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SCIENCE AND TECHNOLOGY

(May 2017 – February 2018)

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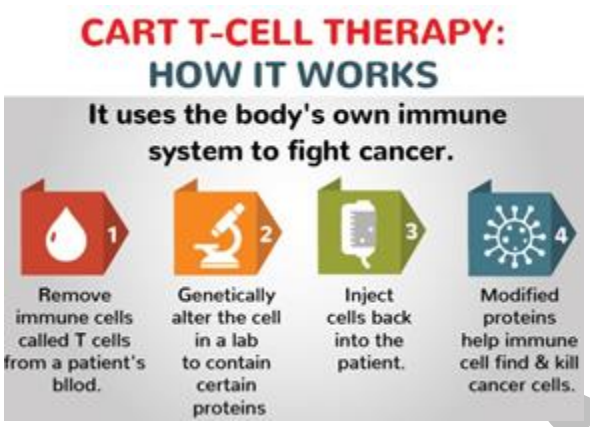
1. BIOTECHNOLOGY

1.1. GENE THERAPY

Why in news?

Recently, U.S Food and Drug Administration (USFDA) approved a **Yescarta (axicabtagene ciloleucel) therapy** to treat adults with certain types of large B-Cell lymphoma (blood cancer).

Yescarta uses **CAR (chimeric antigen receptor) T-cell therapy** for treatment.



About Yescarta therapy

- It is a type of gene therapy that turns cells in the patient's body into a "living drug" that targets and kills cancer cells.
- It has been given **Orphan Drug Designation,** under which it will be provided with financial incentives to encourage the development of drugs.

- **Living Drug -** Genetically modified cells are that are infused back into patients in **CAR T-cell therapy**, continue multiplying to fight disease for months or years. That's why these immunotherapy treatments are called **"living drugs."**
- **Orphan Drug** - A biological product or medicine that is intended to treat **diseases so rare** that sponsors are reluctant to develop them under usual marketing conditions. According to WHO, disease having fewer than 100 patients per 100,000 population is described as rare disease and fewer than 2 patients per 100,000 is described as ultra rare disease. Examples of the rare diseases are haemophilia, thalassemia etc.
- **Genes** – They are the biological templates the body uses to make the structural proteins and enzymes needed to build and maintain tissues and organs. Humans have about 20,000 genes bundled into 23 pairs of chromosomes all coiled up in the nucleus of nearly every cell in the body.

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**.

1.2. GENOME SEQUENCING OF RAGI

Why in news?

Recently, Genome sequencing of Ragi has been done.

Ragi/Finger Millet:

- It was introduced to India in around 3,000 BC.
- It has a low glycemic index, so preferred by diabetics.
- Ragi is drought resistant and is the main crop of dry land farmers.
- It occupies 12% of global millet cultivation area.
- Karnataka, which has the second largest drought-prone crop land after Rajasthan, leads in its cultivation.

What is Genome sequencing?

- Genome sequencing is figuring out **the order of DNA nucleotides, or bases, in a genome** i.e. the order of As (Adenine), Cs (Cytosine), Gs (Guanine), and Ts (Thymine) which make up an organism's DNA. The human genome is made up of over 3 billion of these genetic letters.
- It may provide new information on the genetic basis of poorly understood diseases, with the potential to provide new therapies.

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.
- 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.

Biological computing

- For a long time, it was known that **DNA can be used for data storage**.
- This may be used in future to build biological computers that use biological materials such as RNA, DNA and proteins, mimic biological organisms or are used to study biological organisms
- The biological computer may be an implantable device that is mainly used for tasks like monitoring the body's activities or making simple calculations or inducing therapeutic effects, all at the molecular or cellular level.

Some other genome sequencing projects

Human Genome Project (HGP):

1. **HGP-Read:**
   - This was an international and multi-institutional effort that took **13 years [1990-2003]** and $2.7 billion 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
2. **HGP-Write:**
   - This project was launched in 2016 to write or **build an artificial human genome from scratch** with sophisticated bioengineering tools.
   - HGP-write will aim to address a number of **human health challenges**. Potential applications include growing transplantable human organs, engineering immunity to viruses in cell lines via genome-wide recoding, engineering cancer resistance into new therapeutic cell lines, and accelerating high-productivity, cost-efficient vaccine and pharmaceutical development using human cells and organoids.
   - The project could encourage broad intellectual property access via **patent pooling.**
   - But, the HGP-write will require public involvement and consideration of ethical, legal, and social implications.

The Genome Asia 100k initiative:

- A **non-profit** consortium called Genome Asia 100K **based in Singapore** has announced an ambitious plan to sequence 100,000 Asian individuals in hopes of accelerating **precision medicine** applications for Asian populations.
- Bangalore-based **MedGenome** has also teamed up with it.

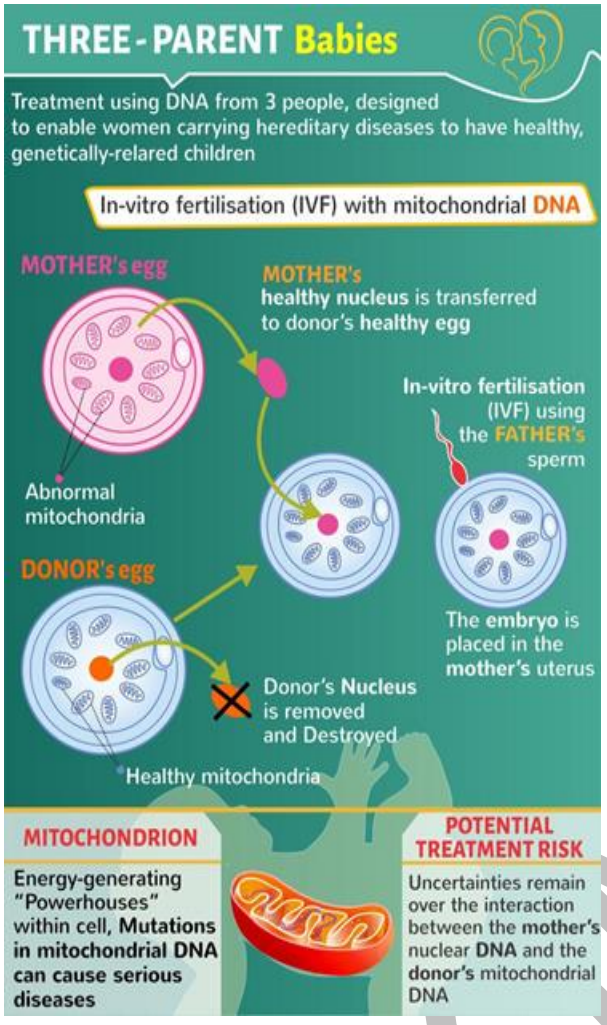
1.3. THREE PARENTS BABY

Why in news?

UK became the first country to have officially approved procedures to create "three-parent" babies.

About "three-parent" babies

- **Mitochondrial Replacement therapy (MRT)** is used to **replace mother's faulty Mitochondrial DNA with healthy Mitochondria from a donor woman** during IVF process, thus the name- "three-parent" baby
- The donor's mitochondria contribute **just 37 genes to the child**, compared with more than 20,000 from the parents. That is a **negligible amount** and far less than one would gain from a blood transfusion or organ transplant.
- **No other characteristics** in terms of intelligence, eye colour, hair colour, height etc. are changed.



About Mitochondrial Disease

- The mitochondria are organelles inside cells that are involved in releasing energy by **producing adenosine triphosphate (ATP)**, the key energy currency that drives metabolism.
- Mitochondria are **inherited solely from the mother** and this results into cases of babies been born with **rare mitochondrial diseases** if mother has the faulty mitchochondrial DNA.

1.4. STEM CELLS THERAPY

Why in news?

Recently, miniature eye-like organs have been successfully grown using **induced pluripotent stem (iPS) cells.**

Stem Cells: Stem cells are a class of undifferentiated cells that are able to differentiate into specialized cell types. Commonly, stem cells are of the following types:

- **Embryonic stem cells** - derived from the inner cell mass of an embryo and these are capable of forming any cell types of the body.
- **Adult stem cells** – also known as somatic stem cell and it refers to non-reproductive cells in the body (eggs or sperm). They generate cells to replace those that are lost through normal repair, disease, or injury. ASCs are found throughout ones lifetime in tissues such as the umbilical cord, placenta, bone marrow, muscle, brain, fat tissue, skin, gut, etc.
- **Induced pluripotent stem (iPS) cells**: These cells are produced by genetically manipulating somatic cells to produce embryonic-like stem cells

Importance

- Stem cells offer new potentials for treating diseases such as diabetes, and heart disease.
- To screen new drugs and to develop model systems to study normal growth and identify causes of birth defects.
- Study how an organism develops from a single cell and how healthy cells replace damaged cells in adult organisms.

Immunosuppressants are a class of drugs that suppress the immune response through various mechanisms. In organ transplantation, they are used to prevent the body from either recognition or attacking the foreign organ.

Draft Guidelines for Stem Cell Research

- The **Indian Council of Medical Research (ICMR)** in association with the **Department of Biotechnology** recently released the revised Draft Guidelines for Stem Cell Research, 2017 which calls for:
  - conducting research in an ethical and scientifically responsible manner
  - involving various stakeholders in research of human stem cells.
  - option of sharing IPRs
  - ensuring compliance with the national guidelines through **National Apex Committee for Stem Cell Research and Therapy** which currently monitors and oversees research activities at the national level.

1.5. BIO-INK

Why in news

- Recently, a new printing material called **flink (functional living ink)**, has been developed by scientists using bacterias.

About Bio-Ink

- Bio ink consists of a hydrogel biomaterial. It temporarily mimics the natural extracellular matrix environment of mammalian cells, giving them time to produce their own milieu.
- Bio inks are ideal for 3D bioprinting, thus provide a 3D environment for culturing cells.

- The bio-ink contains two different polymer components: a natural polymer extracted from seaweed, and a sacrificial synthetic polymer used in the medical industry.
- **Application**: It can be used for printing complex tissues using the patient's own stem cells for surgical bone or cartilage implants, which could be used in knee and hip surgeries.

3D printing

- 3D printing or **additive manufacturing** is a process of making three dimensional solid objects from a digital file.
- It is an additive process wherein an object is **created by laying down successive layers of material** until the object is created. Each of these layers can be seen as a thinly sliced horizontal cross-section of the eventual object.
- 3D printing produces complex (functional) shapes using less material than traditional manufacturing methods.

Application

- **Manufacturing:** Mass customisation, Rapid Prototyping, Rapid manufacturing, cloud-based additive manufacturing.
- **Medical applications:** Printed prosthetics, use of bioprinting in tissue engineering, high dose pills manufacturing.
- **Industrial applications:** Apparel, customisable art and jewelry, in automotive industry as 3D printed cars, construction, fire arms etc.

1.6. BIOTECHNOLOGY IN NORTH EAST REGION

Why in news?

Recently **Department of Biotechnology (DBT)** under Ministry of Science and Technology has announced a series of new programs and missions for North Eastern Region (NER).

Recent Programs and Missions Launched by DBT

- **Phyto-Pharma Plant Mission**
  - The mission would work towards conservation and cultivation of endangered and threatened species
  - Major objectives of the mission are: **Captive cultivation of selected medicinal plants** of NER, **Development of packaging technology** for export market, **Production of safe efficacious phyto-pharmaceutical drugs** following **global standards**.
- **Brahmaputra Biodiversity and Biology Boat (B4)**
  - It is an effort towards conservation of world's largest riverine island and India's first island district – **Majuli** facing excessive erosion, in collaboration with DONER.
  - Under this program, large boats will be set up in the river which will have a **well-equipped laboratory** along with **cold storage facility** to store samples. It will also have a number of satellite boats and rafts will also venture in the river to collect samples.
- **Human Resource Skilling Programs**
  - **Twinning R&D Program –** Under this program DBT has initiated establishment of link institutes in NER with the rest of the country. This has resulted in 252 research publications and 600 junior and senior fellowship being awarded to the students in biotechnology research.
- **Infrastructure and Resource binding –** through establishment of biotech hubs, animal house facility for critical animal experiments, **Advance Animal Disease Diagnostic & Management Consortium (ADMaC)** for surveillance of pathogens from NER, collaborating for conservation of delicate ecology of NER.

1.7. EMBRYO TRANSFER TECHNOLOGY

Why in news?

Department of Animal Husbandry launched Embryo Transfer Technology to increase the livestock productivity.

Embryo Transfer Technology (ETT)

- It is a technique of **assisted reproduction** in which the **embryo or zygote** is collected from a donor animal with **higher genetic merit** and transferred to a recipient animal which serves as **surrogate** for rest of the pregnancy.
- Government has undertaken a Mass Embryo Transfer programme in Indigenous Breeds under the scheme, **National Mission on Bovine Productivity.**

- The programme is implemented with the objective of conservation and development of indigenous breeds under **Rashtriya Gokul Mission.**
- Indigenous Cow Breeds such as **Sahiwal, Gir, Red Sindhi, Ongole, Deoni and Vechur** will be the recipient surrogates under the program.
- **Benefits of ETT**
  - Farmers may get 5-6 times increased number of off springs
  - Calves will be of high genetic merit and born disease free.

About Rashtriya Gokul Mission

- **Aim:** Development and conservation of indigenous bovine breeds to enhance milk production and productivity through:
  - Induction of high genetic merit bulls for semen production,
  - Strengthening of bulls mother farms.
  - Setting up of Gokul Grams.
  - Generating awareness among farmers for rearing of indigenous breeds.

About National Mission on Bovine Productivity

- **Aim:** Enhancing milk production and productivity and thereby making dairying more remunerative to the farmers.
- **Mission components:**
  - **Pashu Sanjivni**- It includes identification of animals in milk using UID, issuing health cards to all animals in milk and uploading data on INAPH data base.
  - **Advance reproductive Technique**- Under the component sex sorted semen production facility is being created at 10 A graded semen stations and 50 Embryo Transfer Technology Labs with IVF facilities are being created in the country.
  - **Creation of E Pashu Haat Portal**- For linking farmers and breeders of indigenous breeds
  - **Establishment of National Bovine Genomic Centre for Indigenous Breeds(NBGC-IB):** For enhancing milk production and productivity through genomic selection among indigenous breeds.

2. NANOTECHNOLOGY

2.1. NANOTECHNOLOGY

Nanotechnology is science, engineering, and technology conducted at the nanoscale, which is about 1 to 100 nanometers. The physical, chemical and biological properties exhibited by a material changes at this size level is unique and peculiar way, i.e. it follows the laws of quantum physics which is very different from the laws of Newtonian physics we see and feel. As nanotechnology allows manipulation of properties at a very small scale, it can have many applications such as:

- **Medical field:** Nano scale diagnostic devices are more efficient in detecting cancer or infection, Nano size drugs can be delivered to targeted areas which can also help fight cancer. For example - **Recently,** a new technology for safer and cheaper diagnosis and treatment of cancer has been found by turning nano-particles of calcium phosphate into fully biodegradable radio frequency (RF) agents that can be imaged in MRI and CT scans.
- **Combating climate change:** by developing nanomaterial which can effectively help to reduce the Carbon Dioxide in the air and **trigger bioremediation** to get rid of toxic waste such as dyes, oil spill etc.
    - **Combating Carbon Emission:** The Nano CO2 Harvester can capture more CO2 than usual and is more efficient fuel converter.
    - **Cleaning Water:** The magnetically charged nanoparticles have been proved potent in researches to have effectively carried on adsorption process to remove heavy & toxic metals, dyes from and oil spills from water bodies.
    - **Accelerating Biodegradation** (Solid Waste Management): They accelerate the conversion of organic waste into organic manures or biogas and fertilizers can also be quickened through use of Nanoparticles (such as Iron oxide particles).

- **Agriculture:** Food processing industry can get better packaging, presentation with least waste and minimum moisture flow and growth of bacteria. Also, **Silver Nanoparticles** which exhibit antifungal, anti-bacterial, anti-inflammatory, antiviral and antiplatelet properties can be used to increase the shelf life of agricultural products.
- **Defence:** Use in intelligence gathering through difficult to detect sensors/cameras/ recording devices, precision guiding tools etc.
- **Construction:** as nanomolecular structures can make asphalt and concrete more robust to water seepage, heat-resistant nanomaterials can block ultraviolet and infrared radiation etc.
- **Energy:** such as Novel hydrogen storage systems based on carbon nanotubes and other lightweight nanomaterials, Nanocatalysts for hydrogen generation etc.

3. SPACE TECHNOLOGY

3.1. ISRO

- The Indian Space Research Organization (ISRO) is the pioneer space exploration agency of the Government of India based at Bengaluru.
- It aims to develop and harness space technology in national development, while pursuing planetary exploration and space science research.
- Indian Space Research Organisation (ISRO) 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, Sensors and payloads 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.

3.1.1. MISSIONS

3.1.1.1. MARS ORBITER MISSION

- Mars Orbiter Mission (MOM), has completed four years in space since its launch on November 5, 2013
- It was India's first interplanetary mission, launched by using a Polar Satellite Launch Vehicle (PSLV) rocket.
- **First Asian Nation**: India had created global history by becoming the first Asian nation to reach the Mars orbit in a space mission.
- **Proved the capability and efficiency of ISRO**: ISRO has become the fourth space agency to reach Mars, after the Soviet space program, NASA, and the European Space Agency
- MOM was aimed to explore and observe Mars surface features, morphology, mineralogy and the Martian atmosphere
- It carried **5 instruments** for Atmospheric studies (**Lyman-Alpha Photometer (LAP**), Methane Sensor for Mars (**MSM**)), Particle environment studies (Mars Exospheric Neutral Composition Analyser (**MENCA)),** Surface imaging studies (Thermal Infrared Imaging Spectrometer **(TIS)**, Mars Colour Camera (**MCC).**
- ISRO was presented with the Indira Gandhi Prize for Peace, Disarmament and Development for the year 2014 for the successful **Mars Orbiter Mission** and for strengthening international co-operation

3.1.1.2. CHANDRAYAAN-1

Why in news?

Recently, scientists from Brown University, USA have created the first map of water trapped in the uppermost layer of Moon's soil using the data captured by instrument on Chandrayan-1.

More on news

- Scientists have stated that the water thus detected by the Chandrayan-1 lunar mission mostly concentrated around the polar region is present everywhere and not just polar region.
- It was also found that the concentration of water changes over the course of Lunar Day at latitudes lower than 60 degrees i.e. wetter in morning and evening and dry during lunar noon with fluctuations up-to 200ppm.

Findings of Chandrayan-1

- **Detection of Water** – Major finding was the detection of **Water (H2O)** and **Hydroxyl (OH)** on the surface of the moon. The data revealed its presence in **abundance around the polar region**.
- **Magma Ocean Hypothesis** – It confirmed the Ocean Magma Hypothesis i.e. the moon was once completely in molten state using HySi and TMC.
- **Evidences of landing site of Apollo 15 and 17** – TMC found the anomalies in Lunar surface about the landing of USA's Apollo-15 and 17.
- **New Spinel-rich Rock –** Data from TMC, HySI, M3 and SIR2 have led to detection of new spinel-rich rock type on lunar far-side.
- **X-Ray signals detected–** C1XS have detected x-ray signals during weak solar flares thus indicating presence of **magnesium, aluminium, silicon and calcium on lunar surface.**

ISRO is planning to launch a fully indigenous Chandrayan-2 in October this year. This would include an orbiter, lander and a rover.

About Chandrayan-1

- **Chandrayan-1** was launched by India in October, 2009 using **PSLV-C11**.
- The primary objective of the mission was to prepare a three-dimensional atlas of both near and far side of the moon and chemical, mineralogical and photo-geological mapping of moon.

- It had made almost 3400 orbits around the moon before it lost contact with Earth in 2009.
- Chandrayaan-1 had payloads from India namely:
  - Terrain Mapping Camera (TMC)
  - Hyper Spectral Imager (HySI)
  - Lunar Laser Ranging Instrument (LLRI)
  - High Energy X-Ray Spectrometer (HEX)
  - Moon Impact Probe (MIP).

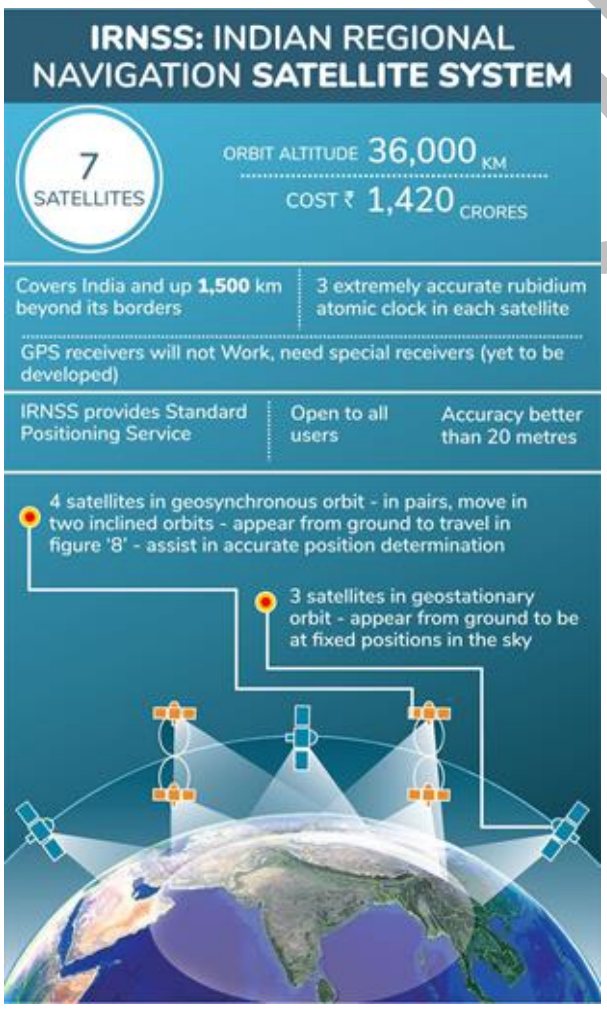
Lunar Day

- **Lunar Day** refers to time taken by the Earth's moon to complete one rotation on its axis and it is also the time taken by the moon to complete one orbit around the Earth.
- **One Lunar Day** equals to 27 Earth Days, 7 hours, 43 minutes and 12 seconds.
- It is usually the phase between two new moons.

3.1.1.3. NAVIC

Why in news?

Recently, IRNSS received setback due to failure of the atomic clocks on board **IRNSS-1A** and unsuccessful launch of navigational satellite **IRNSS 1H.**



An **atomic clock** is a clock device that uses an electronic transition frequency of the electromagnetic spectrum of atoms as a frequency standard for its timekeeping element.

Atomic clocks are the most accurate time and frequency standards known and are used as primary standards for international time distribution services, to control the wave frequency of television broadcasts, and in global navigation satellite systems such as GPS.

A **rubidium atomic clock** is a frequency standard in which a specified hyperfine transition of electrons in rubidium-87 atoms is used to control the output frequency. It is the most inexpensive, compact, and widely used type of atomic clock.

More on news

- IRNSS-1A is the first of the seven satellites comprising the **Navigation with Indian Constellation (NavIC**) - (IRNSS-1G; IRNSS-1F; IRNSS-1E, IRNSS-1D, IRNSS-1C, IRNSS-1B; and IRNSS-1A)
- It has been designed to support vehicle tracking, fleet management, disaster management and mapping services besides terrestrial, marine and aerial navigation for India and its neighbourhood.
- It was carried on **by PSLV (Polar Satellite Launch Vehicle)-C39** to augment the existing **seven satellites of the NavIC constellation.**

NAVIC or IRNSS (Indian Regional Navigation Satellite System)

- It is an independent **indigenous regional system** developed by India on par with the US-based Global Positioning System (GPS), Glonass of Russia, Galileo by Europe, BeiDou by China and Quasi-Zenith Satellite System (QZSS) by Japan**.**
- IRNSS will provide basically two types of services:
  - Standard Positioning Service (SPS) for civilian users
  - Restricted Service (RS), is an encrypted service provided only to specific users
- It offers services like terrestrial and marine navigation, disaster management, vehicle tracking and fleet management, navigation aide for hikers and travellers, visual and voice navigation for drivers and marine & aerial navigation for India and its neighbourhood.

3.1.1.4. ASTROSAT

Why in news?

Astrosat is indulged in observing major events such as merging of two Black holes, gamma ray burst etc.

Background

- US-based **LIGO group** had detected gravitational waves emanating from the merger of two massive black holes located nearly 3 billion light years away. It was also confirmed by Hawaii-based **ATLAS group**.
- However, AstroSat team in collaboration with the **GROWTH** network of observatories, has concluded that this event is due to a gamma ray burst, which was confirmed by POLAR project.
- A **gamma ray burst** is light emanating from a bursting star, that may lead to the formation of a black hole.

GROWTH (Global Relay of Observatories Watching Transients Happen)

- GROWTH is an international scientific collaborative project in astronomy studying the physics of fast-changing events in the cosmos like supernovae, neutron stars or black hole mergers, and near-earth asteroids. It is partnership of eleven universities and research institutions from US, India, Sweden, Taiwan, Japan, Israel and Germany.
- It continuously gathers data of cosmic transient events in the first 24 hours after detection to build a more complete picture and better understand the physical processes of their evolution.
- It jointly operates 17 observatories in the northern hemisphere. Girawali Observatory – IUCAA in Maharashtra (near Pune) is part of this network.

