time in 1955.
- Assam already has **a Bagaan (tea garden) Time,** set an hour ahead of Indian Standard Time (IST).

Related Information

- **Circadian rhythm**
  - It is a pattern that guides our bodies when to sleep, rise, eat and regulating many physiological processes.
  - Biological clocks produce circadian rhythms and regulate their timing.
  - It is affected by environmental cues, like sunlight and temperature.
  - It regulates the periods of tiredness and wakefulness during the 24-hour cycle.
  - The biological clock is generated by a structure of neurons, which is found in the hypothalamus in the brain.
  - Biological clock associated factors include High alertness, Fastest increase in blood pressure. Deep Sleep, Fastest reaction times etc.
- **Countries with most number of time zones**
  - France: 12
  - United States of America: 11
  - Russia: 11
  - United Kingdom: 9

10.3. COLOURED X-RAY ON HUMAN

Why in news?

New Zealand scientists have performed the first-ever 3-D, colour X-ray on a human.

About Colour X-ray

- The device is based on the traditional black-and-white X-ray and incorporates particle-tracking technology developed for CERN's Large Hadron Collider.
- The CERN technology called **Medipix** is like a camera detecting and counting individual sub-atomic particles as they collide with pixels while its shutter is open. This allows for high-resolution, high-contrast pictures.
- When X-rays travel through your body, they're absorbed by denser materials (bones) and pass right through softer ones (muscles and other tissues). The places where the X-rays couldn't pass through appear solid white.
- Instead of recording the X-rays as either passing right through the body or getting absorbed by the bone, this scanner is better as it records the precise energy levels of the X-rays as they hit each particle in your body. It then translates those measurements into different colours representing your bones, muscles, and other tissues.
- Thus, it clearly shows the difference between bone, muscle and cartilage and also the position and size of cancerous tumours as well.
- Other benefits include:
  - **More accurate diagnosis** as it would produce clearer and more accurate pictures.
  - Future version may enable complete image of a human, which may help in **3D printing a lost limb or a malfunctioning organ**
  - **Customised medical care to individual needs** as it would not just show fractures, surrounding tissues, blood and nerve supply but also structures exactly as they are.

10.4. INTERNATIONAL YEAR OF THE PERIODIC TABLE OF CHEMICAL ELEMENTS

Why in News?

The United Nations General Assembly has proclaimed 2019 as **the International Year of the Periodic Table of Chemical Elements** to celebrate its **150 years**.

About the Periodic Table of Chemical Elements

- Russian scientist **Dmitry Mendeleev** published the first periodic table in 1869. He organized all chemical elements by the **atomic mass** (number of protons & neutrons) and other chemical properties.
  - **Mendeleev's Periodic Law:** The Properties of elements are periodic functions of their atomic masses.
- However, the shortcomings of Mendeleev's Periodic Table were **uncertain position of Hydrogen** and **no place for isotopes** (similar chemical properties but different atomic masses) which were discovered later.
- Thus**, Modern periodic table,** managed by the **International Union for Pure and Applied Chemistry (IUPAC)** is arranged on the basis of **atomic number** rather than atomic mass.
  - It is a tabular arrangement of the chemical elements, arranged by atomic number, electron configuration, and **recurring chemical properties**, whose structure shows periodic trends.
  - The **Seven rows** of the table, called **periods**, generally have metals on the left and non-metals on the right.
  - The columns, called **groups**, contain elements with similar chemical behaviours.
  - The elements from atomic numbers 1 (hydrogen) through 118 (oganesson) have been discovered or synthesized, completing seven full rows of the periodic table.
  - It is an exceptional tool for scientists to understand, and even **predict**, the properties of all the elements and elements that are yet to be discovered.

10.5. SCIENCE-BASED TARGETS

Why in news?

Sixteen Indian companies have recently committed to set science-based targets.

More on news

- The **science-based targets initiative** is a global team comprised of people from all partner organisations – the United Nations Global Compact, CDP, WWF and World Resources Institute.
- Targets adopted by companies to reduce greenhouse gas (GHG) emissions are considered "science-based" if they are in line with the level of decarbonization required to keep global temperature increase below 2 degrees Celsius compared to pre- industrial temperatures.
- In March 2018, Mahindra Sanyo Steel became the first Indian company to set its science-based target. Globally, it is also the first steel company to set a target.

10.6. FASTAG

Why in news?

Centre is proposing to make **FASTag compulsory for all commercial vehicles** -- trucks, taxis and buses.

Details

- FASTag is a device which uses RFID technology for making toll-payment directly from the prepaid account.

About RFID

- **Radio-Frequency Identification (RFID)** is the use of radio waves to read and capture information stored on a tag attached to an object. A tag can be read from up to several feet away and **does not need to be within direct line-of-sight of the reader** to be tracked. It is applied for tracking items or as a pass.