POLAR project

POLAR is an international **mission of China and European collaboration** is dedicated to establishing whether the photons from Gama-ray bursts (GRBs) — thought to be a particularly energetic type of stellar explosion — are polarized.

About ASTROSAT

- It is India's first dedicated multi wavelength space observatory.
- It observes universe in the optical, Ultraviolet, low and high energy X-ray regions of the electromagnetic spectrum, whereas most other scientific satellites are capable of observing a narrow range of wavelength band.
- It's dubbed as a smaller version of NASA's Hubble Space Telescope
- Various paylods carried by it are: Large Area X-ray Proportional Counter, Ultraviolet Imaging Telescope, Soft X-Ray Telescope, Scanning Sky Monitor, Cadmium Zinc telluride Imager.

Major objectives of ASTROSAT

- Understand high energy processes in binary star systems containing neutron stars and black holes.
- Estimate magnetic fields of neutron stars.
- Study star birth regions and high energy processes in star systems lying beyond our galaxy.
- Detect new briefly bright X-ray sources in the sky.

3.1.1.5. CREW MODULE ATMOSPHERIC REENTRY EXPERIMENT (CARE)

- It's a module developed by ISRO to carry human beings to space.
- ISRO tested it's ability to re-enter the Earth's atmosphere with thermal resistance, parachute deployment in cluster formation, aero braking system and apex cover separation procedures.

3.1.1.6. ADITYA L1

Why in news?

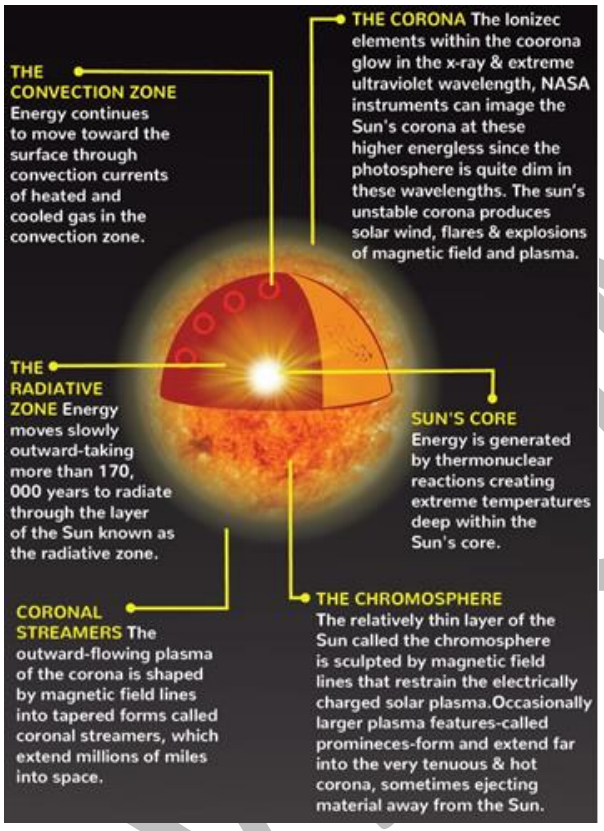
- India is set to launch its first solar mission Aditya-L1 in 2019.

About Aditya L1

- The Aditya L1 will be placed **in a halo orbit around a vantage point in space known as L1 Lagrange point.**
- 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.
- The Aditya L1 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.

- **Halo Orbit:** It is periodic, three-dimensional orbit near the L1, L2 and L3 lagrange point (unstable) in a three body system.
- **Lagrange Point:** It 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.
- **Corona:** The outer layers of the Sun, extending to thousands of km above the disc (photosphere) is termed as the corona. It has a temperature of more than a million degree Kelvin which is much higher than the solar disc temperature of around 6000K.



3.1.2. LAUNCHERS

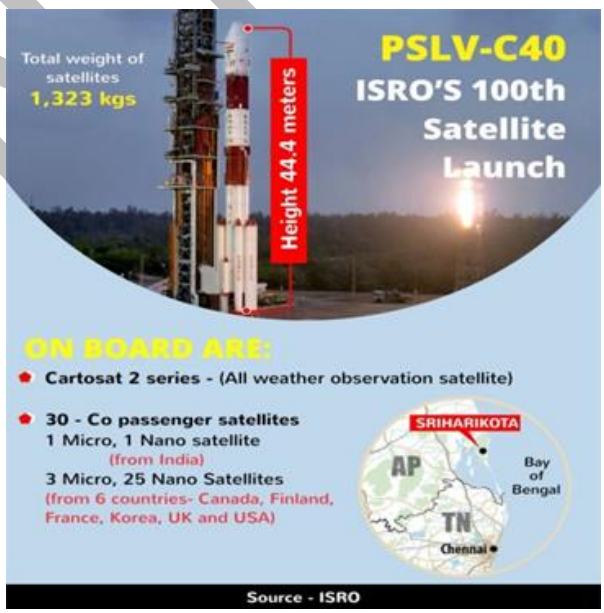
3.1.2.1. PSLV C40

Why in news?

- ISRO's through **PSLV C40 has successfully placed 31 satellites (second highest number launched by ISRO using a single rocket) including main payload Cartosat-2s series and 28 foreign satellites in two different orbits.**
- It also includes the Indian nano satellite, NIUSAT which belongs to Tamil Nadu's Nooral Islam University. This will provide multi-spectral imagery for agricultural crop monitoring and disaster management support applications. **Nanosatellites** or **nanosats** weigh between 1 kg and 10 kg.

Significance of the launch

- The launch marks the roll out of the **100th satellite by ISRO**
- It is also significant in the sense that India failed in its last attempt to launch its backup navigation satellite IRNSS-1H on board PSLV-C39 failed.
- It is the second time that ISRO will be achieving the two orbits feat. This was done through the "**multiple burn technology**" under which the rocket's engine is switched off and then switched on to control its height.
- It reinstates India's position as a successful multiple satellite launcher.
- Government recently also announced funding to develop an exclusive **Small Satellite Launch Vehicle (SSLV)** to cater mini and micro satellites exclusively.



3.1.2.2. GSLV MK III

Why in News?

- Recently, **GSLV MK III D1 rocket (GSAT 19)** was launched successfully.

Background

- The first experimental flight of **LVM3-X/CARE mission** successfully tested the atmospheric phase of flight. Crew module Atmospheric Reentry Experiment was also carried out in this flight. This was the first testing of the indigenous cryogenic engine.

Cryogenic: Cryogenic propellants are liquefied gases stored at very low temperatures, most frequently liquid hydrogen as the fuel and liquid oxygen as the oxidizer.

- The liquid fuel and oxidizer are pumped from the storage tanks to an expansion chamber and injected into the combustion chamber where they are mixed and ignited by a flame or spark.
- The fuel expands as it burns and the hot exhaust gases are directed out of the nozzle to provide thrust.

Features

- It is the **heaviest rocket** to be launched from India till now.
- Apart from the upper cryogenic stage, the vehicle has **two solid strap-on motors (S200) and a core liquid booster (L110)**.
- For the first time there will be **no transponders on the satellite**. It will be using a new way beaming data down **using multiple frequency beams**. It is therefore called "**a high through put satellite**".
- For the first time, it would have **indigenously made Lithium ion batteries**.
- This spacecraft would have advanced technologies including miniaturized heat pipe, fibre optic gyro, Micro Electro-Mechanical Systems (MEMS) accelerometer.

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 first and third stage using solid rocket motors and second and fourth stages using liquid rocket engines.
- PSLV is classified into its various versions like core-alone version (PSLV-CA), PSLV-G or PSLV-XL variants depending on the number of these strap-on 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**:
  1. **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).
  2. **GSLV-III**: It is a three stage vehicle with an **indigenous cryogenic upper stage engine (C25)**. It has been designed to carry heavier communication satellites weighing upto up to 4000 kg into the Geosynchronous Transfer Orbit.

3.1.2.3. REUSABLE LAUNCH VEHICLE–TECHNOLOGY DEMONSTRATOR (RLV-TD)

- It is one of the most technologically challenging endeavors of ISRO, that is, developing essential technologies for a fully reusable launch vehicle
- If developed, it would enable low cost access to space. The configuration of RLV-TD is similar to that of an aircraft and combines the complexity of both launch vehicles and aircraft.

3.1.3. SATELLITE

There are various types of satellite in India

- **Communication satellite** - The Indian National Satellite (INSAT) system is one of the largest domestic communication satellite systems placed in Geo-stationary orbit. GSAT-17 joins the constellation of INSAT System. The INSAT system provides services to telecommunications, television broadcasting, satellite newsgathering, societal applications, weather forecasting, disaster warning and Search and Rescue operations.

GSAT

- A GSAT is a series of geosynchronous satellite placed in **geosynchronous orbit**, with an orbital period the 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.
    - **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.

GSAT-7 or Rukmini

- Rukmini was the first military communication satellite launched by the ISRO in 2013, for the Indian Defence forces, with the Indian Navy being the primary user.
- It's a multi-band military communication satellite, placed into a geosynchronous orbit, to secure real-time communication

- **Earth Observations satellite** - ISRO has launched many operational remote sensing satellites such as CARTOSAT 2, RESOURCSAT 1, OCEANSAT 2 etc. in sun-synchronous orbit and INSAT-3D, Kalpana etc. in geo-synchronous orbit. The data from these satellites are used for several applications covering agriculture, water resources, urban planning, rural development, mineral prospecting, environment, forestry, ocean resources and disaster management.
- Navigation satellite - To meet the user requirements of the positioning, navigation and timing services. Example – IRNSS, GPS Aided GEO Augmented Navigation (GAGAN) to meet civil aviation requirements.
- Space Science satellite - research in areas like astronomy, astrophysics, planetary and earth sciences, atmospheric sciences and theoretical physics. For example – Astrosat, Chandrayaan-1 2, MOM
- Experimental satellite - ISRO has launched many small satellites mainly for the experimental purposes such as Remote Sensing, Atmospheric Studies, Payload Development, Orbit Controls, recovery technology etc. For example AryaBhata, APPLE etc.
- Small Satellite – It is envisaged to provide platform for stand-alone payloads for earth imaging and science missions within a quick turn around time.
- Student satellite - ISRO has influenced educational institutions by its activities like making satellites for communication, remote sensing and astronomy etc.

3.1.3.1. HYPERSPECTRAL IMAGING SATELLITE

Why in news?

ISRO plans to launch HySIS (Hyperspectral Imaging Satellite) – an earth observation satellite, using a critical chip it has developed called "**optical imaging detector array**".

What is hyperspectral imaging?

- Hyperspectral imaging, or imaging spectroscopy, combines the power of digital imaging and spectroscopy. Hyperspex imaging is enabled by an optical imaging detector chip
- For each pixel in an image, a hyperspectral camera acquires the light intensity (radiance) for a large number of contiguous spectral bands.
- Every pixel in the image thus contains a continuous spectrum in the visible and near infra-red regions and can be used to characterize the objects in the scene with great precision and detail.
- **Significance**: Hyperspectral images provide much more detailed information about the scene than a normal color camera, which only acquires three different spectral channels corresponding to the visual primary colors red, green and blue.
- Hyperspectral imaging leads to a vastly improved ability to classify the objects in the scene based on their spectral properties.

3.1.4. SPACE ACTIVITIES BILL, 2017

Why in news?

- The government of India has come up with **Space Activities Bill 2017**, a draft law meant to regulate the space sector.

Background

- **Department of Space(DoS)** is the **nodal agency for space activities in India** which include:

- **Space Infrastructure**: spacecraft for various applications and associated ground infrastructure
- **Space Transportation systems**: various class of launch vehicles and associated ground infrastructure **Space applications:** for various national requirements through establishment of necessary ground infrastructure and coordination mechanisms.

- Space activities in India till now have been governed by **Satellite Communication Policy, 2000** (which enacted a framework to provide licenses to private sector players to operate communication satellites over India) **and the Remote Sensing Data Policy, 2011.**
- Internationally, the outer space activities are governed by **relevant chapters of international law in general** and by **United Nations' (UN) Treaties and principles evolved under UN Committee on Peaceful Uses of Outer Space (UNCOPUOS)** in particular

About Space Activities Bill 2017

- It is needed to encourage the participation of private sector agencies in space activities in India. This will supplement the manpower requirement of ISRO.
- The draft law includes provisions such as providing non-transferable licence to carry out commercial space activity, supporting such activities professionally ad technically, regulating their operations, penal provisions for undertaking such activities without authorization etc.

UN Office for Outer Space Affairs (UNOOSA), 1958.

- It promotes international cooperation in peaceful uses of Outer Space.
- It serves as the secretariat for UNGA's UN committee on Peaceful Uses of Outer Space **(COPUOS).**
- It also establishes UN register for Objects launched into Outer space.
- It manages the UN Platform for Space based Information for Disaster Management and Emergency Response **(UN -SPIDER).**

Outer Space Treaty, 1967.

- **Aim**: To preserve space for peaceful uses by prohibiting the use of space weapons, the development of space-weapon technology, and technology related to "missile defense."
- It would prevent any nation from gaining a military advantage in outer space.

3.1.5. VILLAGE RESOURCE CENTRES

Why in news?

ISRO has established around 473 Village Resource Centres (VRCs) on a pilot basis, in association with selected NGOs, Trusts and State Government Departments.

What is Village Resource Centres (VRC)?

This is one of the unique initiatives that use Satellite Communication (SATCOM) network and Earth Observation (EO) satellite data to reach out to the villages to address the needs of the local people in villages itself.

Applications: VRCs provide wide varieties of services in rural areas:

- **Tele-medicine** concept connects the sick people in villages, through VSAT network, to the doctors, who located in cities/urban areas or the Super-speciality hospitals, for providing health services.
- The **Tele-education** uses SATCOM to provide a virtual classroom facility to far-flung villages or remote areas in the country and helps in imparting education to the needy, career guidance to rural students etc.
- Advisories related to agriculture like crop pest and diseases, fertilizer/pesticides, organic farming, crop insurance etc.
- Skill development and vocational training to the rural population.
- Other areas of application include Panchayat planning, Weather information, Marketing information, Watershed Development, Drinking water etc.

3.1.6. SARASWATI: A SUPERCLUSTER OF GALAXIES

Why in News?

A team of Indian scientists has reported the discovery of a previously unknown 'supercluster' of galaxies, some four billion light years away from Earth, and named it Saraswati.

What are Superclusters?

- Galaxies are like the building blocks of the universe, they contain a huge number of stars. Galaxy clusters have 3-100 galaxies, and super clusters are the clusters of clusters.
- Within superclusters, clusters are connected by filaments and sheets of dark matter with galaxies embedded in them

- Sarawati has 42 clusters and it is 4000 million light years from earth.

3.1.7. NASA-ISRO SYNTHETIC APERTURE RADAR (NISAR)

What is NISAR mission?

- It is the **world's most expensive earth imaging satellite** till date ($1.5 billion), being jointly developed by India and USA and expected to be launched around **2021.**
- NISAR is **a dual frequency L-band and S-band** radar mission, that will map Earth every 12 days from two directions.
- **NASA and Jet Propulsion Laboratory** will be responsible for the design & development of **L-band SAR**, while **ISRO** will be responsible for the design & development of **S-band SAR**
- It will make global integrated measurements of the **causes and consequences of land surface changes**.
- NISAR will provide a means of resolving **highly spatial and temporally complex processes** ranging from ecosystem disturbances, to ice sheet collapse and natural hazards including earthquakes, tsunamis, volcanoes, and landslides.
- Post completion, NISAR will be integrated with ISRO's spacecraft and launched on board India's GSLV.

NASA AND ISRO:

- The two space research organisations signed a framework agreement in **2008** that called for cooperation in the exploration and use of outer space for peaceful purposes.
- Under the agreement, both ISRO and NASA have executed an implementing arrangement for cooperation in NISAR mission, which is **valid until 2034.**
- The arrangement provides scope for joint activities on science & applications of NISAR data after the launch.

Earlier collaborations between NASA and ISRO:

- **Chandrayaan-I** mission, 2005: Moon Mineralogy mapper from NASA accompanied the mission, resulting in "joint-discovery" of water on moon.
- **Mars Orbiter Mission** (Mangalyaan), 2014: where NASA's navigational expertise in deep space trajectory and maneuverability aided the mission.

3.2. NASA

NASA MISSIONS	MATTER OF STUDY
Parker Solar Probe	• **Solar corona**, solar wind and solar energetic particles
GOLD & ICON Mission	• Refer to Global-scale Observations of the Limb and Disk (GOLD) and Ionospheric Connection Explorer (ICON) respectively • **Ionosphere region** to understand more about hurricanes & geomagnetic storms
New Frontiers program	• Explore the solar system. Two recently selected missions: **Comet Astrobiology Exploration Sample Return (CAESAR)** for visiting comet 67P/Churyumov-Gerasimenko **Dragonfly:** spacecraft to study Titan, Saturn's largest moon • Three older missions: **Juno Mission**: Juno spacecraft to orbit Jupiter. Earlier, Galileo probe in its mission had found evidence of subsurface saltwater on Jupiter's moons Europa, Ganymede and Callisto **OSIRIS-Rex**: Origins, Spectral Interpretation, Resource Identification, Security-Regolith Explorer is NASA's first unmanned asteroid sampling mission heading towards a near-Earth asteroid called Bennu. **New Horizons Spacecraft**: To study Pluto, its moons (such as Nix and Hydra) and the Kuiper belt
SOFIA Mission (Flying Observatory)	• Stratospheric Observatory for Infrared Astronomy (SOFIA) is world's largest airborne astronomical observatory built as a joint project of NASA and the German Aerospace Centre to observe celestial magnetic fields, star forming regions, comets and Saturn's giant moon Titan
Cassini Mission	• launched through collaboration between NASA, ESA and the Italian space agency to study Saturn and its system of rings and moons (Saturn's largest moon is Titan) • **first spacecraft to orbit Saturn**
Exploration Mission-1	• It will be the first integrated test of NASA's deep space exploration systems: the Orion spacecraft and Space

	Launch System (SLS) rocket (most powerful rocket in the world • Orion Spacecraft is designed to take astronauts beyond low-Earth orbit and explore the Moon, Mars and other destinations
Voyager 1 and 2	• Year 2017 marked 40th anniversary of its journey • They have explored all the giant planets of our outer solar system, Jupiter, Saturn, Uranus and Neptune; 48 of their moons; and the unique system of rings and magnetic fields • Voyager 1 was the first spacecraft to have entered interstellar space
Kepler Mission	• ***Kepler*** is a space observatory launched by NASA to discover Earth-size planets orbiting other stars. • 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.
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 a dwarf planet, the only one located in the inner circle of the solar system, rest all are located on the outer edges.
AIDA (Asteroid Impact and Deflection Assessment) Mission	• It is the 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), and ESA's Asteroid Impact Mission (AIM). • Its target is the binary near-Earth asteroid Didymos, a binary system, classified as a potentially hazardous asteroid. • NASA has also designed a spacecraft named Hammer (Hypervelocity Asteroid Mitigation Mission for Emergency Response), which could deflect a asteroids, if it happens to hit Earth.
SPARCS	• Star-Planet Activity Research CubeSat (SPARCS) is a space telescope to study the habitability and high-energy environment around **M-dwarf stars.**
TESS	• **Transiting Exoplanet Survey Satellite (TESS)** to study exoplanets in orbit around the brightest stars in the sky. TESS will monitor more than 200,000 stars for temporary drops in brightness caused by planetary transits.
InSight Mars lander	• for Mars (Red Planet) which will study the interior of **Mars** and listen for Marsquakes
ICESat-2 and GRACE Follow-On	• to continue the long-term record of how Earth's ice sheets, sea level, and underground water reserves are changing

Roll-out Solar Array (ROSA)	• It is a collaboration between NASA and two private companies with an aim to develop flexible solar array (adaptable to different sizes) that could one day power satellites and spacecraft. • It is 20% lighter and four times smaller in volume than traditional solar panels.
Imaging X-ray Polarimetry Explorer mission	• The proposal for this mission was accepted under NASA's Explorers Programme which provides frequent, low-cost access to space for investigations. • This mission is aimed at studying some of the most extreme and exotic astronomical objects by studying the polarisation of X-rays emitted from their surrounding environments as

	direct image cannot be taken of such as objects like black holes, neutron stars etc.
New Aviation Horizons initiative	• It aims to commercialise ultra-efficient subsonic transportation • Recently, NASA has completed preliminary design review of the **Quiet Supersonic Transport (QueSST)** aircraft, initial design stage of planned **Low Boom Flight Demonstration (LBFD)** experimental airplane, otherwise known as an X-plane
Joint Polar Satellite System-1 (JPSS) spacecraft	• It is a partnership between NOAA (National Oceanic and Atmospheric Administration) and NASA • It's first in NOAA's series of four, next-generation operational **environmental satellites** designed to circle the Earth in a polar orbit.
Backyard Worlds project	• It is a citizen science project which lets anyone with a computer and an Internet connection flip through images taken by NASA's Wide Field Infrared Survey Explorer (WISE) spacecraft. • **WISE** is a space telescope launched in 2009 by NASA to map the entire sky in infrared wavelengths. Its goal was to find objects that had not been imaged before, including very bright galaxies, very cold stars, and nearby asteroids and comets.
Hubble Space Telescpe	• It is a joint venture between NASA and the European Space Agency (ESA) — was launched in its orbit 552 km above Earth • It has the ability to see in multiple wavelengths — near-infrared, visible light and near-ultraviolet • It has recently discovered seven Earth-sized planets orbiting the ultracool dwarf star **TRAPPIST-1** making it the planetary system with the largest number of Earth-sized planets discovered so far.
James Webb Space Telescope	• 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. • One of its main goals is to use spectroscopy to determine the atmospheric components of alien worlds.
Kilopower project	• It's a small nuclear reactor that can generate a reliable power supply which can be used to provide safe and plentiful energy for future robotic and human missions for Mars and beyond

3.3. OTHER SPACE RELATED DEVELOPMENTS

3.3.1. BLUE MOON

Why in news?

- On January 31, 2018, a rare Blue Moon event was experienced on large parts of the globe.

About the news

- It was a rare moment as **blue moon, a supermoon and a total lunar eclipse** fell on same day after more than 150 years.
- **Blue Moon**: When two full moons appear in the same calendar month, the second is termed a "blue moon". First full moon occurred on Jan 1, 2018.
- **Super Moon:** occurs when the full moon is at the closest point of its orbit to the Earth, which is also called the perigee. The moon appears 30% brighter and 14% bigger than the apogee full moon
- **Blood Moon:** The moon turns into red color during the height of the eclipse as some light does reach it even though the moon is in the shadow of the Earth. Fine particles in the atmosphere scatter (Rayleigh scattering) the blue component of solar spectrum, & what reaches us is the longer wavelength red light.
- A **lunar eclipse** happens whenever the moon passes through Earth's shadow, also known as its umbra.

Solar eclipse

- A solar eclipse occurs when the moon gets between Earth and the sun, and the moon casts a shadow over Earth.
- It can only take place at the phase of new moon, when the moon passes directly between the sun and Earth and its shadows fall upon Earth's surface.
- However, eclipses do not happen at every new moon because the moon's orbit is tilted just over 5 degrees relative to Earth's orbit around the sun. Thus, the moon's shadow usually passes either above or below Earth.

3.3.2. METEOR SHOWER

Why in news?

- Perseid Meteor Shower fell on Earth in August peaked on August 12.
- Geminid meteor shower fell on Earth on December 12.

Asteroids, Meteoroid, Meteors and Meteorites

Asteroids – 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. 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.

What is a Meteor Shower?

- Earth in its yearly motion around the Sun passes through a debris trail left behind by a comet. The meteor shower is caused when debris heat up as they enter the atmosphere and burn up in a bright burst of light.
- When the debris is in space, they are called "meteoroids," but when they reach Earth's atmosphere, they're designated as "meteors."

What is Perseid Meteor Shower?

- Perseid meteor Shower is the dust of Comet Swift Tuttle which passes through Earth every year.
- The meteor shower is caused when debris heat up as they enter the atmosphere and burn up in a bright burst of light.
- When the debris is in space, they are called "meteoroids," but when they reach Earth's atmosphere, they're designated as "meteors."

Comet Swift-Tuttle

- Comet Swift-Tuttle, having a nucleus of about 16 miles (26 kilometres) wide, is the largest object known to repeatedly pass by Earth.
- The Comet last passed nearby Earth during its orbit around the sun in 1992. It will next pass by the Earth in 2026.

About Geminid Meteor Shower

- Usually meteor shower happens due to the debris left behind by a Comet. However, it

can happen due to an asteroid as well such as in the case of Geminid Shower.

- Geminid Meteor shower is the dust particle of constellation of Gemini. **Earth passes through the path of its parent asteroid 3200 Phaethon every year.**

About 3200 Phaethon

- It is an **Apollo Asteroid** and has characteristics close to a comet.
- Sometime the orbits of an asteroid intersect with the orbit of Mars and Earth. The earth orbiting asteroids are called Apollo Asteroids.

3.3.3. SOLAR FLARE

Why in news?

- Proxima Centauri (the second closest star to Earth) was found to be sending out massive solar flare. The finding diminishes the chance of life expected in **Proxima Centauri b,** a planet revolving in the habitable Goldilocks zone of this Red (Cool) Dwarf Star.
- The 3 space based observatories (Astro-sat, Chandra (X-ray observatory managed by NASA), and Hubble Space Telescope) and a ground based Observatory HARPS (High Accuracy Radial Velocity Planet Searcher) participated in the multi-wavelength observational campaign and observed the solar flare in Proxima Centauri.

What is Solar/Stellar Flare?

- It is a dramatic increase in **brightness of a star** thought to be due to the **magnetic energy** stored in the star's atmosphere.
- When observed in Sun, they are often accompanied by **coronal mass ejection**.
- Solar flare ejects clouds of electrons, ions and atoms along with electromagnetic radiations.
- Bombardment with such huge amount of energy (as observed in Proxima centauri) can strip water from the atmosphere or Oceans and sterilise the ground.

Impact of Solar Flare of Sun:

- They occur in active regions around sunspots.
- When flare is ejected in the direction of the earth, the particles hitting the upper earth's atmosphere may cause **AURORA/Polar light** (Aurora Borealis- Northern light and Aurora Australis- Southern Light).
- X-rays and UV rays may affect **ionosphere** and disrupt long range **radio communication**.
- The radiation risks posed by solar flares are one of the major hurdles in manned space missions.

HARPS: High precision spectrograph mounted on European Southern Observatory's 3.6m telescope at La Silla Observatory in Chile.

3.3.4. HALF OF THE UNIVERSE'S 'MISSING MATTER' IS FINALLY FOUND

Why in news?

- In a world's first, the elusive 'missing' half of the universe's observable matter has been found.

Background

- The universe is made up of regular 'visible' matter, dark matter and dark energy- though experts are yet to detect the latter two.
- Measurements of radiation left over from the Big Bang showed that about 5% of the mass in the universe comes in the form of ordinary matter, with the rest being accounted for by dark matter (25%) and dark energy (70%).
- Dark matter has never been directly observed and the nature of dark energy is almost completely mysterious, but even tracking down the 5% of ordinary matter has proved more complicated. Counting up of all the observable objects in the sky – stars, planets, galaxies and so on –only accounts for between a 10th and a fifth of what ought to be out there. The deficit is known as the **"missing baryon problem".**
- Now missing matter has been discovered. It is made of particles called **baryons** linking galaxies together through **filaments of hot gas**.

Hot Gas Filaments

- The distribution of ordinary matter in the universe is not homogeneous.
- Instead, under the action of gravity, matter is concentrated into so-called filamentary structures, forming a network of knots and links called the 'cosmic web'.
- Gas filaments between some galaxies contain subatomic particles called baryons.

What Is a Baryon?

- Leptons and quarks are the basic building blocks of matter
- Baryons are subatomic particles made up of three even smaller particles called **quarks**
- Quark-based particles, baryons take part in the strong interaction between particles, whereas leptons, which are not quark based, do not.
- The most familiar baryons are the proton and the neutron, which make up the central body of atoms. Baryons therefore comprise most of the

mass of the visible universe.
- The best known **lepton** is the electron.

Related information
- **Anti-matter:** Every matter has its corresponding anti-matter. It shares the same mass as their matter counterparts, but qualities such as electric charge are opposite. For example, positively charged positron is the antiparticle to the negatively charged electron and proton has the negatively charged anti-proton.

Dark Matter and Dark energy

NASA defines it in the form of what it is not than what it is.

- First, it is dark, meaning that it is not in the form of stars and planets that we see.
- Second, it is not in the form of dark clouds of normal matter, matter made up of particles called baryons.
- Third, dark matter is not antimatter, because we do not see the unique gamma rays that are produced when antimatter annihilates with matter.
- Finally, it does not include large galaxy-sized black holes.

It doesn't interact with baryonic matter and it's completely invisible to light and other forms of electromagnetic radiation, making dark matter impossible to detect with current instruments. But scientists are confident it exists because of the gravitational effects it appears to have on galaxies and galaxy clusters.

Dark energy

Dark energy, discovered in the 1990s, is even more mysterious. Scientists have no plausible explanation for dark energy. According to one idea, dark energy is a fifth and previously unknown type of fundamental force called quintessence, which fills the universe like a fluid.

During 1990s, the scientists realized that instead of decelerating, the universe is expanding more rapidly. Scientists assume that the accelerated expansion of the universe is driven by a kind of repulsive force generated by quantum fluctuations in otherwise "empty" space. Also, the force seems to be growing stronger as the universe expands. For lack of a better name, scientists call this mysterious force **dark energy.**

Difference:

- Dark matter attracts, dark energy repels.
- While dark matter pulls matter inward, dark energy pushes it outward.
- While dark energy shows itself only on the largest cosmic scale, dark matter exerts its influence on individual galaxies as well as the universe at large.

3.3.5. BOSONS

Why in news?

Recently 125th birthday of famous physicist Satyendra Nath Bose was celebrated after whom Higgs Boson was named by CERN.

Higgs Boson
- **It is popularly known as the God particle.**
- **It was discovered by Large Hadron Collider (LHC),** the world's largest and most powerful particle accelerator, at CERN
- CERN is the world's largest nuclear and particle physics laboratory. At CERN, scientists and engineers are probing the fundamental structure of the Universe.

- **Satyendra Nath Bose** worked with Albert Einstein to develop the Bose-Einstein statistics according to which **bosons can overlap and coexist with other bosons**.

Fundamental of bosons

All fundamental particles in nature can be divided into one of two categories, **Fermions or Bosons**

- **Particles that make up matter called Fermions**
  - **Examples:** electrons, protons, leptons, quarks, neutrinos.
- **Particle that carry force called Boson**. They obey Bose-Einstein statistics.
  - Bosons are sometimes called **force particles** because they control the interaction of physical forces
  - Examples: photons, 4He atoms, gluons, W Boson, Z Boson.

3.3.6. INDIA NEUTRINO OBSERVATORY (INO)

Why in news

Recently, **Ministry of Environment and Forests (MoEF)** granted environmental clearance to India-based Neutrino Observatory (INO) project to be setup in Bodi West hills, Tamil Nadu with certain conditions.

About Neutrino
- Neutrinos are one of the fundamental particles which make up the universe and second most abundant particle in the universe after photon.
- Neutrinos are similar to the electron, with one crucial difference: they do not carry electric charge.
- Neutrinos are of 3 types - electron neutrino, muon neutrino and tau neutrino.

- Neutrinos can be created in several ways, including in certain types of radioactive decay, in nuclear reactions such as those that take place in the Sun, in nuclear reactors.
- It's Nicknamed as 'blueprint of nature' by scientists.

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.

India-based Neutrino Observatory (INO) Project

- It is a multi-institutional effort aimed at building a world-class underground laboratory with a rock cover of approx. 1200m for nonaccelerator based high energy and nuclear physics research in India.
- It and will have a 50,000-tonne magnetic detector to study neutrinos that are significant in particle physics.
- In the 1960s, India had a neutrino observatory located at the Kolar Gold Fields in Karnataka. However, the laboratory was shut in the 1990s because the mines were being closed.
- **Significance:** Determination of neutrino masses is the most significant open problem in particle physics today and is the key goal of the INO project.
- **Benefits:** understanding the particle, understanding the **evolution of the universe, role in nuclear non-proliferation through remote monitoring, study of Geoneutrinos** might help creating an earthquake warning system.

3.3.7. MOST ANCIENT SPIRAL GALAXY FOUND

Why in news?

Scientists have recently discovered the most ancient spiral galaxy in the universe that existed 11 billion years ago.

More about the news

- The discovery was made by using a technique that combines gravitational lensing with the **Near-infrared Integral Field Spectrograph (NIFS).**
    - **Gravitational Lensing** is a phenomenon in which the gravity of a massive object (like a galaxy or a cluster of galaxies) bends and amplifies the light from an object that lies beyond it.
- The galaxy, known as A1689B11, existed just 2.6 billion years after the Big Bang, when the universe was only one fifth of its present age.
- In a spiral galaxy, the stars, gas and dust are gathered in spiral arms that spread outward from the galaxy's center.
- Spiral galaxies are exceptionally rare in the early universe, and this discovery opens the door to investigating how galaxies transition from highly chaotic, turbulent discs to tranquil, thin discs like those of our own Milky Way galaxy.

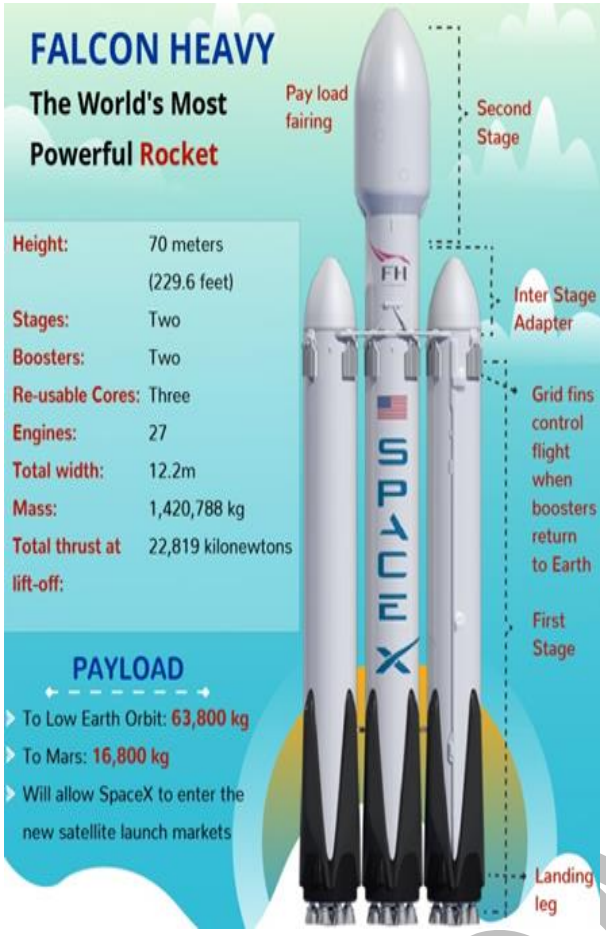
3.3.8. SPACEX'S FALCON HEAVY LAUNCHED

Why in news?

Recently, Falcon heavy rocket lift off from Cape Canaveral.

More about Falcon Heavy

- Falcon Heavy is the most powerful rocket in the world after NASA's Saturn V.
- It has been developed by **private spaceflight company SpaceX** and is 230 feet tall and can lift nearly 64 metric ton pay load to low Earth Orbit at a cost of 90 million USD.
- The engine can be started multiple times to place payloads in various orbits such as **low Earth, geosynchronous transfer orbit (GTO) and geosynchronous orbit.**
- **Mongolia's first satellite, Mazaalai** is accompanying SpaceX Falcon 9 rocket
    - It was launched through **Joint Global Multi-Nation Birds Satellite Project** funded by UNCESCO and JAPAN.
    - Project is a cross-border interdisciplinary satellite project for non-space-faring nations, aimed at supporting developing countries to build and launch their first satellite.
    - It is named after a Mongolia's endangered gobi bear.



3.3.9. VENUS SATELLITE

Why in news?

- **Israel** has launched its first environmental research satellite, Venus satellite which is built jointly by Israel and France.

More on satellite

- It is placed in **sun-synchronous orbit** and its **goal** is to obtain **high-resolution photographs** of specific sites to track various **environmental issues**
- It will also **monitor Earth's vegetation** to distinguish plants planted at as little as five meters apart. This makes possible "**precision agriculture**," in which farmers would be able to accurately plan for water, fertilizer, and pesticide needs.
- The **mission** will also test the operation of an innovative electric propulsion system based on the Israeli-designed Hall Effect Thrusters.

3.3.10. WATER AS PROPELLANT IN CUBESAT

Why in news?

- Engineers at Purdue University in the US have designed and tested a micropropulsion system that uses liquid water as the propellant for orbital maneuvering of **tiny satellites** called **CubeSats**.
- Pure water is chosen as the propellant since it is green, safe, easy to use and free from the risk of contaminating sensitive instruments by the backflow from plumes as in the case of thrusters using chemical propellants.

3.3.11. THE REMOVEDEBRIS MISSION

Why in news?

University of Surrey, UK has decided to launch Remove Debris mission this year to remove space debris.

Significance

- There is almost 7,000 tons of active space debris—from old satellites and spacecraft to lost components and spent rocket parts-orbiting Earth at any given moment which may take years to disintegrate.
- More debris, could lead to more collisions - a cascade effect known as the **Kessler syndrome** which may render space eventually inoperable for important services like navigation, communications, weather forecasting etc.
- The Remove Debris satellite platform will showcase four methods such as **Net capture, Harpoon Capture**, **Vision-based navigation, De-orbiting process** for release, capture and deorbit two space debris targets, called DebriSATs:

International Space debris Committee

It is an international governmental forum for the worldwide coordination of activities related to the issues of man-made and natural debris in space to facilitate opportunities for cooperation in space debris research, to review the progress of ongoing cooperative activities, and to identify debris mitigation options.

3.3.12. NATIONAL LARGE SOLAR TELESCOPE

Why in News?

Wildlife panel of the **Union Environment Ministry** had in 2017 cleared plan for diversion of Ladakh forest area for national large solar telescope **(NLST).**

Why Ladhak Region for NLST

- High altitude region which will fundamentally enhance the NLST capacity.
- Prolong region of sunshine, clear sky (high visibility) with low sessional variation.
- Low concentration of aerosol and dust particles in sky.
- Lower wind speed and presence of mild gusts and direction; also the laminar winds blowing in favourable condition.

What is National Large Solar Telescope (NLST)

- It will be a 2-m class, multipurpose and state-of-the-art solar telescope (NLST).
- NLST will be the largest solar telescope in the world.
- The project of NLST would be implemented by Bangalore based, Indian Institute of Astrophysics (IIAP).

Features of National Large Solar Telescope

- It is capable of **doing both day and night astronomy** because of unprecedented high spatial resolution.
- It will fill the longitude gap between Japan and Europe. Currently, there is no telescope between these regions.
- It will help in **understanding the formation and decay of sunspots** by using Helioseismology, which is a powerful technique for probing the solar interior using acoustic Oscillations.

3.4. IMPORTANT TERMS RELATED TO SPACE

- **Geo Magnetic Storm:** A geomagnetic storm is a major disturbance of Earth's magnetosphere that occurs due to exchange of energy from the solar wind into the space environment surrounding Earth. They create beautiful **auroras or the Polar Lights**, but they also can disrupt navigation systems such as the **Global Navigation Satellite System (GNSS)** and create harmful **Geomagnetic Induced Currents (GICs)** in the power grid and pipelines.
- **Kuiper belt:** It is flat ring of icy small bodies that revolve around the Sun beyond the orbit of the planet Neptune. It is home to three officially recognized dwarf planets: Pluto, Haumea, and Makemake. It is thought to be the source of most of the observed short-period comets, particularly those that orbit the Sun in less than 20 years
- **Exoplanets**: Planets outside our solar system are called exoplanets. Most of these are part of star systems. There are some "rogue" exoplanets, which are not attached to any star system. The first exoplanet, 51 Pegasi b, was discovered in 1995.
- "**Goldilocks" zone:** The exoplanets must orbit within a distance of their stars in which liquid water can exist on the planet's surface, receiving about as much sunlight as Earth. This distance is called the "Goldilocks" zone because it is neither too far or too close to the star that life becomes impossible.
- **Dwarf Star**: A relatively small, low mass star that emits an average or below average amount of light, when compared with Giant or Super-Giant Stars.
  - The colour of dwarf stars can range from blue to red, the corresponding temperature varying from high (above 10,000 K) to low (a few thousand K)
  - Red Dwarfs are the most common star in milky way.
  - Our Sun is a Yellow Dwarf Star.
  - A white Dwarf star is a remnant of Red Giant Star which has exhausted all its fuel. The maximum mass of a stable white dwarf star can be 1.44 times the mass of the sun also known as **Chandrasekhar limit**
  - A mass greater than the limit will turn the star into a neutron star or black hole at the end of its life.
- **Brown dwarfs**, sometimes called "failed stars", are spread throughout the Milky Way. They are strikingly similar to Jupiter. Scientists study their atmospheres in order to look at what weather on other worlds might look like
- **Tidal Locking** – It is the name given to the situation when an object's orbital period matches its rotational period. A great example of this is our own Moon. The moon

takes 28 days to go around the Earth and 28 days to rotate once around it's axis. This results in the same face of the Moon always facing the Earth. Recently, discovered hottest known planet, designated KELT-9b is also tidally locked to its star.

- **International space station**: It is a multi-nation project with contributions from 15 nations. However, 5 major partners include: USA, Russia, Europe, Canada and Japan. It is a habitable artificial satellite in low earth orbit and is the largest single structure humans ever put into space. Astronaut time and research time on the space station is allocated to space agencies according to how much money or resources that they contribute.

4. DEFENCE TECHNOLOGY

4.1. INTEGRATED GUIDED MISSILE DEVELOPMENT PLAN (IGDMP)

Why in news?

Recently several missiles, such as **Agni II, 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

4.1.1. AGNI

- It is an **intercontinental surface-to-surface, nuclear capable ballistic missile** developed by DRDO
- 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**.** MIRV means one missile can carry several warheads, each for different targets.

Missile	
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's an Intercontinental Ballistic Misille • Coverage: 5000 km • Maximim speed: 24 times speed of sound • Canister-lauch for quick-response, higher reliability, longer shelf-life, less maintenance and enhanced road mobility

4.1.2. PRITHVI

- Both Prithvi-I and Prithvi-II is surface-to-surface ballistic missile
- Prithvi-II is indigenously developed and nuclear-capable surface-to-surface missile. It is a **short-range ballistic missile (SRBM)** developed by DRDO.
- It is capable of carrying 500-1,000 kilogram of warheads.
- It uses advanced inertial guidance system with manoeuvring trajectory to hit its target.
- Dhanush (also known as Prithvi III), a naval variant of this Prithvi missile, has also been tested recently.

Prithvi-I	Prithvi-II
Short-range, road-mobile, liquid propellant ballistic missile	Short-range, road-mobile, liquid-propellant ballistic missile
It uses a single-stage, liquid propellant engine	It uses a single-stage, liquid propellant twin engine.
It has a minimum range of 40 km and a maximum of 150 km.	It has a maximum range of 350 km

4.1.3. NAG

- It is a **third generation "fire and forget" ATGM (**anti-tank guided missile) developed by the DRDO.
- The missile is equipped with highly **advanced Imaging Infrared Radar (IRR) seeker** and has integrated avionics technology in its arsenal.
- Nag can be launched from land and air-based platforms. The land version is currently available for integration on the **Nag missile carrier (NAMICA),** which is derived from a BMP-2 tracked infantry combat vehicle.
- 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 has maximum range of 4 km while air based version has a maximum range of 7 km.

4.1.4. AKASH MISSILE

- Developed by the Defence Research and Development Organisation (DRDO), its a supersonic surface-to-air missile.
- Akash has a strike range of about 25 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.

Defence Research & Development Organisation (DRDO)
- It works under Department of Defence Research and Development of **Ministry of Defence.**
- DRDO was formed in 1958 through the amalgamation **Technical Development Establishment (TDEs)** of the Indian Army and the **Directorate of Technical Development & Production (DTDP**) with the **Defence Science Organisation (DSO)**
- **Mission:** DRDO dedicatedly working towards enhancing self-reliance in Defence Systems and undertakes design & development leading to production of world class weapon systems and equipment in accordance with the expressed needs and the qualitative requirements laid down by the three services.

4.1.5. TRISHUL MISSILE

- Developed by DRDO, It's 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.
- Trishul, with its quickest reaction time, high frequency operation, high manoeuverability, high lethal capability and multi-roles for three services, is state-of-the-art system providing considerable advantage to the Armed forces.

4.2. OTHER MISSILE TESTS

4.2.1. BRAHMOS TESTED FROM ANDAMAN ISLANDS

Why in news?

The land-to-land configuration of BRAHMOS Block III, missile was launched from **a Mobile Autonomous Launcher (MAL)** for its full-range testing in the Andaman and Nicobar Islands.

About the Missile

- It is a joint venture between **India and Russia and is named after the Brahmaputra and Moscowa rivers.**
- The first stage of the system takes the missile to supersonic speed and the second stage with liquid ramjet accelerates it to 2.8 mach.
- **Brahmos ALCM (Air Launched Cruise Missile),** is the heaviest weapon to be deployed on India's Su-30.

Significance

- With this test launch, India becomes the **first country** to have the capability to have a multi-platform weapon.
- It can be used for multi-mission roles, including precision strikes on terror camps across the border as well as against high value naval targets in the Indian Ocean.
- After India became a member of the **Missile Technology Control Regime (MTCR)** in 2016, India and Russia are now planning to jointly

develop a new generation of Brahmos missiles with 600 km-plus range. Earlier range was restricted to sub-300 kms.

- **Ramjet:** A ramjet engine does not have any turbines unlike the turbojet engines. It achieves compression of intake air just by the forward speed of the air vehicle.
- Scramjet engine The first experiment towards the realisation of an Air Breathing Propulsion System in Scramjet Engine was conducted in 2016. It uses Hydrogen as fuel and the Oxygen from the atmospheric air as the oxidiser.
- **Fire and Forget:** It means the missile guidance does not require further guidance after the launch and still hit the target without the launcher being in line-of-sight of the target.

4.2.2. NIRBHAY SUBSONIC CRUISE MISSILE

Why in news?

Recently, DRDO successfully test fired NIRBHAY missile.

About the Missile

- **NIRBHAY** is India's first indigenous **Long Range Sub-Sonic Cruise Missile,** developed and designed by Defence Research and Development Organisation (DRDO).
- It can carry a warhead of 200 kg to 300 kg at a speed of 0.6 to 0.7 Mach with a launch weight of about 1500 kg.
- It can avoid detection as it has ability to cruise at heights as low as 100 m.
- It is powered by solid rocket motor booster and has a range of 1000km.
- The successful development would provide a definite boost to **armed forces, indigenous defence industry and India's capability to design and develop lethal weapons** of strategic importance.
- With the successful launch of NIRBHAY, India joins the select league of nations that possess the ability to make sub-sonic cruise missile.

4.2.3. ASTRA MISSILE

- The final Development Flight Trials of **Astra - Beyond Visual Range Air to Air Missile (BVRAAM)** were successfully conducted over the Bay of Bengal, off the Coast of Chandipur, Odisha recently.
- The missile has been developed by the **Defence Research and Development Organization (DRDO)** together with Indian Air Force (IAF).
- It is an all-weather weapon's system capable of destroying an enemy target 60 to 70 km far away. In a typical Astra engagement both the launcher and the target move at a speed in excess of 1000 kmph.
- Built indigenously, development of ASTRA missiles will provide major business opportunities for Indian players.

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.

4.3. AIR DEFENCE SYSTEMS

4.3.1. ADVANCED MRSAM

Why in news?

- The Indian Army has signed a MoU with the Defence Research and Development Organisation (DRDO) to raise one regiment of the **advanced Medium Range Surface to Air Missiles (MRSAM)**,

Recently tested Missiles:

- **Maitri**: This is also a **QRSAM** being developed by DRDO with the help of **France**.
- **SPYDER (Surface to Air Python and Derby) missile system** is a Low level QRSAM (15km range) developed by **Israel's** Rafael Advanced defence system and is to be deployed on Pakistan border.

About MRSAM

- **It is an advanced, all weather, mobile, land-based air defence system.**

- It is capable of engaging multiple aerial targets at ranges of more than 50 km.
- The system will be jointly developed by Israel and DRDO with the involvement of private sectors and DPSUs. The system will have majority indigenous content, giving boost to the Make-in-India initiative.
- The MRSAM is a land-based variant of the long-range surface-to-air missile (LRSAM) or Barak-8 naval air defence system, which is designed to operate from naval vessels and has range upto 100 km.
- Barak-8 was also jointly developed with Israel

4.3.2. ENDO-ATMOSPHERIC INTERCEPTOR MISSILE

Why in news

Recently, India successfully test-fired it's indigenously developed **Advanced Air Defence (AAD)** supersonic interceptor missile.

Advanced Area Defence (AAD) Interceptor Missile

- It is an indigenously developed single stage missile powered by solid propellant.
- The interceptor missile has a navigation system, mobile launcher, secure data link for interception, independent tracking and sophisticated radars.
- The missile is capable of destroying incoming ballistic missile at low altitude within 30 km of the earth's atmosphere.

Ballistic Missile Defence System

- It is being developed by DRDO in order to develop multi-layered ballistic missile defence system to protect the country against rouge attacks.
- India has developed a functional 'iron dome' Ballistic missile which comprise of Endo and Exo Atmospheric Missiles.
- It consists of two interceptor missiles namely:
  - **Prithvi Defence vehicle (PDV)** missile for exo-atmospheric ranges - capable of destroying targets at a high altitude of more than 120 km
  - **Advanced Area Defence (Ashwin) missile** for endo-atmosphere - capable of intercepting incoming targets at an altitude of 15 to 25 kms
- India is the **fifth nation** in the world to have a robust Ballistic Missile Defence system. Other countries are US, Russia, Israel and China.