Other related technologies

- **Near Field Communication (NFC)** is a shortrange high frequency wireless communication technology that enables the exchange of data between devices over about a 10 cm distance. It is used in credit card related payments, e-booking etc.
- **Barcode scanner** detects the light reflected from the barcode. This needs to be kept in range of several inches to several feet to read the code.
- **QR code (Quick Response code)**
  - It's a **two-dimensional (matrix) machine readable bar code** made up of black and white square.
  - It carries information **both horizontally and vertically**. It has **error correction capability** and data stored in it can be restored even if it is partially damaged or dirty.
  - It is capable of **360 degrees (omnidirectional)**, high speed reading.
  - QR Code can store up to 7089 digits as compared to conventional bar codes which can store max 20 digits.
- **Bluetooth technology**
  - It is a high speed low powered wireless technology which uses radio waves to link phones, computers and other network devices over short distance.
  - Wireless signals transmitted with Bluetooth cover short distances, typically **up to 30 feet (10 meters).**
  - Bluetooth sends and receives radio waves in a band (frequency band of 2.45GHz) of 79 different frequencies and can connect up to "eight devices" simultaneously
  - It **overcomes the constraints of line of sight** and one to one communication as in other mode of wireless communications like infrared.
  - It guarantees security at bit level. When a group of two or more Bluetooth devices are sharing information together, they form a kind of ad-hoc, mini computer network called a **piconet**.
  - It removes the problem of radio interference by using a technique called **Speed Frequency Hopping**. This ensures that the interference won't take place as each transmitter will be on different frequencies.

10.7. DRY SORBENT INJECTION (DSI)

Why in News?

NTPC is opting for dry Sorbent Injection (DSI) system for controlling sulphur dioxide (SO_2) emissions.

About DSI

- Dry Sorbent Injection (DSI) system is a pollution control system for the reduction of SOx (SO_2, SO_3), HCl and **heavy metals like mercury**.
- It is a dry process in which a sorbent (a material used to absorb or adsorb liquids or gases) is injected into the coal fired boiler where it interacts with various pollutants like SOx, HCl and the **resultant dry waste is removed via either an electrostatic precipitator** (ESP) or a fabric filter baghouse.
- It offers various advantages in comparison to traditional acid gas scrubber technology such as: lower capital cost, wide range of favourable operation conditions, and much lesser time for completing installation and commissioning.

10.8. ARTIFICIAL LEAF

Why in news?

Indian Institute of Sciences' researchers have developed an **artificial leaf** recently.

About Artificial Leaf or Quantum Leaf

- It will help in reducing carbon footprint as it absorbs carbon dioxide in the atmosphere to generate fuel and oxygen in the process, simulating the process of photosynthesis.
- While most plants **convert less than one per cent o**f the available solar energy into chemical energy, the leaf can **convert about 20 per cent of the incident solar energy into chemical energy. Also,** it is **100 times more efficient than a natural leaf** in absorbing carbon dioxide during the process.
- It is composed of **completely biocompatible, earth abundant, semiconductor nano crystals** called **Quantum dots** which act as catalyst to convert absorbed **CO_2 into bicarbonate and then 'formate'** (derivative of formic acid) that can be used as **bio fuel.**
- It uses copper aluminium sulphate and zinc sulphide as semiconductors.
- The bio fuel generated is not only **100% combustible** but the **carbon dioxide emitted** in the combustion of the fuel can be **recycled by the quantum leaves** too.

Quantum Dot

- It is **a semiconductor nano crystal** which **is made of specific materials**.
- It has a discrete quantized energy spectrum.
- It contains a small finite number of **conduction band electrons, valence band holes, or excitons**.
- They are typically between **10 and 50 nm in size**
- They glow a particular color after being illuminated by light.
- The color they glow depends on the size of the nanoparticle. The smaller the nanoparticle, the higher the energy difference between valence band and conduction band, which results in a deeper blue color. For a larger nanoparticle, the energy difference is lower, which shifts the glow toward red.
- It has many **applications** in several areas such as **solar cells, transistors, LEDs, medical imaging and quantum computing.**

10.9. 106TH INDIAN SCIENCE CONGRESS

Why in news?

The 106th session of the Indian Science Congress was held recently at Jalandhar.

Details

- It is conducted annually by the **Indian Science Congress Association (ISCA)**, under Department of Science and Technology.
- Its first session was held in Kolkata under the General Presidentship of Ashutosh Mukherjee in 1914. In 1947, Jawaharlal Nehru, the first Prime Minister, was the General President. The tradition has been carried on by successive PMs for the last 70 years.
- The theme this year was **"Future India: Science and Technology"**. PM emphasized on **connecting science, technology and innovation with the people**, in his address.

10.10. OTHER IMPORTANT NEWS

10.10.1. NEW ELEMENT WITH MAGNETIC PROPERTIES DISCOVERED

- Researchers at the University of Minnesota (US) have discovered **magnetic properties in chemical element Ruthenium (Ru).**
- **Ru** belongs to the platinum group, has atomic number 44 and is mostly used in the electronics industry for chip resistors and electrical contacts.
- It is the **fourth element to have unique magnetic properties** at room temperature. Other than this only three elements have been found to be ferromagnetic at room temperature **- iron (Fe), cobalt (Co), and nickel (Ni).**
- It is one of the **rarest metals on the earth,** resistant to oxidation, and additional theoretical predictions claim it has a high thermal stability.