4.3.3. QUICK REACTION SURFACE-TO-AIR MISSILE (QRSAM)

Why in news?

The DRDO has successfully test fired **indigenously developed** QRSAM recently.

Details

- It is a **canister-based** high-speed and **short-range** weapon system
- It is a highly mobile air defence system which can destroy multiple targets at a distance of **25 km** in less than one minute.
- It can also **deceive enemy radars** making it difficult to be detected
- Considered to be a unique system in its class, the missile is expected to supplement **medium range surface-to-air missile Akash.**
- It is an **all-weather and all-terrain missile** having electronic counter measures against all known aircraft jammers.
- The missile uses **high-energy solid propellant.**

4.4. SURVEILLANCE TECHNOLOGIES

4.4.1. NETRA

Why in news?

- Recently, for the first time mid **air-to-air refuelling** of the Embraer transport aircraft was carried which is mounted with NETRA.

Significance

- Air-to-air refuelling allows the aircraft to stay airborne much beyond their limits, allowing better exploitation of capabilities and boosting the force's capabilities.

About NETRA

- It is a first indigenously developed **airborne early warning and control system (AEW&C)**, mounted on a Brazilian Embraer-145, developed by Defense Research and Development Organization (**DRDO)**.
- AEW&C is also called **eye-in-the-sky** which is capable of long-range surveillance and a force multiplier.
- India is only 4th such nation after United States, Russia and Israel that have such technology on their own.

- Currently Indian Air Force using 3 **Israeli Phalcon AWACS (Airborne Warning and Control System)** which are mounted on Russian IL-76 heavy-lift planes. These Phalcon AWACS has a range of 400 kms and 360-degre coverage.

Important features of NETRA are:

- Range of 200 kms (Capability to detect aerial threats from incoming aircraft and missiles).
- 240 degrees coverage (simultaneously scan the area on both sides of aircraft)
- State of the art active electronically scanned radar and Secondary surveillance radar.
- Electronic and communication counter measures.
- Line of sight and beyond line of sight data link.
- Voice communication system and self-protection suit.

4.4.2. RUSTOM-2 DRONE

Why in news?

Recently DRDO successfully carried out test flight of Rustom-2 drone.

More about Rustom-2

- Rustom-2 is medium-altitude long-endurance drone (MALE) designed and developed by Aeronautical Development Establishment (ADE) of the DRDO, Hindustan Aeronautics Ltd and Bharat Electronics.
- It can fly up to an altitude of 22,000 feet and has endurance of over 20 hours.
- It can carry variety of payloads like Electronic Intelligence (ELINT), Synthetic Aperture Radar (SAR), Communication Intelligence (COMINT) and Situational Awareness Payloads (SAP) for performing missions even during the night.
- It will be used by all three services of Indian armed forces, primarily for intelligence, surveillance and reconnaissance (ISR) operations.
- Rustom 2 can fly missions on manual as well as autonomous modes.

More about Drones

Recently, Director General of Civil Aviation (DGCA) released the Civil Aviation Requirements (CAR) for the operation of civil **Remotely Piloted Aircraft System (RPAS) or Drones** in India.

UAVs: It operates without a human pilot. UAVs are commonly used in both the military and police forces in situations where the risk of sending a human piloted aircraft is unacceptable, or the situation makes using a manned aircraft impractical.

Background

- DGCA in October 2014 restricted the use of drones and unmanned aircraft system by civilians.
- Current aircraft rules also do not cover use of drones for civilian purposes as well as their sale and purchase.
- Unregulated usage poses **Security Threat** and chances for air collisions and accidents.

Directorate General of Civil Aviation

- DGCA is the civil aviation regulatory body responsible for regulating of air transport services to/from and within India.

Key Functions

- Registration of civil aircraft and licensing of pilots and aircraft maintenance engineers.
- Coordination with ICAO (International Civil Aviation Organization).
- Safety oversight and surveillance.
- Advising government in matters of air transport including those related to bilateral air services agreements.

Various Unmanned Aerial Vehicles in India

- **Nishant:** It was designed for battlefield surveillance and reconnaissance and has been designed and developed by ADE.
- **Panchi:** It wheeled version of UAV Nishant and has been designed and developed by ADE.
- **Lakshya:** It is a reusable aerial target system.
- **Daksh:** It is a land based drone used for bomb disposal developed by DRDO.

Provision under Regulation

- **Definition:** A remotely piloted aircraft (RPA) is defined as an unmanned aircraft which is piloted from a remote station.
- The DCGA has divided the drones into five categories based on their **Maximum Take-Off Weight** (MTOW)
  - **Nano:** Less than or equal to 250 grams.
  - **Micro**: Greater than 250 grams and less than or equal to 2 kg.
  - **Mini:** Greater than 2 kg and less than or equal to 25 kg.
  - **Small:** Greater than 25 kg and less than or equal to 150 kg.
  - **Large**: Greater than 150 kg.
- A **Unique Identification Number** and **radio frequency tags** would be a mandatory requirement for operating drones.
- **Exemption**: Drones in nano category- weighing up to 250 grams- and those operated by government agencies would not require any permit.

- **Pilot:** The remote pilot for any drone must be at least 18 years old and has to go through a prescribed training process.
- **No Drone Zones:**
  - Drones are barred from being operated within 5km of an airport, within 50km from international border and beyond 500 metre (horizontal) into sea along the coastline.
  - Drones would not be allowed within 5 km radius from Vijay Chowk (in national capital), over eco-sensitive zones like national parks and wildlife sanctuaries and from a mobile platform such as a moving vehicle, ship or aircraft.
  - Due permissions would also be needed when drones are being used over densely populated areas or near an area affecting public safety or where emergency operations are underway.
- **Penalties:** Any violation of rules shall attract penal actions including penalties under the Indian Penal Code

Advantage of UAVs

- **Damage assessment** of property after natural calamities, use by Armed Forces for tactical purposes at border, **Surveillance and Crowd Management**, **Monitoring of wildlife, SENSAGRI (SENsor based Smart AGRIculture), many e-mmorce use it for delivering products.**

4.4.3. MUNTRA, INDIA'S FIRST UNMANNED TANK

Why in news?

- Muntra, the first **unmanned, remotely operated tank** of India has been made by **DRDO** (the Defence Research and Development Organisation) for surveillance missions, mine detection and reconnaissance in areas with nuclear and biological threat. It can be used in Naxal-hit areas as well.
- **Features:** The tank has radar, an integrated camera along with laser range finder which can spy on a ground target 15km away. The tank is tested at Mahajan field firing range in Rajasthan under dusty desert condition.
- **Other details: Indian defence Ministry** has relaunched an ambitious **Future Combat Ready Vehicles (FCRV) program** to find a cutting edge tank for the mid-2020s and beyond.

Types of Muntra tanks:
- **Muntra S**: For surveillance mission
- **Muntra M**: For detecting mines
- **Muntra N**: For operation in areas where there is nuclear or bio-weapon risks.

Tanks used by India: T-72M, T-90S, Arjun Mark 1, Arjun Mark-2 etc.

4.5. TECHNOLOGICAL DEVELOPMENTS IN NAVY

4.5.1. SCORPENE CLASS SUBMARINE

Why in news?

Indian Navy recently launched Scorpene-class (conventional diesel electric attack submarines) submarine INS Karanj.

More about INS Karanj

- INS Karanj is the third of the six Scorpene-class submarines under the Project 75 programme of Indian navy
- The first one, **INS Kalvari** (named after the tiger shark) was commissioned on December 2017.The second one**, INS Khandari** is undergoing sea trials. Remaining three **submarines *Vela*, *Vagir* and *Vagsheer*** are in various stages of outfitting.
- The Scorpene submarines can undertake various missions such as anti-surface warfare, anti-submarine warfare, intelligence gathering, mine laying and area surveillance.

4.5.2. ARIHANT CLASS SUBMARINE

Why in news?

Aridhaman the second *Arihant*-class nuclear-powered ballistic missile submarine was slated to be launched and inducted into services.

INS Arihant
- It is India's first indigenously built nuclear powered submarine which was built under the Advanced Technology Vessel project
- It is based on the design of the Russian Project 971 Akula I-class nuclear powered attack submarine.

More about INS Aridhaman

- It is **nuclear-power ballistic missile** submarine indigenously built under the **Advanced Technology Vessel (ATV)** project at Visakhapatnam.
- It is powered by a **pressurized water reactor**

- After the induction of INS Arihant and INS Aridhaman India has become 6th country in the world to have nuclear powered submarine after UNSC permanent members - USA, UK, China, Russia and France.

4.5.3. PROJECT 28

Why in news?

Recently INS Kiltan, Anti-Submarine Warfare (ASW) stealth corvette was commissioned into the Indian Navy.

Details

- INS Kiltan is third of the four kamorta class anti-submarine warfare corvettes being built under naval modernisation project P-28.
- INS Kamorta and INS Kadmatt which were two ships constructed earlier under the same project. The fourth ship INS kavaratti is still under construction.
- It is India's first major warship to have a superstructure of carbon fibre composite material resulting in improved stealth features, lower top weight and maintenance costs.
- It was designed by Directorate of Naval Design and constructed by Garden Reach Shipbuilders & Engineers Limited, Kolkata.

4.5.4. FIRST INDIGENOUSLY BUILT FLOATING DOCK

Why in news?

The Indian Navy's first indigenously built Floating Dock (FDN-2) was launched at shipyard in Kattupalli, Near Ennore port, Chennai.

About the dock

- The floating dock is 185 metres long and 40 metres wide. It will enable docking of all kinds of vessels.
- This will include naval ships and submarines of up to 8,000 tonnes displacement.
- It would include draughts of up to seven metres, during both day and night.
- FDN-2 will be based in the Andaman and Nicobar Islands.

4.5.5. NAVAL OFFSHORE PATROL VEHICLE (NOPV)

- Two **diesel engine driven** NOPVs named **Shachi** and **Shruti** were launched at Pipavav, Gujarat.
- These ships are part of 5 ship project being built by **Reliance Defence and Engineering Limited.**
- The NOPVs would increase the **ocean surveillance and patrolling capabilities** of the Indian Navy.

4.6. DEFENCE RELATED NEWS

4.6.1. COMPREHENSIVE INTEGRATED BORDER MANAGEMENT SYSTEM (CIBMS)

Why in News?

- Recently Border Security Force (BSF) personnel detected a fifth (since 2012) cross-border tunnel in the forest area of Jammu which has intensified the demand for CIBMS.

Background

- The trigger for implementing the CIBMS was the **Pathankot terrorist attack** followed by warning by the Punjab and Haryana High Court. Following this the MHA sanctioned the implementation of CIBMS through two pilot projects (stretches in Jammu sector of India-Pakistan Border).
- Further a committee under **Madhukar Gupta (2016)**, was explicitly tasked to recommend technological solutions to secure the international border.

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** such as sensors, detectors, cameras, etc. as well as existing equipment **for round-the-clock surveillance** of the international border.
  - An **efficient and dedicated communication network** including fiber optic cables and **satellite communication** for transmitting data gathered; and
  - A **command and control centre** to which the data will be transmitted providing a composite picture of the international border.
- This would improve prevention of infiltration and smuggling attempts, cover gaps at rivers and nullahs, providing all-round security in even adverse climatic conditions & give relief to BSF troops.

4.6.2. 'SAMADHAN' DOCTRINE FOR NAXAL VIOLENCE

Why in news?

- Recently, 25 jawans lost their lives in the Sukma attack, the deadliest Naxal strike on the CRPF in years. In answer to Naxal problem, Ministry of Home Affairs launched **Operation 'SAMADHAN'**
- Operation Samadhan involves Smart leadership, Aggressive strategy, Motivation and Training, Actionable intelligence, Dashbord based key performance indicators, Harnessing technology and No access to funds to LWE groups.

4.6.3. AADDHAR SECURITY

Why in News?

Recently, Unique Identification Authority of India (UIDAI), announced introduction of a **two-tier security system** in the wake of alleged data breaches of Aadhaar.

Unique Identification Authority of India (UIDAI)

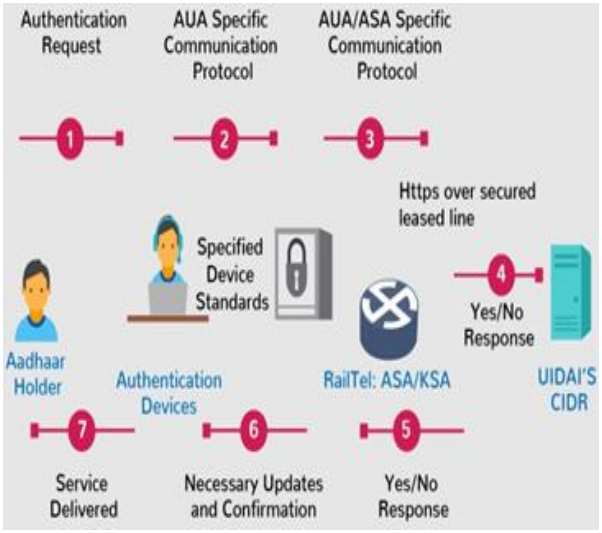
- **It** is a statutory authority established under the provisions of the **Aadhaar Act, 2016.**
- It works under the aegis of Ministry of Electronics and Information technology.
- It is responsible for Aadhaar enrolment, authentication, developing the policy, procedure and system for issuing Aadhaar numbers etc.
- It consists of a Chairperson appointed on part-time basis, two part-time Members and a Chief Executive Officer who shall be the Member-Secretary of the Authority.

Proposed two tier security system

- **Virtual IDs**
  - It is a 16-digit temporary number (like an OTP) which can **only generated by Aadhaar holders** in place of Aadhaar numbers to validate their identity.
  - It can be generated through UIDAI's portal, enrolment centres, Aadhaar's mobile app, etc.
  - There will be **only one active and valid VID** for an Aadhaar number at any given time.
- **Limited KYC:** It involves giving an **agency-specific UID 'token'** for e-KYC authentication. It eliminates the need of many agencies storing Aadhaar numbers while still enabling their own paperless KYC.
- For better safety of Aadhar Data, all **Authentication User Agencies (AUAs)** will be divided into two categories:
  - Global AUAs – Agencies whose services, by law, require them to store the Aadhaar number will be qualified as Global AUAs and will enjoy access to full demographic details of an individual along with the ability to store Aadhaar numbers within their system.
  - Local AUAs – They will neither get access to full KYC, nor can they store the Aadhaar number on their systems. Instead, they will get a tokenised number issued by UIDAI to identify their customers. UID token will be a unique 72-character alphanumeric string for each Aadhaar number for each particular AUA entity.

What are AUAs?

- It is an entity that provides Aadhaar Enabled Services to Aadhaar number holders, uses the authentication as facilitated by the **Authentication Service Agency** (ASA).
- An AUA may be a government, public, or private legal agency registered in India that uses UIDAI's Aadhaar authentication services and sends authentication requests to enable its services or business functions.
- **ASAs** are entities that have secure leased line connectivity with the CIDR and transmit authentication requests to CIDR on behalf of one or more AUAs



- **Security features in physical Aadhaar card** – There is no hologram or digital signature but rather a QR code, which is just an image representation of a text. Thus, in its physical form, its coloured photocopy may look as good as the original.

4.6.4. NTRO UNDER INTELLIGENCE ACT

Why in News?

- Recently, the Home Ministry issued a notification **listing National Technical Research Organization (NTRO) under the Intelligence Organizations (Restriction of Rights) Act, 1985**.

Intelligence Organizations (Restriction of Rights) Act 1985

- The aim of this act is to prevent leakage of information by intelligence agencies.
- It prevents employees of a notified agency -
  - From forming unions/associations.
  - Puts restrictions on the employee's freedom of speech
  - Bars any communication with the press or publishing a book or other document without the permission of the head of the intelligence organization.

About NTRO

- The NTRO was created after the 1999 Kargil conflict as a dedicated **technical intelligence agency**. It was finally constituted in 2004.
- NTRO reports to the Prime Minister's Office (PMO) and the National Security Advisor (NSA).
- It functions under the National Security Adviser.
- It also includes National Institute of Cryptology Research and Development.

Various Intelligence Agencies in India

1. **Research and Analysis Wing (RAW) –**
   - It was founded in 1968 to counter Chinese influence but over time its focus has shifted to Pakistan.
   - It is India's premier external intelligence agency.
   - It reports directly to the Prime Minister and not to the Department of Defence.
   - It's primary objectives include
     - Monitoring the political and military developments in adjoining countries, which have direct bearing on India's national security and in the formulation of its foreign policy.
     - Seeking the control and limitation of the supply of military hardware to Pakistan, mostly from European countries, the United States, and China.
2. **Intelligence Bureau**
   - It was founded by the Britishers as an intelligence agency for both external and domestic intelligence gathering. After the 1962 war with China, the external intelligence function was taken away from it.
   - It also executes counter intelligence and counter terrorism tasks.
3. **Directorate of Revenue Intelligence**
   - It is the apex anti-smuggling agency of India, working under the Central Board of Excise Customs, Ministry of Finance.
   - It is tasked with detecting and curbing smuggling of contraband, including drug trafficking and illicit international trade in wildlife and environmentally sensitive items.
   - It also combats commercial frauds related to international trade and Custom duty evasion.
4. **Narcotics Control Bureau –** It was formed in 1986 as per a provision of The Narcotic Drugs and Psychotropic Substances Act, 1985. It is an intelligence agency and coordinates actions of concerned authorities over trade of illicit narcotics from the country.

4.6.5. MERGER OF NCRB WITH BPRD

Government has recently notified the merger of National Crime Records Bureau (NCRB) with Bureau of Police Research and Development (BPRD).

- NCRB is an attached office to the Ministry of Home Affairs which was established in 1986 to empower Indian Police with the power of information Technology solutions and criminal intelligence to enforce the law effectively.
- BPRD was established in 1970 as a national police organisation to study, research and develop on subjects and issues related to policing.
- Reason for merger
  - boost crime data collection and research efforts
  - improve administrative efficiency
  - optimum utilisation of resources
  - Better outcome to crime data collected by NCRB and research work done by BPRD.

4.6.6. CREATION OF SPACE, CYBER AND SPECIAL OPERATIONS COMMANDS

Why in news?

- Recently, three new formations under Defence Ministry namely Defence Cyber Agency, Defence Space Agency and a Special Operations Division have been proposed.

- **Joint military Doctrine of the Indian armed forces, 2017** and **Naresh Chandra Task Force 2012** had also underscored the need to prepare the defence forces for the **"emerging triad"** of space, cyberspace and special operations.

Details

- The three organisations will be developed as **Tri-service organisations** to promote integration and jointness among military, air-force and navy in respective domains.
- **Defence Cyber Agency (DCA)** will work in close co-ordination with the National Cyber Security Advisor. It will focus on non-civilian cyber issues, including safeguarding critical infrastructure.
- **Defence Space Agency (DSA)** will work closely with ISRO and DRDO for better utilisation and integration of space resources including information from surveillance satellites.
- **Special Operations Division (SOD)** will have central pool of personnel from the Special Forces of the Army (Para commandoes), Navy (Marcos) and IAF (Garud's). They will be equipped and trained together for unconventional warfare capabilities.

4.6.7. NATIONAL AUTHORITY FOR CHEMICAL WEAPONS CONVENTION (NACWC)

Why in news?

- **The National Authority for Chemical Weapons Convention (NACWC)** has been awarded ISO 9001:2008, Certificate which is a recognition of successful performance of the authority with enhanced administrative efficiency and accountability.
- The ISO 9001 Certificate makes the **NACWC** the first among all 188 members nations of **OPCW** to attain this distinction. It is also the first Government of India department to have qualified for ISO 9001:2008 certification.

Chemical Weapons Convention (CWC)

- It is an arms control treaty that outlaws the production, stockpiling, and use of chemical weapons and their precursors.
- The Convention opened for signature in Paris on 13 January 1993. It is administered by the **Organisation for the Prohibition of Chemical Weapons (OPCW)**, an intergovernmental organization based in The Hague, Netherlands.
- Each State Party is obliged to designate or establish a representative called **National Authority** to ensure that the Convention is implemented effectively.
- The main responsibilities of the National Authority are:
  - Escorting OPCW inspections of relevant industrial or military sites;
  - Submitting initial and annual declarations;
  - Assisting and protecting those States Parties which are threatened by, or have suffered chemical attack; and,
  - Fostering the peaceful uses of chemistry.

About NACWC

- NACWC was set up as an office of Cabinet Secretariat to fulfil obligations under Chemical Weapons Convention (CWC).
- It was established under Chemical Weapons Convention Act, 2000. It acts as national focal point for effective bond with **Organisation for Prohibition of Chemical Weapons (OPCW)** and other State Parties.

What is a chemical weapon?

- A chemical weapon is any toxic chemical that can cause death, injury, incapacitation, and sensory irritation, deployed via a delivery system, such as an artillery shell, rocket, or ballistic missile.
- Chemical weapons are considered weapons of mass destruction and their use in armed conflict is a violation of international law.
- Primary forms of chemical weapons include nerve agents, blister agents, choking agents, and blood agents.
  - **Choking Agents**: chlorine and phosgene,
  - **Blister Agents (Or Vesicants):** mustard and lewisite,
  - **Blood Agents**: hydrogen cyanide,
  - **Nerve Agents**: sarin, soman, VX.

About VX nerve agent

- It acts on the nervous system (hence the name nerve agents), typically the nerves that control breathing.
- It is a clear, tasteless and colourless liquid with a consistency something like engine oil.
- Just one drop containing 10 milligrams of VX, absorbed through the skin, is enough to cause "fatal disruption of the nervous system
- It inhibits the enzyme acetylcholinesterase, which breaks down the neurotransmitter acetylcholine which overstimulates the

tissues, resulting in respiratory paralysis and death.
- The VX nerve agent is banned under international law because it's a chemical weapon as defined in the Chemical Weapons Conventions.

4.6.8. THERMOBARIC BOMB

Why in news?

- US recently dropped GBU-43 Massive Ordnance Air Blast (MOAB) bomb on Afghanistan.

More on news

- GBU-43 Massive Ordnance Air Blast (MOAB), popularly called the **Mother of All Bombs** has been developed by United States military. It is a thermobaric bomb
- Thermobaric bomb **uses oxygen from the surrounding air** to generate an intense, high-temperature blast wave that packs an incredible amount of energy into a small, localised area.
- It differs from conventional bombs in terms of weight of explosives packed in it. For example: GBU-43 packs in 8,000 kg of explosives. In comparison, the average weight of most deployed conventional bombs which is roughly 250 kg.
- Russia also possesses thermobaric bomb, popularly known as **Father of All Bombs** which is four times more powerful than the U.S. weapon.

Other types of bombs

Hydrogen Bombs

- Hydrogen bombs are thermonuclear weapons which employs **fusion of isotopes of hydrogen**.
- The result is greatly **increased explosive power** when compared to single-stage fission weapons.
- Salient Features of Hydrogen Bomb:
  - The energy released in a Hydrogen bomb is several magnitudes higher than an Atom bomb.
  - A fusion bomb is more sophisticated and difficult to make, since it requires a much higher temperature -- in the order of millions of degrees centigrade. So a fission is carried out first to produce more energy, which is then used to initiate fusion.
  - It is easier to make Hydrogen bombs in **small size**, so it is easier to place them in missiles.
  - **Hiroshima and Nagasaki** both were atomic bombs and till date Hydrogen bombs have never been used in war.

Atomic Bombs

- Atomic bombs differ from hydrogen bombs primarily due to the fact they are **fission bombs**. It develops its energy from the fission of heavy, unstable nuclei.
- Radioactive forms of elements such as **plutonium and uranium** are especially susceptible to fission
- In fission reactions, heavy nucleus breaks up when it is bombarded with neutrons. The reaction that follows also releases neutrons along with two lighter nuclei. These 2 nuclei are then bombarded with the neutrons generate making it a chain reaction.

4.6.9. LASER WEAPONS SYSTEM (LAWS)

- Laws is world's first laser weapon, launched by US
- It releases photons at the speed of light silently hitting their target and burning it to a temperature of thousands of degrees.
- It is completely invisible

5. IT AND COMPUTER

5.1. BIG DATA

Why in news?

- Big data is being increasingly used by the government in policy formation.

What is Big Data?

- Big data is a term that describes the large volume of data – both structured and unstructured beyond the ability of commonly used software tools to capture, curate, manage, and process data within a tolerable elapsed time.
- Big data can be analyzed for insights that lead to better decisions and strategic business moves.
- Big data is characterized by **4Vs – Variety, Volume Velocity and Value**. Additionally, two more concepts have been added – Variability and Complexity
- Interesting insights from big data can be got using **data mining.**

Data mining

- It's defined as a process used to extract usable data from a larger set of any raw data by analysing data patterns in large batches of data using one or more software
- It involves effective data collection and warehousing as well as computer processing.
- It uses sophisticated mathematical algorithms for segmenting the data and evaluating the probability of future events.
- Data mining is also known as **Knowledge Discovery in Data (KDD).**

Applications of Big Data

- Better understanding and targeting of customers.
- Optimization of Businesses processes
- optimizing treatment and even predicting diseases
- Analyze and improve the performance of individuals
- Prevent cyber-attacks, detect credit card fraud, foil terrorism and even predict criminal activity.
- optimizing the heating or lighting in our homes, the traffic flow in our cities, or the energy grid across the country.

In the wake of challenges for Big data in India, government had constituted a committee under Justice **B.N. Srikrishna** which came out with a white paper on Data Protection Framework for India. Earlier in 2016, CAG finalized a Big Data Management Policy to make itself future ready.

5.2. MAHARASHTRA'S PUBLIC CLOUD POLICY

Why in News?

Maharashtra became the first state to mandate its departments to shift their data storage onto the cloud unlike currently where government departments have their own data storage facilities.

Details

- **Cloud Storage-** Cloud storage is a service model in which data is maintained, managed, backed up remotely and made available to users over a network or cloud services platform (typically the Internet).
- Apart from storage, cloud computing also involves on-demand delivery of compute power, applications, and other IT resources

Similar Government initiatives

- **Digilocker Service-** It is a part of goverment's Digital India Initiative, to enable Indian citizens to store certain official documents on the cloud.
- **GI Cloud Initiative (Meghraj):** To accelerate delivery of e-services in the country while optimizing ICT spending of the Government. The **National Informatics Centre (NIC)** is providing National Cloud services under this.

5.3. BLOCK-CHAIN TECHNOLOGY

Why in news?

The Finance Ministry recently issued a statement warning against investing in bitcoin and other cryptocurrencies (CCs). These currencies use a technology called blockchain.

What are cryptocurrencies?

- A cryptocurrency is a digital or virtual currency that uses cryptography for security. Hence it is difficult to counterfeit. It is not issued by any central authority, rendering it theoretically immune to government interference or manipulation.

- The first cryptocurrency to capture the public imagination was Bitcoin, which was launched in 2009 by an individual or group known under the pseudonym Satoshi Nakamoto. Bitcoin's success has spawned a number of competing cryptocurrencies, such as Litecoin, Ethereum, Namecoin, PPCoin etc.
- **Advantages:** easier to transfer funds with minimal processing fees, safety from hackers due to block-chain technology and difficult to counterfaeit
- **Disadvantages:** well-suited for illegal activities such as money laundering, tax evasion due to anonymous nature of transactions, rate of exchange of cryptocurrencies fluctuate widely and a digital cryptocurrency balance can be wiped out by a computer crash. Recently concerns are being raised on its immunity to hacks as well.
- Various countries have adopted use of bitcoins with regulations such as China, South Korea, Japan etc.
- Some countries are also coming up with their virtual currencies such as PETRO by Venezuela, SOV (Sovereign) by Marshall Islands etc.
- India does not consider crypto-currencies as legal tender or coin.

What is it?

- Blockchains are basically digital ledgers or decentralized database of financial transactions that are immutable and instantly updated across the world.
- **Distributed database**: The blockchain database isn't stored in any single location, meaning the records it keeps are truly public and easily verifiable.
- Whenever a financial transaction happens, it is grouped in a cryptographically protected block with other transactions and sent out to the entire network.
- The members in the network then validate the transactions by solving complex coded problems.
- The new validated block is then added to the chain in a linear, chronological order and linked to older blocks making it a chain of blocks that show every transaction made in the history of that blockchain
- Thus, the blockchain cannot be controlled by a single entity and has no single point of failure

Importance

- The World Economic Forum in 2015, predicts that 10% of global GDP will be stored on the blockchain by 2027.
- Crypto currency (CC) is just one use of Blockchain technology. The other possible uses are – streamlining payment mechanism, eliminated the need for trust. Programmable money to not allow using products of company flouting norms, promoting artificial intelligence and internet of things etc.

Challenges:

The main challenges today are the missing standards, the unclear legal and regulatory framework, lacking confidence and technical issues. Current blockchains have trouble with scalability and latency (i.e. verification speed).

5.4. INDIA JOINS QUANTUM COMPUTING RACE

Why in news?

Department of Science and Technology is planning to fund a project to develop quantum computers.

What is quantum computing?

- In a classical computer, information is stored using binary units, or bits. A bit is either a 0 or 1. A quantum computer instead takes advantage of quantum mechanical properties to process information **using quantum bits, or qubits**.
- They function according to two key **principles of quantum physics**: **superposition and entanglement.**
- **Superposition** means that each qubit can represent both a 1 and a 0 at the same time.
- **Entanglement** means that qubits in a superposition can be correlated with each other; that is, the state of one (whether it is a 1 or a 0) can depend on the state of another.
- Using these two principles, qubits can act as more sophisticated switches, enabling quantum computers to function in ways that allow them to solve difficult problems that are intractable using today's computers.
- The computing power of a quantum computer increases exponentially as the qubits are increased.
- **It can be used in research in new medicine and organic materials as** quantum computers would require 3.5 million fewer steps as compared to a traditional machine.
- **Other uses –** efficient logistics and delivery mechanism, more secure platforms for banking transactions, revolutionize artificial

intelligence by faster processing of complicated data, faster communication etc.

Quantum mechanics (QM): QM deals with sub-atomic particles viz electrons and photons. It is used in making products such as integrated circuit chips and fibre-optic lines for global, instantaneous communication.

Quantum cryptography: It is a recent technique that can be used to ensure the confidentiality of information transmitted between two parties by exploiting the counterintuitive behavior of elementary particles such as photons. Quantum cryptography is different from traditional cryptographic systems in that it relies more on physics, rather than mathematics, as a key aspect of its security model.

QUESS

- China launched the world's first satellite under the **Quantum Experiments at Space Scale (QUESS) mission**, to test the fundamentals of quantum communication in space.
- It is known as **Micius,** after an ancient Chinese philosopher.

5.5. SUPERCOMPUTERS PRATYUSH AND MIHIR

Why in news?

Recently, the Minister for Earth Sciences (MoES) unveiled India's fastest supercomputer named Pratyush and high performance computer system 'Mihir'.

National Supercomputing Mission

- It's implemented and steered jointly by the Department of Science and Technology (DST) and Department of Electronics and Information Technology (DeitY)
- Mission 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**) under Ministry of Electronics & Information Technology.
- The NKN is another programme of the government which connects academic institutions and R&D labs over a high speed network
- The Mission also includes development of highly professional High Performance Computing (HPC) aware human resource for meeting challenges of development of these applications.

More on news

- MoES has acquired a high performance computing (HPC) system which is an array of computers jointly hosted by **IITM, Pune and National Centre for Medium Range Weather Forecasting, Noida.**
- The HPC at Pune is named **Pratyush** with a capacity of **4 petaflops** (a measure of a computer's processing speed expressed as a quadrillion floating point operations per second) and HPC at Noida named **Mihir** with capacity of **2.8 petaflops** giving a total capacity of **6.8 petaflops**.
- It is India's first **multi-petaflop supercomputer** and is the **fourth fastest super-computer in the world** which is dedicated to weather and climate research after Japan, U.S.A. and United Kingdom.
- It will also take India up from the present **365th position to top 30** in the **infrastructural ranking** of **Top 500 HPC facilities** in the world.
- Other top five super computers of India are SahasraT (Cray XC40), Aaditya (IBM/Lenovo system), TIFR Colour Boson (Cray XC-30), IIT Delhi HPC and Param Yuva 2.
- Sunway TaihuLight is the World's fastest computer, belonging to China

5.6. PANEL FOR AI ROADMAP

Why in news?

- The government has formed a high-level panel under the chairmanship of Rajiv Kumar to lay out a roadmap for India's research and development on AI and its applications.

Artificial Intelligence

- It is branch of computer science dealing with simulation of intelligent behavior in computers vis-a-vis visual perception, speech recognition, decision making and translation between languages.
- It enables computer system to carry out task on their own that otherwise requires human intelligence.
- Robotics is also a major field related to AI.

Other Developments

- Recently, **Department of Defence Production constituted** a task force headed by **N Chandrasekaran,** to study use of artificial intelligence in military.

- Commerce and Industry Minister Sets up Task Force chaired **by V. Kamakoti on Artificial Intelligence for Economic Transformation.**

5.6.1. PROJECT BRAINWAVE

- Microsoft has launched **"Project Brainwave",** a deep learning acceleration platform for real-time artificial intelligence (AI).
- It uses the massive **field-programmable gate array (FPGA)** infrastructure.
- The system architecture allows very high throughput, with the FPGA processing requests as fast as the network can stream them.
- **Significance:** Real-time AI is becoming increasingly important as cloud infrastructures process live data streams, whether they be search queries, videos, sensor streams, or interactions with users.

About deep learning

- It is a subset of machine learning which utilizes hierarchical level of artificial neural networks to process unstructured data.
- **Neural networks** are a set of algorithms, modeled loosely after the human brain, that are designed to recognize patterns
- A hierarchical neural network is an artificial neural network(ANN) with multiple hidden layers between the input and output layers

5.6.2. HUMANOID

- A humanoid robot is a robot with its overall appearance based on that of the human body.
- **Features of Humanoid Robots**
  - Self-maintenance
  - Autonomous learning
  - Avoiding harmful situations to people, property, and itself
  - Safe interacting with human beings and the environment
- Androids are humanoid robots built to resemble a male human, and Gynoids are humanoid robots built to resemble a human female.
- Recently, Humanoid Robot Sophia became world's first robot citizen as Saudi Arabia granted citizenship to her in a bid to promote **artificial intelligence.**
- **Other Example:** Unplugged (USA), Asimo (Japan), Icub (Cognitive Universal Body by European university), Poppy (france), Lexy & Tess (Germany), Actroid-Sit (Japan) etc.

About Sophia

- Sophia is a social humanoid robot developed by Hong Kong-based company Hanson Robotics under David Hanson.
- Sophia is conceptually similar to the computer program ELIZA, which was one of the first attempts at simulating a human conversation.
- The software has been programmed to give pre-written responses to specific questions .The information is shared in a cloud network which allows input and responses to be analysed with **blockchain technology.**
- She also made surprise appearance at UN and also joined meeting on artificial intelligence and sustainable development.

In Artificial intelligence, turing test is a method of inquiry for determining whether or not a computer is capable of thinking like a human being.

5.7. TELECOM SECTOR

5.7.1. BHARAT NET PROJECT

Why in news?

As of now, over 1.04 lakh gram panchayats have been made "service ready" for providing broadband connectivity as on March 11 under Bharat Net project

About International Telecommunications Union

- ITU is the United Nations specialized agency for information and communication technologies – ICTs.
- It allocates global radio spectrum and satellite orbits, develop the technical standards that ensure networks and technologies seamlessly interconnect, and strive to improve access to ICTs to underserved communities worldwide.
- **Members:** It includes both public and private sector membership i.e 193 UN Member States and ICT regulators, many leading academic institutions and some 700 tech companies.

Bharat Net Project

- In 2011, **National Optical Fibre Network (now called Bharat Net Project)** was launched to provide broadband connectivity to **2.5 lakh Gram Panchayats** with an affordable broadband connectivity of 2 Mbps to 20 Mbps.
- It is being implemented by a **special purpose vehicle (SPV)** named **Bharat Broadband Network Ltd (BBNL)** set up under Companies Act.

- It is funded through **Universal Service Obligation Fund (USOF)**
- Bharat Net Project is also significant for generation of as much as 5 lakh jobs during the installation of Wi-Fi hot spots.
- Some issues involved are high usage of internet through mobile phone, cyber security, high cost of services, low internet education.

Universal Service Obligation Fund:

- It aims to provide non-discriminatory access to quality ICT services at affordable prices to people in rural and remote areas through subsidy support to incentivizing telecom service providers to venture forth and provide services to such target beneficiaries.
- It was envisaged in National Telecom Policy, 1999 and was given statutory status through Indian Telegraph (Amendment) Act, 2003.
- The resources are raised through a 'Universal Access Levy (UAL)', which would be a percentage of the revenue earned by the operators under various licenses.

Optical Fibre Technology

- Fibre optics, is the science of transmitting data, voice, and images by the passage of light through thin, transparent fibres.
- Optical fibre is made up of semiconducting materials and usually has a cylindrical structure. In inner core there is material of higher refractive index than in outer core resulting in Total Internal Reflection (TIR)
- When light passes from a medium with **one index of refraction (m1**) to another medium with a **lower index of refraction (m2),** it bends or refracts away from an imaginary line perpendicular to the surface (normal line)
- However at **critical angle,** the refracted light travel along the surface between the two media and at angle greater than critical angle, the refracted beam will be reflected entirely back into m1. This phenomenon is known as total internal reflection.
- Optical fibers allow data signals to propagate through them by ensuring that the light signal enters the fiber at an angle greater than the critical angle of the interface between two types of glass.

5.7.2. 5G

Why in news?

- The government has set up a **high level forum** to evaluate roadmaps and formulate a strategy to adopt **5G in the country by 2020.**

What is 5G?

- 5G is a wireless communication technology. It is the next generation mobile networks technology after 4G LTE networks.
- The final standard for 5G will be set up by the **International Telecommunications Union (ITU).**

What is spectrum and how does it work?

- Spectrum refers to the radiowaves that are used by mobile phones to transmit data.
- The spectrum has been divided into bands by the government for uninterrupted transmission of data.
- Carriers in India use airwaves in the 800 Mhz, 900 Mhz, 1800 Mhz, 2100 Mhz, 2300 Mhz and 2500 Mhz bands.

Generation	Year
1 generation (1G)	• First wireless communication. • Voice Calls. • Limited capacity, not secure, background interference • 2 Kbps
2 Generation (2G)	• Digital version of 1G technology • Voice calls, Short messages, browsing (partial) • Low network range, slow data rates • 64 Kbps
3 Generation (3G)	• Digital broadband, speed increments • Video conferencing, mobile TV, GPS • High power consumption, Low network coverage, High cost of spectrum licence. • 2 Mbps
4 Generation (4G)	• Very high speeds, All IP • High speed applications, mobile TV, Wearable devices • Hard to implement, complicated hardware required • 1 Gbps
5 Generation (5G)	• Cell densification, software defined network, low signal traffic • Hologram TV, Augemented reality, Ultra large and high data transfer, energy saving. • More than 1 Gbps

Low-**frequency transmissions** can travel greater distances before losing their integrity, and they can pass through dense objects more easily. Less data can be transmitted over these radio waves.

Higher-frequency transmissions carry more data, but are poorer at penetrating obstacles. The higher the frequency, the lower the wavelength, and thus the more energy that's required to cover the same distance.

Wireless Planning and Coordination (WPC) Wing, under Department of Telecommunications (DoT) is responsible for spectrum management at the national level.

About The internet of things (IoT)

- The internet of things (IoT) is the network of physical devices, vehicles, buildings and other items-embedded with electronics, software, sensors, and network connectivity that enable these objects to collect and exchange data.
- Thus IoT creates opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency, accuracy and economic benefits
- IoT is one of the platforms of today's Smart City, and Smart Energy Management Systems. It can also be used to improve crop yield to help feed the world's growing population.

About Array of Things (AoT):

- It's an urban sensing project, a network of interactive, modular sensor boxes that will be installed around city to collect real-time data on the city's environment, infrastructure, and activity for research and public use.
- It is expected to provide localised information to the authorities enabling them to act quickly in emergencies and warn citizens of environmental threats.

VoLTE (Voice over Long Term Evolution)

- It is an Internet Protocol Multimedia Subsystem (IMS) specification which enables a variety of services to operate seamlessly on the network rather than having to switch to different applications for voice or video.
- Volte offer high definition (HD) quality voice calls, lesser call drops and calls get connected significantly faster, in comparison with standard voice calls over 3G and 2G networks.

5.7.3. FREE SPACE OPTICAL COMMUNICATION

Why in news?

- X Development LLC, a subsidiary of Google's parent company Alphabet will supply and deploy two thousand cutting-edge **Free Space Optical Communication (FSOC) links** for Andhra Pradesh (AP) fiber-grid.
- AP Fibre Grid project is aimed to establish a highly scalable network infrastructure, accessible on a nondiscriminatory basis, to provide on demand, affordable and end-to-end broadband connectivity for all households, institutions & Offices. It is being implemented by Andhra Pradesh State Fibernet Limited

X is a research and development facility founded by Google in January 2010.

It has been working on several projects including driver-less car, product delivery through flying vehicles, Project Loon, Google glass **among** other technologies.

What is Free Space Optical Communication?

- It is an optical communication technology in which data is transmitted by propagation of light in free space allowing optical connectivity.
- Working of FSO is similar to OFC (optical fiber cable) networks but the only difference is that the optical beams are sent through free air or vaccum instead of glass fiber.
- It is a **Line of Sight (LOS) technology**. It consists of an optical transceiver at both ends to provide full duplex (bidirectional) capability.
- It is capable of sending up to 1.25 Gbps of data, voice, and video communications simultaneously through the air.
- **Advantages: low initial investment,** flexible network that delivers **better speed** than broadband, security due to line of sight operation etc.
- **Challenges:** misalignment errors, geometric losses, background noise, weather attenuation losses and atmospheric turbulence.

Light-fidelity (LiFi)

- It is a **high speed wireless communications** through light emitting diodes (LEDs).
- It uses both **visible and near-visible** light for **free-space communication**.
- LiFi is **not strictly a line-of-sight technology** i.e. data rate is not dependent on the line of sight but on the signal quality at the device.

Parameters	Light Fidelity	Wireless Fidelity
Speed for data transfer	>1 Gbps	Upto 15 Mbps
Carrier	Light as a carrier	Use Radio spectrum
Cost	Cheaper than WiFi	Expensive due to radio spectrum

Operating Frequency	Hundred to Tera Hz	2.4 GHz
Coverage	About 10 metre	About 32 metre

5.7.4. RFID

Why in news?

Recently National Highways Authority of India launched two mobile apps **MyFASTag and FASTag Partner** to facilitate Electronic Toll Collection. 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 short-range 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. This code can be read by the camera of a smartphone.
  - 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 (omni-directional), 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 without wires.
  - 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.

5.7.5. TARANG SANCHAR PORTAL

Why in News?

- The Telecom Department launched a portal – Tarang Sanchar Portal that will allow people to track radiation emitted from mobile towers within a locality.
- The portal will empower consumers to know about the towers working in a particular area and whether they are compliant to the Electromagnetic field (EMF) emission norms defined by the government.
- In general, mobile tower emissions rules in India are ten times more stringent than the global norms

About radiation

Energy emitted from a source is generally referred to as radiation. There are two types of radiation:

- **Ionizing radiation** is radiation with enough energy to cause chemical changes by breaking chemical bonds. This ionization process results in the formation of two charged particles or ions: the molecule with a net positive charge, and the free electron with a negative charge. This effect can cause damage to living tissue.

- Examples include heat or light from the sun, microwaves from an oven, X rays from an X-ray tube, and gamma rays from radioactive elements

- **Non-ionizing radiation** is the term given to radiation in the part of the electromagnetic spectrum where there is insufficient energy to cause ionization but may have enough energy to excite molecules and atoms causing then to vibrate faster.
  - **Example:** It includes electric and magnetic fields, radio waves, microwaves, infrared, ultraviolet, and visible radiation.

Application of Radiation

- **Medical Application**: X-Ray, CT, and PET machines use X-ray (X-ray and CT) and Gamma radiation (PET) to produce detailed images of the human body,
- **Industrial Application**: to examine welds for defects or irregularities, or examining other materials to locate structural anomalies or internal components.
- **Food irradiation** is the process of using radioactive sources to sterilize foodstuffs.
- **As a disinfectant**: Ultraviolet light is used to disinfect drinking water in some homes.
- **Pollution Abatement**: Radiation is used to help remove toxic pollutants, such as exhaust gases from coal-fired power stations and industry. For example, electron beam radiation.

5.7.6. TRAI FAVOURS NET NEUTRALITY

Why in news?

- Recently, Telecom Regulatory Authority of India (TRAI) has favoured net neutrality.
- Also, Washington has become first state recently to enact its own net-neutrality rules

Net Neutrality

- Net Neutrality or Network neutrality is the idea that Internet service providers (ISPs) should treat all data that travels over their networks fairly, without improper discrimination in favour of particular apps, sites or services.

Background

- The debate on net neutrality in India started from Facebook launching **Free Basics** and Airtel launching **Airtel Zero**.
- These were opposed by IT industry body **Nasscom** as it violated net neutrality principles by differentiating internet access for certain types of services.

Recommendation

- **Non-Discriminatory treatment:** irrespective of sender, receiver protocols used etc.
- **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
- **Reasonable traffic Management practices:** by framing appropriate regulations time to time.
- **Regulatory Body:** TRAI suggested DoT may establish a multi-stakeholder body with framework for collaborative mechanism among the stakeholders for monitoring the net-neutrality.

VoIP

Voice over Internet Protocol (VoIP), is a technology that allows you to make voice calls using a broadband Internet connection instead of a regular (or analog) phone line.

CDN platform

CDN is a system of servers, deployed at the edge of (or within) the terminating network of an access provider, that content provider can use to distribute their content.

5.8. NATION-WIDE HACKATHON #OPENGOVDATAHACK LAUNCHED

Why in news?

Recently, **Ministry for Electronics & Information Technology** launched nation-wide hackathon #OpenGovDataHack with an aim to support and showcase great ideas or talent and enable them to develop apps or infographics by use of Open Government Data.

Background

- **#OpenGovDataHack** is an on-site 24Hrs Challenge which will be held at 7 centres. The participating teams will be required to submit the App prototype and info-graphics, out of

these selected apps will be taken up for further development and the winner will be awarded. The theme of the Hackathon was **"Drinking Water & Sanitation, Transport, Education, Crime and Health"**.

Open Government Data (OGD) Platform

- OGD has been set up by the **National Informatics Centre (NIC)** in accordance with **National Data Sharing and Accessibility Policy (NDSAP) 2012.**

National Data Sharing and Access Policy, 2012

- The Policy aims to provide an enabling provision and platform for providing proactive and open access to the data generated through public funds available with various departments of Government.
- The policy also facilitates the access to Government shareable data readable and machine readable form though an all India network within the framework of various policies, acts and rules.
- The principle of data sharing and accessibility is based on openness, flexibility, transparency, quality, security and machine-readability.

- It is a platform which provides
  - single point access to open data sets, it also provides web based workflows to departments so that they can publish their datasets through a predefined metadata.
  - better visualization tools, better user experience and efficient discoverability of resources.
  - Community participation through blogs, info-graphics, visualizations, mobile and web apps etc.
- OGD platform is currently being supplemented by various sectors such as health and family welfare, home affairs, agriculture, rajya sabha, statistics and programme etc.

5.9. CYBER ISSUES

5.9.1. NIC-CERT

Why in news?

Government inaugurated the new body **National Information Centre-Computer Emergency Response Team (NIC-CERT)** to prevent and predict cyber-attacks on government utilities.

About National Information Centre

- It **comes under Ministry of Electronics and IT (MeitY)** and has a **key role** in e-governance at the national, state and district levels. Almost all Indian-government websites are developed and managed by NIC

Background

- In May 2017, a **ransomware called Wannacry**, infected more than 100,000 computers all over the world.
- Indian **Computer Emergency Response Team (CERT-In**) in June, 2017 issued an advisory about **Petya or Petrwrap,** in the series of ransomware attacks affecting computer systems across the world whose spreading mechanism were similar to attack such as EternalBlue, Psexec, Windows Management Instrumentation.

Effect on India

Government steps to tackle cybercrime

Setting up NIC-CERT

- **NIC-CERT** is a **dedicated body** to detect, prevent and mitigate the impact of cyber-attacks, by monitoring data across the NIC platform, including communication between all the levels of government and between governments to citizens.
- It will help in **real time data monitoring** and operate in close coordination and collaboration with sectoral CERTs and CERT-IN.
- **Securing Digital India Initiative**: NIC-CERT will help in securing digital initiative of government by preventing the threats and vulnerabilities arising due to cyberspace.

- **Malware:** Malware is short for malicious software, meaning software that can be used to compromise computer functions, steal data, bypass access controls, or otherwise cause harm to the host computer. Malware is a broad term that refers to a variety of malicious programs.
- **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.

Two recent initiatives

Cyber Surakshit Bharat Initiative

- It has been launched by **Ministry of Electronics and Information Technology** (MeitY), in association with **National e-Governance Division** (NeGD) and **industry partners**, to strengthen Cybersecurity ecosystem in India.
- It is first public-private partnership of its kind and will leverage the expertise of the IT industry in cybersecurity.
- The founding partners include leading IT companies such as Microsoft, Intel, WIPRO. Its knowledge partners include Cert-In, NIC, NASSCOM and consultancy firms Deloitte and EY.
- It will be operated on three principles of Awareness, Education and Enablement.
- It aims to spread awareness about cybercrime and build capacity of Chief Information Security Officers (CISOs) and frontline IT staff across all government departments.

Global Centre For Cybersecurity

- It has been launched by the World Economic Forum (WEF) with headquarter in Geneva.
- It will function as an autonomous organization under WEF. It will serve as laboratory and early-warning think tank for future cybersecurity scenarios and help to build a safe and secure global cyberspace.
- Its aim is to establish first global platform for governments, businesses, experts and law enforcement agencies to collaborate on cybersecurity challenges and work towards an appropriate and agile regulatory framework on cybersecurity.