Related Information
Ferromagnetism

- It is the property of material by which certain materials (such as iron) form permanent magnets or are attracted to magnets.
- The magnetism in ferromagnetic materials is caused by the alignment patterns of their constituent atoms, which act as elementary electromagnets.
- Ferromagnetism is explained by the concept that some species of atoms possess a magnetic moment—that is, that such an atom itself is an elementary electromagnet produced by the motion of electrons about its nucleus and by the spin of its electrons on their own axes.

10.10.2. FORMALIN

- Formalin is being used in the fishing industry to increase the shelf-life of fish.
- Formalin (formaldehyde) is colorless flammable chemical, used as **an anti-decomposition agent.**
- **Usage:** In pressed wood products, fabrics, insulation materials and as fungicide, germicide & disinfectant and as a preservative for bodies and organs to ensure the specimen doesn't decompose.
- **Impact:** International agency for research on cancer and US FDA both classify formaldehyde as a human carcinogen. It increases risk of leukaemia, blood cancer etc.
- Short term damages for formaldehyde are watery eyes, coughing, wheezing, nausea and skin irritation.

10.10.3. BISPHENOL A (BPA)

- Scientists have created **tiny spheres of Titanium dioxide** that can catch and destroy BPA. BPA being hydrophobic is attracted to the cavity where it is degraded into harmless chemicals.
- Bisphenol A (BPA) is a chemical produced in large quantities for use primarily in the **production of polycarbonate plastics and epoxy resins.**
- Polycarbonate plastics have many applications including use in some food and drink packaging, e.g., water and infant bottles, compact discs, impact-resistant safety equipment, and medical devices.
- BPA **can leach into food** from the protective internal epoxy resin coatings of canned foods and from consumer.
- **BPA is an endocrine system disruptor** and it can interfere with the production, and function of natural hormones. It also contributes to high blood pressure.
- **BPA can also be found in breast milk**. Its Prolonged exposure is suspected of affecting the health of children.

10.10.4. SHIFTING NORTH MAGNETIC POLE

- Recently, World Magentic Model was updated and the location of the Earth's magnetic north pole was changed.
- It is estimated that this wandering point is moving away from the Canadian Arctic and towards Russia. Therefore, the magnetic declination, or the difference between the magnetic north and the true north, is said to be changing with time.
- The location of the poles, especially the magnetic north, is important for individuals using GPS systems and compasses on their smartphones. In addition, several technological inventions in the field of communications also rely on Earth's magnetic poles.
- World Magnetic Model was initially developed by the U.S. National Oceanic and Atmospheric Administration and the British Geological Survey developed to keep track of the changes of the shifting poles.
- The wandering pole is **driven by unpredictable changes in liquid iron deep inside the Earth**.

10.10.5. FIRECRACKERS DEVELOPED BY CSIR

- CSIR scientists have developed **Less Polluting Firecrackers** which are **environment friendly** and **15-20 % cheaper** than the conventional ones. These crackers have been named as safe water releaser (**SWAS**), safe minimal aluminium (**SAFAL**) and safe thermite cracker (**STAR**).
- It has unique property of **releasing water vapour** and /or air as dust suppressant and diluent for gaseous emissions and **matching performance in sound** with conventional crackers.

10.10.6. ONEER

- Council of Scientific and Industrial Research, Indian Institute of Toxicology Research (CSIR-IITR), Lucknow has developed an innovative technology for "Drinking Water Disinfection System" with Trade name "Oneer^{TM}".

10.10.7. IDEATE FOR INDIA

- Recently, **Minister of Electronics & IT** launched a National Challenge for Youths, **"Ideate for India - Creative Solutions using Technology" with an aim to** give school students (class 6-12) an opportunity to become solution creators for the problems.
- The Challenge has been designed by the **National e-Governance Division**, Ministry of Electronics & IT in collaboration with Intel India, with support from the Department of School Education and Literacy.
- Top 50 students will be declared **Tech Creation Champions**.

10.10.8. TELEROBOTIC SURGERY

- India became the **world's first** to successfully perform a telerobotic **heart surgery.**
- **Some other application of Tele-robotics include:**
  - **Space and marine exploration**
  - **Use in Agriculture:** Robinsects/ Nova-Crafters which are GPS and Artificial Intelligence enabled small robotics drones programmed to carry out the pollination. They are based on the concept of **'Biomimetics'** which is the use and implementation of concepts and principles from nature to creating new materials, devices and systems**.**

10.10.9. CUSAT STRATOSPHERE-TROPOSPHERE RADAR (CUSAT ST-205 RADAR)

- **The indigenously built CUSAT ST-205 Radar recently became operational.**
- It is designed to scan the stratosphere over the Indian ocean for movement of air for precision of weather, especially the monsoon. It uses radio waves to detect the atmospheric perturbations.
- It is situated at **the Cochin University**.
- The project was **financially supported by the Department of Science and Technology (DST).**