Global Conference on Cyber Space (GCCS)

- Theme: "Cyber4All: A Secure and Inclusive Cyberspace for Sustainable Development".
- **Aim**: to establish internationally agreed 'rules of the road' for behavior in cyberspace, and create a more focused and inclusive dialogue between all those with a stake in the internet on how to implement them.
- It has set up an institutional mechanism – Global Forum on Cyber Expertise – to enhance capacity building, share best practices and expertise on cyber capacity.

Section 69B of IT Act, 2000, talks about the power to authorize to monitor and collect traffic data or information through any computer resource for Cyber Security.

5.9.2. BUDAPEST CONVENTION

Why in news?

Ministry of home affairs recently called for signing of the **Budapest Convention on cybercrime** owing to the surge in cyber-crime**.**

About Budapest convention on cybercrime

- This convention of the council of Europe is the only binding international instrument on this issue.
- It is the first international treaty on crimes committed via the Internet and other computer networks and deals with issues such as infringements of copyright, computer-related fraud, child pornography and violations of network security.
- It aims to pursue a common criminal policy, especially by adopting appropriate legislation and fostering international police as well as judicial co-operation.
- It provides for procedural law tools to make investigation of cybercrime and securing of e-evidence in relation to any crime more effective
- The Convention has 56 members, including the US and the UK.

Steps taken by Government

- **Information Technology Act, 2000(amended in 2008)** provides a legal framework for transactions carried out by means of electronic data interchange and other means of electronic communication.
- **Indian Computer Emergency Response Team (CERT-in)**: established to enhance the security of India's Communications and

Information Infrastructure through proactive action and effective collaboration. CERT-fin has also been launched exclusively for financial sector.

- **National Cyber Security Policy 2013**: proposes to set up different bodies to tackle various levels of threats, along with a national nodal agency, to coordinate all matters related to cyber security.
- **National Critical Information Infrastructure Protection Centre (NCIIPC)** to battle cyber security threats in strategic areas such as air control, nuclear and space. It will function under the **National Technical Research Organisation (NTRO)**
- **National cyber coordination centre (NCCC)** is being set up to scan internet traffic coming into the country and provide real time situational awareness and alert various security agencies.
- **Indian cyber-crime coordination centre (I4C) and Cyber Warrior Police force** has been established under newly created Cyber and Information Security (CIS) Division (under Ministry of Home Affairs) to tackle internet crimes such as cyber threats, child pornography and online stalking.
- **Digital Army Programme:** a dedicated cloud to digitize and automate processes, procedures and services for the Indian Army, launched as a part of Digital India. This is similar to **Meghraj,** the national cloud initiative.

5.9.3. DIGITAL POLICE PORTAL UNDER CCTNS

Why in news?

Recently Home Minister launched a digital police portal under the CCTNS project.

More on news

- CCTNS has originally aimed at maintenance of crime and criminal records of individuals through a national database, and delivery of web based police related services to all citizens.
- Digital Police portal is a **SMART** policing initiative of government with aim to provide **Services to Citizens** at a National level
  - Report a Crime
  - Request for person verification
  - Links to State Citizen Portal
- The access has been restricted only to authorized officials to protect Privacy of individual and concerns of National security.
- The portal also generates various **thematic reports of trends of incidence of crime** across the country to facilitate policy analysis and undertaking targeted interventions.

Crime and Criminal Tracking Network and Systems (CCTNS)

It is a project of MHA launched in 2009 which aims to:

- Provide Citizen Centric Police Services via a web portal.
- Pan India search on National database of Crime & Criminal records.
- Crime and Criminal reports at State and Centre.
- Computerization of Police Processes.

Inter-operable Criminal Justice System (ICJS)

- It is a component of CCTNS
- ICJS aims to integrate the CCTNS project with the **e-courts and e-prisons databases** initially and later to all components of criminal justice system.

5.9.4. CYBER-SECURITY INDEX

Why in news?

- India is ranked a high 23rd out of 165 nations in **The Global Cybersecurity Index (GCI).**

Background

- The second Global Cybersecurity Index (GCI), released by the **International Telecommunication Union (ITU),** said only about half of all countries have a cybersecurity strategy or are in the process of developing one
- The top 3 most committed countries to cybersecurity are Singapore United States and Malaysia.
- **India has been listed in the "maturing" category, which refers to 77 countries that have developed complex commitments to cybersecurity and engage in cybersecurity programmes and initiatives.**

About ITU

- ITU, based in Geneva, Switzerland, is the leading UN agency for ICT.
- As the global focal point for governments and the private sector, ITU's role in helping the world communicate spans 3 core sectors: radio communication, standardization and development.

ITU also organizes TELECOM events and was the lead organizing agency of the **World Summit on the Information Society**.

5.10. WORLD CONGRESS ON INFORMATION TECHNOLOGY (WCIT)

Why in news?

Recently World Congress on Information Technology (WCIT) 2018 or the 'Olympics of IT' was held in Hyderabad for the first time in India.

More about the news

- The theme of this edition of conference was '**Future Enterprises**.'
- WCIT is a **biennial event** and considered as the biggest event of its kind. It aims to provide single platform to IT experts, policy and decision makers and Government officials from all over the world together to discuss various challenges and and possible solutions to them.
- It is unique in its global perspective on ICT issues and its ability to draw users, providers, media and academia from around the world.
- It was first held in 1978 since then held after every two years. The 2014 WITC 2016 edition was held in Brasilia, Brazil.

6. HEALTH

6.1. VECTOR BORNE DISEASES

Define: Vector-borne diseases are human illnesses caused by parasites, viruses and bacteria that are transmitted by mosquitoes, sandflies, blackflies, ticks, tsetse flies, mites, snails and lice etc.

Example: Diseases such as malaria, dengue, Visceral leishmaniasis, kala-azar/ Dumdum Fever), yellow fever, Japanese encephalitis, Chikungunya, Zika etc.

National Vector Borne Disease Control Programme (NVBDCP)

- It is an umbrella programme for prevention and control of vector borne diseases and is subsumed under National Health Mission.
- Directorate of NVBDCP is the central nodal agency for the prevention and control of vector borne diseases
- Vector borne diseases that are being targeted: Malaria, Dengue, Lymphatic Filariasis, Kala Azar, Japanese Encephalitis, chikungunya

Directorate of National Vector Borne Diseases Control Programme

- It'is the central nodal agency for the prevention and control of vector borne diseases i.e. Malaria, Dengue, Lymphatic Filariasis, Kala-azar, Japanese Encephalitis and Chikungunya in India
- It is under the aegis of **Union Ministry of Health and Family Welfare.**
- **Function**: National level Technical Nodal office for framing technical guidelines & policies as to guide the states for implementation of Programme strategies.

6.1.1. INDIA AND ZIKA VIRUS

Why in news?

Recently the United States sent out an advisory informing its citizens in India about the number of confirmed Zika infections in India.

Background

- The WHO has placed India as a '**Category-2' country** for Zika risk.
- A Category-2, the second highest on a four-point scale and that also includes 2015 Zika-hotspot Brazil, indicates that the virus is being actively transmitted within the country.
- Until April, India was a Category-4 country.

About zika virus

- Zika virus disease is caused by a virus transmitted primarily by **Aedes mosquitoes**. Aedes aegypti is a known vector of several other viruses including yellow fever virus, dengue virus and chikungunya virus.
- Zika can be passed through sex from a person with Zika to his or her partners.
- People with Zika virus disease can have symptoms including mild fever, skin rash, conjunctivitis, muscle and joint pain, malaise or headache. These symptoms normally last for 2-7 days.
- There is scientific consensus that Zika virus is a cause of microcephaly and Guillain-Barré syndrome.
- An additional area of concern is the difference between Zika on the one hand and dengue or chikungunya on the other. While the latter conditions occur soon after a mosquito bite, the presence of the Zika virus will be known six months later, after the birth of microcephalic infants.

- **US scientists have developed a plant-based Zika vaccine** that could be more potent, safer and cheaper to produce than other medicines being developed for the disease.
- It is developed using **tobacco plant** and targets a key protein called DIII, which envelopes the outside of the Zika virus and plays a key role for the virus to infect people.

6.1.2. MONKEY FEVER

Why in news?

Scientists have traced the source of a re-emerging disease, **Kyasanur Forest Disease (KFD)** or **"monkey fever",** to cashew plantations in Goa.

Monkey Fever Symptoms

- High fever with headache, followed by haemorrhagic symptoms such as bleeding from the nose, throat and gums
- Gastrointestinal bleeding,
- Muscle stiffness, tremors, absent reflexes and
- Mental disturbances.

What is monkey fever?

- It is caused by **Kyasanur forest disease virus (KFDV),** a member of the virus family Flaviviridae, which also causes yellow fever and dengue.
- It was first detected in 1957 in Shimoga, Karnataka and is **endemic to South Asia**.

- Monkey fever is so named because it primarily affects black-faced langurs and red-faced bonnet monkeys and result in death. Even when the monkey dies still the KFD virus gets transmitted through ticks thriving on monkeys.
- The **Hard ticks** (Hemaphysalis spinigera) are the reservoir of KFDV. These ticks are known to thrive in the **Western Ghats and transmit the disease to humans**.

6.1.3. ELEPHANTIASIS

Why in news?

Recently, it was speculated that Government will miss out the set deadline to eliminate Elephantiasis.

Elephantiasis or Lymphatic Filariasis

- It is a **parasitic disease** caused by the parasitic worms called **filial worms** which is spread by the bite of the infected black flies and mosquitoes.
- The disease parasite is usually acquired during childhood. The larvae in the human can live in human beings for up-to 5-8 years without showing any symptoms; however the lymphatic system is damaged.
- Elephantiasis leads to **severe swelling** in arms, legs, knees and genitals causes **disfigurement and disability.**

Burden of Disease

- India alone accounts for 40% of world's disease burden with over 31 million microfilaraemics, 23 million cases of symptomatic filariasis, and about 500 million individuals at risk of contracting the disease.
- India had set the ambitious target to eradicate the disease by 2020 which was earlier set at 2015 under the National Health Policy 2002.

Efforts to eradicate the Disease in India

- In 1995, government launched **National Filaria Control Program**
- In India, since 2004, Mass Drug Administration (MDA) is being carried on as a part of the **Hathipaon Mukt Bharat (Filaria Free India) programme** for preventive medication.

6.1.4. KALA AZAR

Why in news?

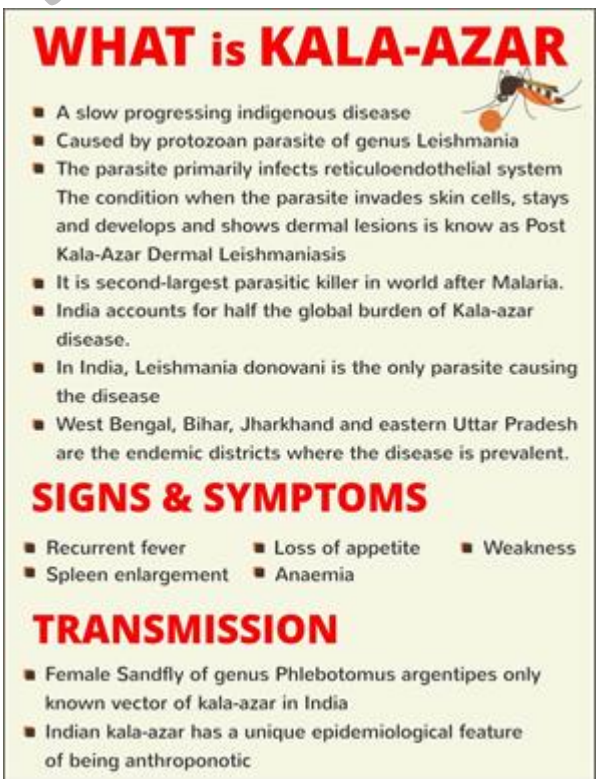
India has missed the deadline (December 2017) of eliminating **Kala Azar (Visceral leishmaniasis or Black fever or Dum Dum fever).**

Background

- In 2017 budget speech, the Finance Minister had announced for elimination (reducing to less than one case in 10,000) of Kala Azar by 2017. It was also reiterated by the National health policy 2017.
- In 2014, the government launched the **Kala Azar Elimination Programme** with support from various international agencies.
- However, endemic blocks have increased from 61 to 68 in 17 districts of Bihar and Jharkhand.

Ancient remedy for Kala Azar

- Scientists from Indian Institute of Chemical Biology in Kolkata tested ancient remedy described in **Charaka Samhita** to fight drug-resistant kala-azar.
- The compound called **mahanine** was isolated from leaves of curry plant commonly used in Indian kitchens has been found to inhibit the growth of kala-azar parasite.



6.1.5. JAPANESE ENCEPHALITIS (JE)

Why in news

In August 2017, around 30 children affected by JE admitted at Gorakhpur's BRD Medical College had died over shortage of oxygen supply.

Encephalitis: It is a non-communicable disease that results in inflammation of the brain. The patient's central nervous system is affected. It can be caused due to bacterial or viral infections of the brain, injection of toxic substances or increased complications of an infectious disease.

- It's transmitted by the infective bite of the Culex species of mosquitoes
- It belong to the same genus as dengue, yellow and West Nile viruses
- Japanese Encephalitis is covered under Universal Immunisation Programme (UIP).

Acute Encephalitis Syndrome (AES) including Japanese Encephalitis (JE) is a group of clinically similar neurologic manifestation caused by several different viruses, bacteria, fungus, parasites, spirochetes, chemical/ toxins etc

- It is characterized by an acute onset of fever and clinical neurological manifestation that includes mental confusion, disorientation, delirium, or coma.

JENVAC: It's first indigenous vaccine to protect children from Japanese encephalitis. It's also the first vaccine to be manufactured in the public-private partnership mode between the Indian Council of Medical Research and Bharat Biotech.

6.2. NEGLECTED TROPICAL DISEASES

Why in news

WHO (World Health Organisation) in it's report on neglected tropical disease (NTD) applauded the progress made on elimination of NTD.

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).

National Programmes in relation to tropical diseases are being implemented:

- **National Vector Borne Disease Control Programme (NVBDCP):** For control of Dengue and elimination of Kala-azar and Lymphatic Filariasis.
- **National Leprosy Eradication Programme**: India has achieved the elimination of leprosy at national level in December 2005. Focus is now to achieve elimination of leprosy at district level.
- **National Programme for Control of Blindness**: Services are provided for the control of Trachoma.
- **School Health Programme:** services are provided for the prevention of Soil-transmitted Helminthiases.
- **National Deworming Day (February 10):** Children between ages 1 to 19 through schools and anganwadi centres were dewormed in order to improve their nutritional status and well-being
- **WASH strategy**: It's a critical component of prevention and care for all NTDs. Provision of safe water, sanitation and hygiene is one of the five key interventions in the **global NTD road map**.

- **WHO NTD roadmap: It** outlined bold targets for the control, elimination or eradication of 17 NTDs by 2020
- **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).

6.2.1. NATIONAL DEWORMING MISSION

Why in news?

Recently government celebrated the National Deworming Day.

About National Deworming Day

- It was started in 2015 as a part of the National Health Mission, implemented in 11 States/UTs across all Government and Government-aided schools and Anganwadi centres.
- It entails single fixed day approach to **treat intestinal worms** in all the children from 1 to 19 years on **February 10 and August 10** each year.
- Along with administering **Albendazole tablets**, some other activities are also performed such as **behaviour change practices**, cleanliness and hygiene guide, use of toilets, wearing shoes or slipper, washing hands before eating food and after using toilet, etc. in order to reduce the incidents of re-infection.

Soil Transmitted Helminth (STH) infection

- It is caused by different species of parasitic worms which can live and replicate in the gastrointestinal system.
- The STHs (hookworms, roundworms, whipworms) are transmitted by eggs present in human faeces, which contaminate the soil in areas where sanitation is poor.
- Infected children are nutritionally and physically impaired. While deworming has been shown to reduce absenteeism in schools; improve health, nutritional, and learning outcomes; and increase the likelihood of higher-wage jobs later in life.

6.3. POLIO VACCINE

Why in news?

- The World Health Organization has declared **Gabon a "polio-free country",** given the lack of new reported or suspected cases in the central African country.
- Now the disease is endemic only in Afghanistan and Pakistan, where the WHO recorded four cases this year—two in each country.

Polio: A fact sheet

- 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 decalred 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.

6.4. MOTHER-TO-CHILD TRANSMISSION OF HIV

What is it: HIV transmitted from a HIV positive mother to her child during pregnancy, delivery or breast feeding is called **mother-to-child transmission (MTCT).**

National Aids Control Organisation (NACO)

It is an organisation which was set up under **Ministry of Health and Family Welfare** for formulation of policies and implementation of programs for prevention and control of HIV/AIDS.

Child Friendly HIV Drug

- Recently, Central Drugs Standard Control Organisation (CDSCO) has registered the child-friendly and heat-stable oral pellet formulation of the HIV drug **lopinavir/ritonavir (LPV/r).**
- **Significance:** The lack of child-friendly HIV formulations is a major reason for a large treatment gap between adults and children. Due to this gap paediatric HIV is considered **neglected disease**. The registration of the pellets is a positive sign as the needs of children are being addressed.

About CDSCO

- It is the national regulatory body for Indian

pharmaceuticals and medical devices under **Ministry of Health and Family Welfare**.
- **Major functions include:** Regulatory control over the import of drugs, approval of new drugs and clinical trials, meetings of Drugs Consultative Committee (DCC) and Drugs Technical Advisory Board (DTAB), approval of certain licences as Central Licence

Mother-to-child-transmission

- Intervention in MTCT cases usually involves –
  - **Antiretroviral treatment** for the mother and a short course of antiretroviral drug for the baby.
  - **Counselling and psychological support** to help mothers safeguard their children against the infections.
- **Steps being taken in India:**
  - Earlier in India, **'Single dose therapy'** was being practised wherein the ART was administered 72 hrs before birth. However, in 2014 WHO recommended 'multidrug therapy' was adopted.
  - **Multidrug Therapy** is a combination of three drugs — Tenofovir, Lamivudine And Efavirenz (TLE) which the infected mother is required to take throughout their lives except nevirapine which is supposed to be taken by new born only for six weeks.
  - In 2002, **Prevention of Parent to Child Transmission of HIV/AIDS (PPTCT) program** was launched.

About HIV
- The Human Immunodeficiency Virus targets the immune system and weakens people's defence systems against infections and some types of cancer making infected individuals immunodeficient gradually.
- The most advanced stage of HIV infection is Acquired Immunodeficiency Syndrome (AIDS), which can take from 2 to 15 years to develop depending on the individual. AIDS is defined by the development of certain cancers, infections, or other severe clinical manifestations.
- It can be transmitted via the exchange of a variety of body fluids from infected individuals, such as blood, breast milk, semen and vaginal secretions.
- Individuals cannot become infected through ordinary day-to-day contact such as hugging, shaking hands, or sharing personal objects, food or water.

6.5. NOROVIRUS AT WINTER OLYMPICS

Why in news?

At the Winter Olympics in Pyeongchang, South Korea, there have been many cases of infection with Norovirus.

Details

- Norovirus is a very contagious virus. It's a common cause of gastroenteritis, or inflammation of the intestine.
- It **spreads** from an infected person mainly by direct contact (such as shaking hands), by touching an infected surface or though contaminated water and food.

6.6. BIRD FLU

Why in news?

- India has declared itself free from Bird Flu (highly pathogenic Avian Influenza - H5N1 and H5N8) and notified it to the **World Organisation for Animal Health.**
- The move will help it resume export of poultry products to the countries which had banned trade in such items early this year.

Avian Influenza

- There are **3 types of influenza viruses**: types A, B, and C. Influenza A viruses infect humans and many different animals
- Influenza type A viruses are classified into subtypes according to the combinations of different virus surface proteins **Haemagglutinin** (H) and **Neuraminidase (N).**
- Influenza A viruses can be classified as avian influenza, swine influenza, or other types of animal influenza viruses
- Examples include avian influenza "bird flu" virus subtypes such as A (H5N1) and A(H9N2).

World organization for Animal Health
- It is recognised as a reference organisation by the World Trade Organization (WTO) and in 2017 has a total of 181 Member Countries.
- It maintains permanent relations with 71 other international and regional organisations.
- Ban is lifted after 90 days of the surveillance is done by the organization.

6.7. H1N1 VIRUS (SWINE FLU)

Why in news?

- Government removed antiviral drugs- oseltamivir and zanavir - from schedule X category allowing all pharmacies to sell and stock these drugs.
- These drugs were earlier restricted as their **misuse and overuse can lead to drug resistance**.

- **Drugs and Cosmetics Rules, 1945**: Any sale of medicine in the country is regulated under this act.
- Drugs specified in Schedules H, H1 and X cannot be sold except on, and in accordance with the prescription of a Registered Medical Practitioner from a licensed premises.

About H1N1 Virus

- It is a **contagious respiratory disease** caused by Type A strains of the Swine Influenza virus.
- It enters body through **inhalation** of droplets or is transferred from a contaminated surface to eyes, nose or mouth and can spread from **human to human**.
- It is called swine flu because in the **past**, the people who caught it had **direct contact with pigs**.

6.8. TUBERCULOSIS

Why in News?

- A joint study conducted by Foundation for Innovative New Diagnostics (FIND) and Revised National TB Control Programme (RNTCP), has found that the Multi-Drug Resistant (MDR) TB is higher among children than expected.

Paediatric TB

- Paediatric MDR-TB cases **had not been documented so far**.
- Children are more prone to primary MDR –TB infection as they are in close contact with infected person.
- TB diagnosis in children is complicated due to challenges associated with sample collection and poor sensitivity of tests like the **Acid fast bacilli (AFB) smear**.
- Thus, the foundation FIND started rolling out **GeneXpert** to diagnose TB
- Government had issued a **specific guideline** for paediatric TB under **Revised National TB Control Program (RNTCP).**
- RNTCP aims at diagnosing and treating TB throughout the country. It uses **DOTS** (Directly Observed Treatment Short course) and **DOTS-plus strategy** (where there are significant cases of MDR-TB)

Recently, Moscow Declaration was also adopted in WHO Global Ministerial Conference on Ending Tuberculosis with an aim towards achieving **SDG Goal 3.3.2** to end epidemic of TB incidence per 1000 population.

Drug Resistant TB

MDR-TB

- It is TB that does not respond to at least isoniazid and rifampicin (2 of the most powerful first line drugs)
- It is developed due to
  - Inappropriate or incorrect use of antimicrobial drugs,
  - Use of ineffective formulations of drugs (such as use of single drugs, poor quality medicines or bad storage conditions)
  - Premature treatment interruption.
- Recently, Ministry of Health has approved Delamanid drug in order to combat the increasing burden of **MDR-TB**.
- Delamanid will be inducted parallel to Bedaquiline **under Revised National Tuberculosis Control Program (RNTCP)** and not replace it

XDR-TB

- It is resistant to at least four of the core anti-TB drugs such as levofloxacin or moxifloxacin, amikacin, capreomycin or kanamycin.)
- Developed due to same mechanism as MDR-TB.

TDR-TB or XXDR-TB

- TB which is resistant to all the first and second line TB drugs.
- This makes it almost but not totally impossible to treat.

GeneXpert MTB/RIF Test

- It detects the presence of **TB bacteria (Mycobacterium tuberculosis),** as well as tests for resistance and genetic mutation to the drug Rifampicin.

6.9. HOME GROWN VACCINE FOR LEPROSY: MYCOBACTERIUM INDICUS PRANII

Why in News?

- National Institute of Immunology has developed **Mycobacterium Indicus Pranii (MIP**), an indigenous vaccine for leprosy.

What is Leprosy?

- Bacterial disease caused by Mycobacterium leprae,
- 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.

Highlights

- India has been declared **Leprosy free country in 2005** because of less than one case per 10,000 population.
- MIP is now being introduced into the **National Leprosy Elimination Programme (NLEP).** It will boost the immune system against the bacterial disease.

6.10. INTENSIFIED DIARRHOEA CONTROL FORTNIGHT

Why in news?

- The Ministry of Health and Family Welfare has launched the **Intensified Diarrhea Control Fortnight (IDCF)** in order to reduce child deaths due to diarrhea.

Background

- WHO estimated diarrhea is second leading cause of death under five year age of children worldwide.
- Despite of consistent decline in Infant Mortality Rate (IMR) and Under-Five Mortality Rate (U5MR) there has been 1 lakh deaths due to diarrhoea in India.

Intensified Diarrhea Control Fortnight (IDCF)

- ASHA worker would undertake distribution of ORS packets to households with under-five children in her village.
- ORS-Zinc Corners will be set-up at health care facilities and non-health facilities such as Schools and Anganwadi centres.
- Apart from oral medicine Health ministry introduced **Rotavirus vaccine** under UIP will also help in reducing diarrhoea mortality.

What is Diarrhea?

- Can be causes by virus, bacteria and parasite.
- Diarrhea is having frequent, loose stools which causes dehydration
- Can be **spread from affected person,** contaminated food or drinking contaminated water.
- Can be prevented with safe drinking water, sanitation, breastfeeding/appropriate nutrition and hand-washing.

What is ORS (Oral Rehydration Salt Solution)?

- ORS is a glucose-electrolyte solution containing salt and sugar water.
- It can be simple, cheap and effective for **all age groups.**
- Supplemented with Zinc tablet, the duo is called **ORS Jodi.**

National Oral Rehydration Therapy (ORT) Program in 1985-86

- Improving maternal knowledge related to the use of home available fluids.
- Ensuring availability of ORS packets at health facilities.
- Integrated part of Child Survival and Safe Motherhood (CSSM) Program.

6.11. FIRST INDIA-DESIGNED VACCINE PASSED WHO TEST

Why in news?

Recently, India made **ROTAVAC vaccine** and **Typbar Typhoid Conjugate Vaccine** received WHO pre-qualification.

ROTAVAC Vacccine

- It is a low cost vaccine developed by **Bharat Biotech Limited** under an **innovative PPP model** involving Ministry of Science and Technology, institutions of the US Government and various NGOs.
- It has been included in India's **Universal Immunization Program** in 2016.

Typbar Typhoid Conjugate Vaccine

- It is the world's first typhoid vaccine, developed by Bharat Biotech limited that can be given to infants older than six months. It and confers long-term protection against typhoid fever.

Significance of Pre-Qualification

- Accelerate **availability of the vaccine** to the developing countries with highest burden of diseases
- Increases the scope for **credible industrial, scientific and regulatory processes** to develop more vaccines in the country.
- Necessary for United Nation agencies like UNICEF, the Pan American Health Organization (PAHO) and GAVI (a vaccine alliance) to purchase the vaccine in partnership with developing countries.

Rotavirus

- It is the most **common cause of diarrhoea** among infants and young children.
- It usually transmitted by **the faecal-oral route** and infects and damages the cells in **the small intestines** and **causes gastroenteritis.**

Typhoid

- It is caused by the bacteria ***Salmonella typhi***.
- The infection is often passed on through **contaminated food and drinking water**, and it is more prevalent in places where hand washing is less frequent.

6.12. NEW DEVELOPMENTS IN NON-COMMUNICABLE DISEASES

According to India State Level Disease Burden Report, over the past 26 years the pattern of diseases has shifted from communicable, maternal, neonatal, and nutritional diseases (CMNNDs) to non-communicable diseases (NCDs) and injuries.

6.12.1. INDIA HYPERTENSION MANAGEMENT INITIATIVE (IHMI)

Why in news?

Ministry of Heath and Family Welfare (MoHFW) and Indian Council of Medical Research (ICMR) launched IHMI.

More about IHMI

- **Aim:** To reduce disability and death related to cardiovascular disease (CVD), by improving the control of high blood pressure (hypertension), reducing salt consumption and eliminating artificial trans-fats, leading risk factors for CVD.
- This initiative will strengthen the cardiovascular disease component of the Health Ministry's **National Program for Control of Cancer, Diabetes, Cardiovascular Diseases and Stroke (NPCDCS)** and is aligned with **WHO's Global HEARTS Initiative** and National Guidelines.

6.12.2. JEEVAN BINDI

Why in news?

A Singapore based marketing agency and Maharashtra based NGO developed a Vermillion (Bindi) named **Jeevan-Bindi** which contains **iodine.**

Iodine

- It is a trace mineral and a nutrient found naturally in the body and can be easily fortified with salt.
- Humans need iodine for the production of thyroid hormones.
- It needed for the cells to convert food into energy.
- **Deficiency leads to** goiter, hyperthyroidism, stunted growth or intellectual disabilities.
- **Source:** seafood, daily products, and other protein food.

National Iodine Deficiency Disorders Control Programme 1992

- It aims at bring the prevalence of IDD(to below 5% in the country
- It ensures 100% consumption of adequately iodated salt (15ppm) at the household level.
- Iodate the entire edible salt in the country.

Jeevan Bindi

- It is medically enhanced version of regular bindi, embedded with iodine along with the adhesive base.
- Bindi delivers the daily requirement of iodine 100-150 adsorption through the skin.
- It needs to be worn every day for up to eight hour to be effective.
- This initiative is supplemented with iodine pills available at community health centre.
- The initiative focus pregnant women because the effects of iodine deficiency are most severe in them and reflected in new-born.

6.12.3. THALASSEMIA

Why in News?

- On World Thalassemia day (May 8) various researchers and health experts called for National Policy on Thalassemia.

What is Thalassemia?

- It is a genetic blood disorder with no cure except bone marrow transplant (BMT).
- Characterised by abnormal production of haemoglobin in the body. The abnormality results in improper oxygen transport and destruction of red blood cells.
- Lead to iron overload, bone deformities and in severe cases can cause heart diseases.
- It requires regular blood transfusions as an effective measure to prolong life.
- Thalassaemia is now considered as a disability under Rights of Persons with Disabilities Act 2016, rather than a health issue.

6.13. ANTIBIOTIC RESISTANCE: WHO REVISES ANTIBIOTICS PROTOCOL

Why in news?

WHO has revised antibiotics protocol to curb antibiotic resistance. This is the biggest revision of the antibiotics section in the essential medicines list (EML)

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.

WHO (World Health Organization)

- It is a specialised agency of UN concerned with international public health.
- It was established on 7 April 1948, headquartered in Geneva, Switzerland.
- The WHO publishes **World Health Report**.

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.

Other International Initiatives

- **'One Health' approach**: to designing and implementing programmes, policies, legislation and research in which multiple sectors communicate and work together to achieve better public health outcomes against the food safety, the control of zoonoses (diseases that can spread between animals and humans, such as flu, rabies), antimicrobial resistance etc.
- World Antibiotic Awareness Week.
- The Global Antimicrobial Resistance Surveillance System.
- Interagency Coordination Group on Antimicrobial Resistance.

Details

WHO has divided the drugs into three categories: **access, watch and reserve**.

- The **'access' category** includes commonly used antibiotics. They will be available at all times as treatment for a wide range of common infections.
- The **'watch' group** covers antibiotics that are recommended as first or second choice treatment for a small number of infections. Prescription of these drugs should be reduced to avoid further development of resistance.
- The **'reserve' category** includes antibiotics that are considered last-resort options and used only in the most severe circumstances such as for life-threatening infections due to multidrug-resistant bacteria.

Recently, Ministry of Science and Technology have released the **Scoping Report on Antimicrobial Resistance in India.**

Highlights of the report

- In 2014, India was the **highest consumer of antibiotics**, followed by China and the United States. However, the per capita consumption of antibiotics in India is much lower than in several other high income countries.
- India has **some of the highest antibiotic resistance rates among bacteria** that commonly cause infections in the community and healthcare facilities.
- It has also pointed that the **resistance to carbapenem class of antibiotic**s (one of the last-resort antibiotics to treat serious bacterial infections in humans) among various bacteria was extremely high.
- Antibiotic-resistant bacterial infections are also increasingly reported among neonates.

- **Essential medicines** are the medicines that "satisfy the priority health care needs of the population".
- These are the medications to which people should have access at all times in sufficient amounts. The prices should be at generally affordable levels.
- The **WHO** publishes **Model List of Essential Medicines** (**EML**) every two years since 1977. It is used by countries to develop their own local lists of essential medicine.

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 **Healthcare Associated Infections (HAI)**.

Hospital Acquired Infections (HAI)

- Also called **nosocomial infections,** HAI are passed onto the patients after being admitted at the hospital facility.
- **International Nosocomial Infection Control Consortium** is an international scientific organisation that works to fight against healthcare associated infections.

Implications

- Creates **additional suffering for patients** and comes at a high cost for their families.
- It **increases hospital stays and creates long-term disability**
- **Increases resistance to antimicrobials**
- Increases cost burden for healthcare systems and causes unnecessary deaths.

Causes of HAI

- **Lack of proper Equipment, Understaffing and Overcrowding, Lack of knowledge of injection and blood transfusion safety, Prolonged and inappropriate use of invasive devices and antibiotics etc.**

Recently, a Bengaluru firm received the international **CARB-X** grant to develop antibiotics to treat HAI. CARB-X a public-private international partnership to address the gap in antibiotic R&D and to improve diagnosis & treatment of drug-resistant 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.
- Recently, **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).

6.14. PLANT DISEASES

Plant disease is an impairment of the normal state of a plant that interrupts or modifies its vital functions. Types of Plant diseases.

- **Rust:** Fungal disease that attacks roses, hollyhocks, snapdragons, daylilies, beans, tomatoes and lawns.
- **Wheat blast:** Fungal disease that attacks the standing crop. Fungus responsible for the wheat blast disease is known as Magnaporthe oryzae

- **Pink Bollworm**: It is a type of insects attack on cotton which has severely impacted cotton plantations in various parts of the country.
- **Blight:** Blight is easily recognizeable by the suddent death of all plant tissue including leaves, stems and flowers. Blight is typically casued by wet and humid conditions.
- **Cotton Whitefly**: Whiteflies are sucking insects and their feeding removes nutrients from the plant
- **Chlorosis (discoloration):** Chlorosis is when a green tissue turns yellow. It has many causes including pathogens, lack of nutrients, and lack of water.
- **Leaf Spot**: Leaf spots are yellow or brown lesions (often look like burn marks) that takes place on leaves. These are caused by pathogens, fungi, pesticide damage and insect feeding.

6.15. FORTIFIED FOODS TO TACKLE MALNUTRITION

Why in news?

- Targeting children, Rajasthan, MP, Haryana and Himachal Pradesh governments have begun using fortified oil for their mid-day meal schemes.
- West Bengal and A&N Islands are distributing fortified wheat flour through the public distribution system.

- **Enrichment of food** is a process by which nutrients are added. Typically, the added nutrients were present in the food in its original form, but were removed at some point during processing.
- **Fortification of food** is the practice of deliberately increasing the content of an essential micronutrient, i.e. vitamins and minerals (such as iron, iodine, zinc) in a food, so as to improve the nutritional quality of the food supply
- **Biofortification** is the process by which the nutritional quality of food crops is improved through agronomic practices, conventional plant breeding, or modern biotechnology. It aims to increase nutrient levels in crops during plant growth rather than through manual means during processing of the crops.
- The **Food Safety and Standards Authority of India (FSSAI)** released a set of standards and a logo (+F logo) last year for all fortified packaged food.

6.16. MILK ADULTERATION

Why in news?

A recent study on milk samples in Delhi found wide adulteration.

Adulteration: Most common harmful adulterants include starch, chlorine, hydrated lime, sodium carbonate, formalin and ammonium sulphate. Milk producers use these to scrimp on milk portions and prepare "synthetic milk" by mixing urea, caustic soda, refined oil and common detergents.

Common Adulterant	Used for
Calcium Carbide and Copper Sulphate	For ripening of Fruit
Colours (Metallic- not permitted)	To enhance the appearance of Fruits & vegetable
Oxytocin (triggers early puberty among girls, male breast etc.)	Induce growth in Vegetable and animals
Saccharin	Induce sweetness in fruits
Parrafin Wax	For Shiny appearance of fruits
Metanil yelllow	For colouring yellow dal

Related facts

- **Neutralizers** are substances added to prevent curdling and increase the shelf life of milk. They could be added in the form of caustic soda, sodium bicarbonate and sodium carbonate.

7. PHARMACEUTICALS

7.1. ACTIVE PHARMACEUTICAL INGREDIENTS

Why in News?

Department of Pharmaceuticals (DoP) has sought support from other government departments to reduce India's import dependence on **Active Pharmaceutical Ingredients** (APIs).

More on news

- **Bulk drugs or APIs** are the active raw materials used in a drug that give it the therapeutic effect.
- **V.M. Katoch committee** was formed to formulate a long-term policy and strategy for promoting domestic manufacture of APIs/bulk drugs in India.
- Recently, Heavy Water Board has signed an agreement with an Indian firm for supply of Heavy Water for development of deuterium labeled compounds, NMR Solvents, d-labeled Active Pharma Ingredients (APIs).

Heavy Water Board (HWB),

- It's a constituent unit of Industries and Minerals Sector under **Department of Atomic Energy.**
- It is primarily responsible for production of Heavy Water (Deuterium Oxide-D2O) which is used as a 'moderator' and 'Coolant' in the nuclear power as well as research reactors.

What is Heavy Water?

- It is a form of water in which the hydrogen in the molecules is partly or wholly replaced by the isotope deuterium.
- Heavy water may be deuterium oxide, D_2O or it may be deuterium protium oxide, DHO.
- Heavy water occurs naturally, although it is much less common than regular water.
- **Non-nuclear uses**: Preservation of Oral Polio Vaccines, for enhancement of biological efficacy, for enhancing life of lubricants, improving mechanical and chemical properties of polymer etc.

Difference with normal water:

- High boiling and freezing point
- More density
- High temperature to achieve maximum density
- High pH i.e. more basic in nature

7.2. PRICE CAP ON KNEE IMPLANTS

Why in News?

- Recently, NPPA **capped the prices of knee implants**, in a move to reduce product prices by as much as 69%.

More on news

- The **central drug regulator** has requested the Union Ministry of Health and Family Welfare **to set up a committee** to work out ways to bring heart valves, orthopaedic implants and intra ocular (eye) lenses under the National List of Essential Medicines (NLEM).
- In response, US firms have approached the United States Trade Representative (USTR) against the price capping with a request to either suspend or withdraw India's benefits under Generalised System of Preferences (GSP).
    - GSP is a preferential tariff system extended by developed countries to developing countries involving reduced MFN tariffs or duty free entry of exported products of beneficiary country into the donor country.
    - MFN status is given by one country to another country with which it is interested in increasing trade. This status gives specific trade advantages such as reduced tariffs. However according to WTO MFN principle, if one country is granted a special favour, the same has to be done for all other WTO members.

National List of Essential Medicines (NLEM)

- **NLEM 2015** contains 376 medicines.
- Criteria for inclusion into this list includes public health emergency, cost effective medicine etc.
- Core Committee formed by the **Ministry of Health,** reviews and revises the medicines in the NLEM
- Once a drug or medical device is included in NLEM, its price can be capped by NPPA

National Pharmaceutical Pricing Authority [NPPA]

- It is an independent body under **Department of Pharmaceuticals** under **Ministry of Chemicals and Fertilizers**.
- Its functions are:
    - To **fix/revise** the controlled bulk drugs prices and formulations.
    - To enforce prices and availability of the

medicines under the **Drugs (Prices Control) Order, 1995/2013.**
- To recover amounts overcharged by manufacturers for the controlled drugs from the consumers.
- To **monitor** the prices of decontrolled drugs in order to keep them at reasonable levels.

7.3. DIGITAL THERAPEUTICS OR DIGICEUTICALS

Why in news?

America's Food and Drug Administration (FDA) has given its approval to some digital therapeutics.

More about Digital therapeutics

- It can broadly be defined as a treatment or therapy that utilizes digital and often Internet-based health technologies to spur changes in patient behavior to treat a medical or psychological condition. It uses methods rooted in **cognitive behavioral therapy** to spur patients to make lifestyle changes.
- It is often used as a **preventive measure** for patients who are at risk of developing more serious conditions. For instance, a patient with prediabetes may be prescribed digital therapeutics as a method to change their diet and behavior.
- It can also be used to treat patients with psychological and neurological disorders.

7.4. USE OF PET BOTTLES FOR MEDICINES

Why in news?

National Institute of Nutrition (NIN) will assess the health impact of the use of polyethylene terephthalate (PET) or plastic bottles to package medicines.

About Polyethylene terephthalate (PET)

- PET is a strong, stiff synthetic fibre and resin, and a member of the polyester family of polymers.
- It is produced by the polymerization of ethylene glycol and terephthalic acid.

Applications

- It is a major industrial polymer and is used for making disposable beverage bottles, photographic film and magnetic recording tape.
- Also made into fibre filling for insulated clothing and for furniture and pillows.
- Industrial applications of PET are automobile tire yarns, conveyor belts and drive belts, reinforcement for fire and garden hoses, seat belts, nonwoven fabrics for stabilizing drainage ditches, culverts, and railroad beds, and disposable medical garments.

National Institute of Nutrition

- The **National Institute of Nutrition** (**NIN**), established in 1918 and presently located in Hyderabad, is India's premier nutrition research institute. It is one of the oldest research centers in India under the Indian Council of Medical Research.
- **Mission:** To enable food and nutrition security conducive to good health, growth & development and increase productivity, so as to achieve the national nutrition goals as per the national nutrition policy.
- 2018 marks NIN Centenary (1918-2018) Celebrations. It is organising Conference on "Nutrition Before, Beyond and During First 1000 Days of Life – Evidence to Action"

7.5. BIOSIMILAR FOR CANCER

Why in news?

Recently, Biocon became the first Indian company to get a US Food and Drug Administration (USFDA) nod for a biosimilar drug Ogivri.

More from news

- Ogivri is a biosimilar to Herceptin, used for treatment of breast cancer or stomach cancer and second for cancer.

What are biosimilars?

- A biosimilar medicine is a biological medicine that is developed to be **highly similar and clinically equivalent** to an existing biological medicine.
- A biosimilar contains **a version of an active substance of an already approved biological medicine**, which is referred to as the 'reference medicine' or 'originator medicine'.
- They are different from generic medicines, because they contain simpler chemical structures and are identical, in terms of molecular structure, to their reference drugs.

- Development of Biosimilars is challenging as it requires high investment and much longer time as compared to generic drug manufacturing.

Biological Medicines

- Biological medicines are derived from living cells or organisms.
- These medicines are proteins, such as hormones or antibodies that the human body produces but in certain diseases, their production shuts down or weakens.
- The most important biological medicines are used to treat
  - Diabetes by substituting for the body's own insulin production
  - Various cancers, difficult skin and joint diseases, asthma etc.

7.6. NATIONAL BIOPHARMA MISSION

Recently, Innovate in India (i3) i.e. the National Biopharma Mission was launched by the government to make India a hub for design and development of novel, affordable and effective biopharmaceutical products and solutions.

About Biopharma mission

- Currently India has only 2.8% share in the global biopharmaceutical market, **the program would elevate this to 5% resulting in an additional business opportunity of 16 Billion USD.**
- The Mission to be **implemented by Biotechnology Industry Research Assistance Council (BIRAC),** a Public Sector Undertaking of Department of Biotechnology, will bring together expertise from national and international corridors to provide strategic guidance and direction to move promising solutions through the product development value chain.

8. IPR

8.1. INTERNATIONAL INTELLECTUAL PROPERTY INDEX 2018

Why in news?

Recently, Global Innovation Policy Centre (GIPC) of US Chambers of Commerce had released the International Intellectual Property Index (IIPI).

What is Intellectual Property Rights (IPR)?

- Intellectual Property refers to **creation of mind** such as inventions, literary and artistic works and symbols, names and images used in commerce.
- IPR are the rights which allow creators of patents, trademarks or copyrighted work to benefit them for their own work or investment. These rights have been outlined in **Article 27 of Universal Declaration of Human Rights**.
- 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).

National Intellectual Rights Policy

It is a vision document which aims to create and exploit synergies between all form of intellectual property, concerned statuses and agencies.

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.

CIPAM, a professional body created **under DIPP** has been entrusted with the implementation of the **National IPR Policy 2016.**

About the Index

- It is an **annual Index** which examines a country's Intellectual Property (IP) framework across eight categories of indicators – patents, copyrights, trademarks, trade secrets and market access, enforcement, commercialisation of IP assets, systemic efficiencies and ratification of international treaties.

Highlights of the IIPI 2018

- USA topped the list followed by UK and Sweden.
- India has been ranked 44 out of 50 countries up from 43 out of 45 in 5th edition.

Steps taken by Government to improve the Intellectual Property Rights ecosystem

- A comprehensive **National IPR policy** has been put in place. (please refer to the box)
- Integrated approach and synergy had been adopted through transferring various IP offices and Acts under DIPP and also merging **Copyrights Board** with **Intellectual Property Appellate Board**.
- **Cell for IPR Promotion and Management** has also been established for assisting in simplifying and streamlining of IP processes as well as creating IPR awareness, commercialization and enforcement.
- A Scheme for facilitating **Start-up Intellectual Property Protection (SIPP)** has been launched for encouraging innovation and creativity of Start-Ups.
- India has also become the 90th member of **Madrid Protocol**.

Madrid Protocol

- It is an international treaty that allows a trademark owner to seek registration in any of the countries that have joined Madrid Protocol by filing a single application.
- International Bureau of the World Intellectual Property Organisation administers the international registration system.

- The **Department of Industrial Policy and Promotion (DIPP)** has inked agreement with **Punjab State Council of Science and Technology** to establish **India's first TISC (Technology and Innovation Support Center)**.
  - TISC is WIPO's **(World Intellectual Property Organisations)** program that provides innovators in developing countries with access to locally based, high quality technology information and related services.
  - The program will help innovators **to fully exploit their creative potential and also protect their Intellectual Property Rights (IPRs).**

- **CIPAM (Cell for IPR Promotion and Management)** has been designated as the national focal point for the TISC network.

- **Scheme for IPR Awareness –Creative India; Innovative India** has been launched by CIPAM to raise IPR awareness across India
- CIPAM has also launched **IPrism**, an Intellectual Property Competition for college and university students to foster a culture of innovation and creativity.

WIPO

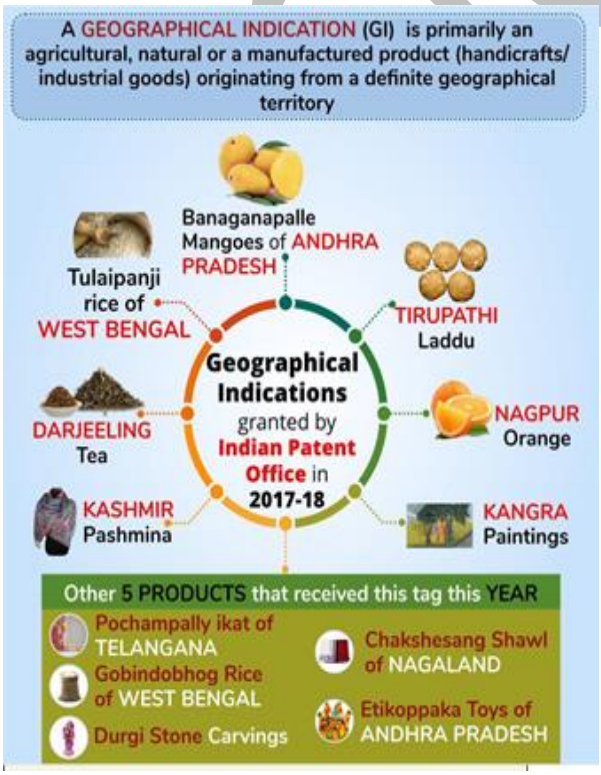
- WIPO is the global forum for intellectual property services, policy, information and cooperation.
- It a specialized a self-funding agency of the United Nations, with 189 member states.
- It was established in 1967 and is headquartered in Geneva, Switzerland.

8.2. GEOGRAPHICAL INDICATION

Why in news?

Recently, Geographical Indication (GI) registry granted GI tag to:

- Stone sculptures of Mamallapuram
- Etikoppaka toys.
- Banglar rosogulla (West Bengal).
- **Gobindobhog rice,** a speciality from Burdwan district of West Bengal.
- **Nilambur Teak:** grown in Nilambur region



- **About the Nilambur Teak**
  - It is also known as **Malabar teak** and the **Mecca of Teak.**
  - It is the **first forest produce** to get GI tag.
  - It is known for its durability, earthy colour and larger size.
  - It exhibits **high resistance to fungal decay** and shows **antioxidant properties** making it ideal for usage in construction purposes like Buckingham Palace, the Kabba building in Mecca, the Titanic etc.
  - It is also known for hydrophobicity and its oily nature.
  - Teak also has the **highest capacity for carbon sequestration** among trees in India.

About the Gobindobhog rice

- A speciality from Burdwan district of West Bengal.
- It is cultivated late and therefore not much affected by rains.
- It is less prone to pests as well.
- The productivity per area is high and farmers get better prices for of this variety.

GI Tag for other Rice variety in India:

- **Kalanamak Rice:** Uttar Pradesh
- **Basmati rice**: Punjab, Haryana, Himachal Pradesh and Uttarakhand and parts of Uttar Pradesh and Jammu & Kashmir
- **Ambemohar Rice:** Maharashtra
- **Palakkadan Matta Rice, Navara rice, Pokkali Rice, Wayanad Jeerakasala Rice, Wayanad Gandhakasala Rice, Kaipad Rice**: Kerala

Other GI product from WEST Bengal

Darjeeling Tea, Santiniketan Leather Goods, Laxman Bhog Mango, Fazli Mango, Himsagar (Khirsapati Mango), Santipore Saree, Baluchari Saree, Dhaniakhali Saree, Joynagarer Moa, Bardhman Sitabhog and Bardhman Mihidana.

Geographical Indications of Goods (Registration and Protection) Act, 1999

- As a member of the World Trade Organization (WTO), India enacted the Act to comply with the Agreement on Trade-Related Aspects of Intellectual Property Rights **(TRIPS).**
- **GI is covered as element** of intellectual property rights (IPRs) under **Paris Convention for Protection of Industrial Property.**
- The Act is administered by the **Controller General of Patents, Designs and Trade Mark**s, who is also the Registrar of Geographical Indications.

How are GI protected

- **Sui Generis Systems** (i.e. special regimes of protection)
- Using Collective Or Certification; and

- Methods focusing on business practices, including administrative product approval schemes.

What is GI tag?

- It is an indication that is definite to a **specific geographical territory.** It is used for agricultural, natural and manufactured goods having special quality and established reputation.
- For a product to get the tag, it needs to be produced or processed or prepared in that region.
- The registration of a GI **is valid for 10 years** after which it needs to be renewed.
- GIs **support local production** and are an important economic tool for the uplift of rural and tribal communities.
- GI is a **collective right.** Producers can use the collective GI mark to commercially exploit the products.
- Geographical Indicators in India are governed by "The Geographical Indications of Goods (Registration & Protection) Act, 1999".

Types of IPR (apart from Geographical Indications)

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.

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.
- Copyrights in India are governed by "The Copyright Act, 1957".

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: Stone sculptures of Mamallapuram, and pur Etikoppaka toys are covered in culture booklet

9. ALTERNATIVE ENERGY

9.1. SOLAR TECHNOLOGY

Why in news?

Recently, world's largest solar park of 2,000 MW, named as **'Shakti Sthala'** set up at Pavagada in Tumakuru district, Karnataka.

Solar Park scheme

- Launched by Ministry of New and renewable Energy (MNRE) and implemented by Solar Energy Corporation (SECI).
- **Objective**: To create at least 50 solar parts with a capacity of 500 MW and above by 2019-20.
- **Solar Park:** It's a concentrated zone of development of solar power generation projects and provides developers an area that is well constructed, with proper infrastructure, access to amenities and by minimizing paper works for project implementation.

Solar Energy Corporation of India ltd" (SECI)

- It's a **CPSU** under the administrative control of the MNRE,
- **Objective:** It's responsible for implementation of a number of schemes of MNRE, major ones being the VGF schemes for large-scale grid-connected projects under JNNSM, solar park scheme and grid-connected solar rooftop scheme etc
- It is the only CPSU dedicated to the solar energy sector.

Sunrush: It's a 25-year period (1992-2017) in which solar power has grown exponentially, transforming the technology from rarefied oddity to the world's fastest-growing energy source.

Solar technology

- Solar energy is the cleanest, most abundant renewable energy source available.
- Three primary technologies by which solar energy is commonly harnessed by:
  - **Photovoltaics (PV):** It directly convert sunlight to electricity.
  - **Concentrating Solar Power (CSP)**: It uses heat from the sun (thermal energy) to drive utility-scale, electric turbines.

About Solar Cells/Photovoltaic (PV) Cells: PV gets its name from the process of converting light (photons) to electricity (voltage), which is called the PV effect.

- **How it works:** When sunlight strikes the PV module, made of a semiconductor material, electrons are stripped from their atomic bonds. This flow of electrons produces an electric current. Types of solar cell
  - **First Generation solar cells** are made from silicon, are usually flat-plate.
  - **Second-generation solar cells** are called thin-film solar cells because they are made from amorphous silicon or nonsilicon materials such as cadmium telluride.
  - **Third-generation solar cells:** They are made from a variety of new materials besides silicon, including solar inks using conventional printing press technologies, solar dyes, and conductive plastics.

Perovskite Solar Cells

- **What is Perovskite**: A perovskite is a material that has the same crystal structure as the mineral calcium titanium oxide (also known as Perovskite).
- **Perovskite Solar Cell** is one that includes a perovskite-structured compound, most commonly a hybrid organic-inorganic lead or tin halide-based material, as the light-harvesting active layer.
- Perovskite captures energy from a different part of sunlight's wavelength than silicon.
- Perovskite solar cells in last few years have outpaced all other third-generation solar technologies in terms of efficiency and cost.

9.2. INDIA'S THREE-STAGE NUCLEAR POWER PROGRAMME

It was formulated by Dr. Homi Bhabha in the 1950s to secure the country's long term energy independence, through the use of uranium and thorium reserves found in the monazite sands of coastal regions of South India.

Objective: To utilize the known resources of thorium reserve found in India (India has 25% of world thorium reserves but only 1-2% global uranium reserve), to provide safe and reliable electric power for the country's social and economic progress and to be self-reliant in all aspects of nuclear technology.

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 II – 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**.

STAGE III – 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.
- According to the three-stage programme, Indian nuclear energy could grow to about 10 GW through PHWRs fueled by domestic uranium, and the growth above that would have to come from FBRs till about 50GW.

About Atomic Energy Regulatory Board (AERB)

- Atomic Energy Regulatory Board is a **statutory body** created by the President under Atomic Energy Act, 1962 to carry out the regulatory and safety functions under the Act.
- It derives its regulatory powers from the rules and notifications promulgated under the Atomic Energy Act, 1962 and the Environmental (Protection) Act, 1986.

	BWR	PWR	PHWR	FBR
Purpose	Electricity	Electricity, nuclear powered ships	Electricity, plutonium production	Electricity, plutonium production
Coolant	Water	water	Heavy water (D_2O)	Molten, liquid sodium
Moderator	Water	water	Heavy water (D_2O)	Not required
Fuel	Uranium dioxide	Uranium dioxide (UO2)	UO2 or metal	Plutonium dioxide and UO2 in different combinations
Enrichment level	Low-enriched	Low-enriched	Not-enriched	Various mixtures of P-239 and U-235

BWR – boiling water reactor // PWR – pressurized water reactor.

9.3. COLD FUSION

Cold Fusion

- Cold fusion describes a form of energy generated when hydrogen interacts with various metals like nickel and palladium. Excess heat is generated by the interaction that can be used to turn the turbine.
- Cold fusion seeks to produce nuclear energy without harmful radiation, complex equipment and the application of very high temperatures and pressures.
- The major challenge is to control the reaction.

9.4. GRAPHENE BASED BATTERY

Why in news

Recently, Scientists have developed a new graphene-based battery material with charging speed five times faster than lithium-ion batteries.

About Graphene

- Graphene form of carbon consists of **planar sheets (2D structure)** which are one atom thick, with the atoms arranged in a **hexagonal lattice** (honeycomb-shaped lattice).
- Very good conductor of electricity and heat
- About 200 times stronger than steel and nearly transparent.
- Impermeable to gases
- **Applications**: It can be used as/in Paints and coatings, lubricants, oils and functional fluids, capacitors and batteries, thermal management applications, display materials and packaging, solar cells, inks and 3D-printers' materials and films etc.

Types of Batteries

Alkaline batteries

- They are non-rechargeable, high energy density, batteries that have a long life span.
- Electrolyte used in it is alkaline (non-acidic).
- Generally, it has zinc as anode and a carbon rod/manganese dioxide as cathode with potassium hydroxide as the electrolyte. This is similar to dry cell where only electrolyte is different, i.e., ammonium chloride.

Non-alkaline batteries: They are similar to alkaline batteries except the electrolyte used is acidic in nature, generally a mixture of ammonium chloride and zinc chloride.

- In lead acid battery, the reaction of lead and lead oxide with the sulfuric acid electrolyte produces a voltage

Fuel cell

- A fuel cell uses the chemical energy of hydrogen or another fuel to cleanly and efficiently produce electricity. If hydrogen is the fuel, electricity, water, and heat are the only products.
- Fuel cells work like batteries, but they do not run down or need recharging. They produce electricity and heat as long as fuel is supplied.
- Fuel-cell vehicles use a completely different propulsion system from conventional vehicles that can be two or three times more efficient
- Hydrogen as a pure gas is not easily available. Thus, making it very costly source of energy.

9.5. LITHIUM-ION BATTERY

Why in news?

- Recently, ISRO has approved commercial use of lithium-ion battery technology.

Advantages of lithium-ion batteries over lead acid batteries

- **Weight**: Lithium-ion batteries are one-third the weight of lead acid batteries.
- **Efficiency**: Lithium-ion batteries are nearly 100% efficient in both charge and discharge while the lead batteries have the 70% efficiency.
- **Discharge**: Lithium-ion batteries are discharged 100% versus less than 80% for lead acid.
- **Cycle Life**: Rechargeable lithium-ion batteries cycle 5000 times or more compared to just 400-500 cycles in lead acid.
- **Voltage**: Lithium-ion batteries maintain their voltage throughout the entire discharge cycle. Lead acid voltage drops consistently throughout the discharge cycle.
- **Cost**: Despite the higher upfront cost of lithium-ion batteries, the true cost of ownership is far less than lead acid when considering life span and performance.
- **Environmental Impact**: Lithium-ion batteries are a much cleaner technology and are safer for the environment.

Common usage of Li-ion battery: Pacemakers, digital cameras, Smartphones, Solar Power Storage, battery backup systems, Rocket launcher etc.

9.6. ARTIFICIAL LEAF

Why in news?

Scientists at CSIR have developed an **artificial leaf** that absorbs sunlight to generate hydrogen fuel from water.

CSIR

Council of Scientific and Industrial Research is India's premier national R&D organisation established in 1942.

- It operates as an **autonomous body** under Societies Registration Act 1860 and comes broadly under purview of Ministry of Science and Technology.
- **Prime Minister** of India is the chairman of CSIR.

Bionic Leaf uses solar energy to split water molecules into oxygen and hydrogen, and hydrogen-eating bacteria to produce liquid fuels from CO2.

Mechanism

- Artificial leaf is an ultra-thin wireless device that consists of semi-conductors stacked in such a manner as to simulate the natural leaf system.
- When visible light strikes the semi-conductors electrons move in single direction thus producing electric current which almost instantaneously splits water into hydrogen.
- A palm size artificial leaf can produce six litres of hydrogen fuel per hour thus making it extremely environment friendly.

9.7. SUPERCRITICAL CO2-BRAYTON CYCLE

Why in news?

Indian scientists have developed a **super critical carbon dioxide** Brayton test loop facility that would help generate clean energy from future power plants.

Brayton cycle - A thermodynamic cycle using constant pressure, heat addition and rejection to spin the blades of a turbine, which can be used to generate electricity.

Key facts

- This is India's first test-bed for next generation, efficient, compact, waterless super critical carbon dioxide **Brayton cycle** test loop for power generation.
- The term "supercritical" describes the state of carbon dioxide above its critical temperature of 31°C and critical pressure of 73 atmospheres making it twice as dense as steam.
- Today's thermal power plants use steam to carry heat away from the source and turn a turbine to generate power. However, it could generate more power if, instead of steam, **supercritical CO2 (SCO2)** is used.

10. RESEARCH AND DEVELOPMENT

10.1. INDIA'S SPENDING ON R&D

Background

As per a study of the National Science and Technology Management Information System (NSTMIS), India's gross research spending on R&D has consistently been increasing over the years.

Recently Ministry of Science & Technology announced four new schemes to promote young scientists and researchers in the country.

Teacher Associateship for Research Excellence (TARE) Scheme

- It aims to **tap the latent potential of faculty** working in state universities, colleges and private academic institutions who are well trained but have difficulty in pursuing their research due to reasons like lack of facilities, funding and guidance.
- The scheme **facilitates mobility of such faculty** members to carryout research in well-established public funded institution such as IITs, IISc, NITs, CSIR, ICAR, etc. Up to 500 TAs (Teacher Associates) will be supported under this scheme.

Overseas Visiting Doctoral Fellowship (OVDF)

- This has been instituted for enhancing the **international mobility of Indian research students** with potential to create a talented pool of globally trained manpower.
- It offers opportunities for up to 100 PhD students admitted in the Indian institutions for gaining exposure and training in overseas universities for period up to 12 months during their doctoral research.

Distinguished Investigator Award (DIA)

- This has been initiated to **recognize and reward Principal Investigators** (PIs) of Science and Engineering Research Board/Department of Science and Technology projects who have performed remarkably well.
- It is a one-time career award devised to specifically cater to the younger scientists who have not received any other prestigious awards or fellowships.

Augmenting Writing Skills for Articulating Research (AWSAR) scheme

- This has been initiated to encourage, empower and endow popular science writing through newspapers, magazines, blogs, social media, etc. by young PhD Scholars.
- The scheme aims to tap the tremendous potential in the country to popularize & communicate science and also to inculcate scientific temperament in the masses.

Details

- While India spent 0.69 per cent of its GDP on R&D in 2014-15, other major countries spent much more.
- India topped the list with regard to the government's participation in R&D but hit the bottom in terms of participation of institutions of higher education.
- The central government accounted for 45.1 per cent of total expenditure, followed by private sector industries (38.1 per cent), state governments (7.4 per cent), higher education sector (3.9 per cent) and the public sector industries (5.5 per cent).
- Women's participation in extra mural R&D projects has increased significantly from a mere 13% in 2000-01 to 29 % in 2014-15.
- The country's share in global research publications increased from 2.2 per cent in 2000 to 3.7 per cent in 2013 while the number of researchers per million population increased from 110 in 2000 to 218 in 2015.

Other scheme launched

NIDHI (National Initiative for Development and Harnessing Innovations),

- It's an umbrella program by the Department of Science & Technology (DST) for nurturing ideas and innovations (knowledge-based and technology-driven) into successful startups.
- A**im:** to provide technological solutions not only to the pressing needs of the society but also targets to create new avenues for wealth and job creation.

KIRAN (Knowledge Involvement in Research Advancement through Nurturing)

- Implemeted by Department of Science & technology
- **Aim**: To bring gender equality to the field of science and technology and build leadership positions for women
- **Objective**: To increase the number of lady researchers in the country, and to provide research grants, especially to those who are female researchers and technologists taking a break in their career due to household or domestic compulsions.

10.2. PRIME MINISTER'S RESEARCH FELLOWSHIP SCHEME

Why in news?

Cabinet recently decided to implement "Prime Minister's Fellowship Scheme".

About the Scheme

- It is a public-private partnership (PPP) between **Science & Engineering Research Board (SERB)**, which is an autonomous body under the Department of Science and Technology (DST), Government of India, and Confederation of Indian Industry (CII).
- It aims to improve the quality of research by attracting the best talents across the country and reduce brain drain.
- Under the scheme around 1000 students who have completed B.Tech or integrated M.Tech or M.sc in Science and technology streams will be offered direct admission in PhD programme in the IITs/IISc with a fixed amount of fellowship.
- Apart from this, a research grant of Rs.2 lakhs will be provided to each of the Fellows for a period of 5 years to enable them to participate in international research conferences and present research papers.

Science & Engineering Research Board

- It is a **statutory body** established through an Act of Parliament.
- Supporting basic research in emerging areas of Science & Engineering are the primary mandate of the Board.
- The Board is vested with **both financial and administrative powers** to enable quicker decisions on research issues, greatly improving thereby our responsiveness to the genuine needs of the research scientists and the S&T system.

10.3. ATL COMMUNITY DAY

Why in news?

Recently Atal Innovation Mission celebrated Community Drive Initiative as a part of ATL Community Day under aegis of NITI Aayog.

Atal Innovation Mission (AIM)

- It is government's endeavour (including **Self-employment and Talent Utilization)** to promote a **culture of innovation and entrepreneurship**.
- Its objective is to serve as a platform of world-class Innovation Hubs, Grand Challenges, Start-up businesses and other self-employment activities, particularly in technology areas.

Two core functions of AIM:

- **Entrepreneurship promotion** through Self-Employment and Talent Utilization (SETU) where innovators will be supported and mentored.
- **Innovation promotion** – to provide a platform where innovative ideas will be generated.

Atal Tinkering Lab (ATL) Community Day

- It is an initiative under which 25 young mentors will interact with over 200 children not enrolled in formal education system by conducting brief sessions.
- It is aimed at **maximising the impact of Atal Tinkering Lab** by **extending innovation to children** with a purpose to provide them with **same educational tools as the students in ATL** to enable them to **become problem solvers** and inspire **the spirit of innovation**.

Atal Tinkering Labs

- They are **dedicated innovation play workspaces** for students between class 6-12 to learn **innovation skills** and develop ideas for **stimulating innovations**.
- Atal Innovation Mission supports establishment of ATLs for realising the need to create scientific temper and cultivate the spirit of curiosity, entrepreneurship and innovation among young minds and achieve the vision of "Cultivate one Million children in India as Neoteric Innovators."
- Under ATLs children will get a chance to work with tools and equipment to understand what, how and why aspects of **STEM** (Science, Technology, Engineering and Math)
- These labs are equipped with **state of the art technology** like 3D printers, robotics, sensory technology kits, Internet of Things etc. and are **designed to spur the spark of creativity** and go **beyond regular curriculum** and **text book learning**.

Other Initiatives under ATLs

- **Unbox Tinkering –** It is a training workshop for ATL In-charge to make them understand the philosophy of the Labs and technically equip them to guide the students.
- **ATL School of the Month Challenge–** These were conducted to engage the ATLs.
- **Atal Tinkering Marathon –** They are a 2 month long events that align with national mission and focus on clean energy, health,

smart mobility, smart agriculture, waste management and water resources. The top performer in the event gets to participate at multiple external events such as World Robotics Olympiad and Maker Faire.

- **Mentor India programme:** It's a strategic nation building initiative to engage leaders who can guide and mentor schools students in over 900 Atal Tinkering Labs established by Atal Innovation Mission (AIM) in schools across India.

10.4. SCHEMES FOR BRAIN GAIN

Department of Science and Technology (DST)-

- **VAJRA (Visiting Advanced Joint Research) faculty scheme**
  - It is being implemented by **Science and Engineering Research Board** to enable NRI and overseas scientists community to participate and carry out R&D in the country.
  - International Faculty/ scientists/ technologists including Non-resident Indians (NRI) and Persons of Indian Origin (PIO) / Overseas Citizen of India (OCI) are offered **adjunct / visiting faculty positions in Indian Institutions/ Universities for a period of 1-3 months under this scheme.**
  - The faculty can also undertake the role of teaching /mentoring apart from R&D.
  - Public funded institutions and national laboratories are allowed to host the VAJRA faculty.
- **Ramanujan Fellowship Program:**
  - for Indian scientists and engineers from all over the world, especially those who wish to return to India, to take up scientific research positions at any of the scientific institutions and universities in India.
  - All areas of science are covered under this Fellowship and the Fellowship is given for 5 years duration with financial support.
  - This along with other schemes were referred by Indian delegation to the **Biotechnology Innovation Organization** (BIO) 2017 held in San Diego
- **Innovation in Science Pursuit for Inspired Research (INSPIRE) Faculty Scheme:** offers a contractual research positions to Indian citizens and people of Indian origin including NRI/PIO status with PhD (in science, engineering, pharmacy, medicine, and agriculture related subjects) from any recognized university in the world.

Department of Biotechnology (DBT)

- **Ramalingaswami Re-entry Fellowship** for Indian Nationals who are working overseas in various fields of biotechnology and life sciences and are interested in taking up scientific research positions in India.
  - It allows fellows to work in any of the scientific institutions/ universities in the country and would also be eligible for regular research grant through extramural and other research schemes of various S&T agencies of the Government of India.
- DBT also runs **Welcome Trust Fellowship Program** (Indian scientists, physicians researchers and bio-engineers), and Energy Biosciences Overseas Fellowship (scientists of Indian origin working outside India to pursue R&D in an Indian scientific institute /university in fields of energy related biological sciences and bio-energy).

Biotechnology Innovation Organization (BIO)

BIO is the world's largest trade association representing biotechnology companies, academic institutions, state biotechnology centers and related organizations across the United States and in more than 30 other nations. BIO members are involved in the research and development of innovative healthcare, agricultural, industrial and environmental biotechnology products.

The BIO International Convention, hosted by BIO since 1993, is the largest global event for the biotechnology industry and attracts the biggest names in biotech, offers key networking and partnering opportunities, and provides insights and inspiration on the major trends affecting the industry. The BIO International Convention helps BIO fulfill its mission to help grow the global biotech industry.

10.5. PT. DEEN DAYAL UPADHAYAY VIGYAN GRAM SANKUL PARIYOJANA

Why in news?

Recently, Ministry of Science and technology has launched **Pt. Deen Dayal Upadhayay Vigyan Gram Sankul Pariyojana** in Uttarakhand.

About Pt. Deen Dayal Upadhayay Vigyan Gram Sankul Pariyojana.

- Under the scheme Department of Science and Technology will adopt and develop a cluster of villages into self-sustainable in time bound manner.
- In this the local resources and manpower will be utilised which will be further imparted value addition in local produce and services.
- At present four clusters have been identified namely - Gaindikhata, Bazeera, Bhigun (in Garhwal) and Kausani (in Kumaon) which will be expanded further after validation of these clusters.
- Areas of intervention would include –
  - Processing and value addition in milk, honey, mushrooms, herbal tea horticulture, forest produce etc.
  - Traditional handicraft of Uttarakhand
  - Post-harvest processing of Kiwi, strawberry, cherry, tulsi etc. through solar drying
  - Extraction of apricot through cold press technology
  - Stringent intervention in product and process control will also be maintained for energy and water conservation.

11. AWARDS

11.1. INDIRA GANDHI PRIZE FOR PEACE, DISARMAMENT AND DEVELOPMENT, 2014

- The **Indian Space Research Organization (ISRO)**.
- Amul and ISRO have signed a MoU for fodder assessment through satellite technology.
- The main objective is identification/discrimination between food crops and fodder crops and identifying suitable areas of current fallows and cultivable wastelands at the village level.

11.2. NOBEL IN CHEMISTRY

Why in News?

- Nobel Prize for Chemistry has been awarded to Jacques Dubochet, Joachim Frank and Richard Henderson for the development of high-resolution cryo-electron microscopy.

More on News

- Cryo-electron microscopy is a method for imaging frozen-hydrated specimens at cryogenic temperatures by electron microscopy.
- Specimens that are to be analysed would remain in their native state without the need for dyes or fixatives, which would allow the study of fine cellular structures, viruses and protein complexes at molecular resolution.
- Contrary to earlier electron micro-scoping, cryo-electron miscroscopy can view solutions (as water would not evaporate under microscope's vacuum).
- It helps researchers to freeze biomolecules mid-movement and visualise the processes they have never previously seen.
- It has been used to image the elusive Zika virus and its medicine associated research.

11.3. NOBEL PRIZE IN PHYSICS

Why in News?

- Nobel Prize for Physics has been awarded to Scientists Rainer Weiss, Barry Barish and Kip Thorne for contributions to the **LIGO detector** and the **observation of gravitational waves.**

- **Neutron stars** are created when giant stars die in supernovas and their cores collapse, with the protons and electrons essentially melting into each other to form neutrons.
- **Black holes**: It is a place in space where gravity pulls so much that even light can not get out. The gravity is so strong because matter has been squeezed into a tiny space. This can happen when a star is dying.

What are Gravitational Waves and LIGOs?

- **Gravitational waves** are distortions or 'ripples' in the fabric of space-time caused by some of the most violent and energetic processes in the Universe (star explodes asymmetrically (called a supernova), when two big stars orbit each other, when two black holes orbit each other and merge).
- These ripples travel at the **speed of light** through the Universe, carrying with them information about their cataclysmic origins, as well as invaluable **clues to the nature of gravity** itself.
- **Albert Einstein** predicted the existence of gravitational waves in 1916 in his **general theory of relativity**
- To detect these waves scientists developed the Laser Interferometer Gravitational-Wave Observatory or LIGO.

Significance

- It offers a new way to observe the cosmos, helping scientists explore the nature of mysterious objects including black holes and neutron star.
- It helps in solving some big mysteries in astrophysics – including the cause of bright flashes of light known as "gamma ray bursts" and even the origins of heavy elements such as gold.
- Indian contribution played a major role, especially in extracting signal from noise, in detecting the gravitational waves with the engagement of 40 scientists from 13 Indian institutions.

Gravitational wave detector in India: INDIGO

- India-LIGO project will be a replica of the two LIGO detectors and would be stationed at a perpendicular direction to the detectors in USA.

- It is piloted by Department of Atomic Energy (DAE) & Department of Science and Technology (DST).
- It will be jointly coordinated and executed by three Indian research institutions: the Inter-University Centre for Astronomy and Astrophysics (IUCAA), Pune and Department of Atomic Energy organisations: Institute for Plasma Research (IPR), Gandhinagar and the Raja Ramanna Centre for Advanced Technology (RRCAT), Indore.
- The LIGO lab in India will be built in **Maharashtra's Hingoli District**.

11.4. NOBEL PRIZE IN MEDICINE

Why in News?

- Nobel Prize in Physiology or Medicine 2017 was awarded to Jeffrey C. Hall, Michael Rosbash and Michael W. Young for their discoveries of molecular mechanisms controlling the **circadian rhythm**.

More on News

- The discoveries explain how plants, animals and humans adapt their biological rhythm so that it is synchronised with the Earth's revolutions.
- The scientist used fruit flies to isolate a gene that controls the normal daily biological rhythm and showed how this gene encoded a protein that accumulates in the cell during the night and degrades during the day.

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.

12. RECENT DEVELOPMENT IN S&T

12.1. XFEL GENERATES FIRST X-RAY LASER LIGHT

Why in news

- European XFEL, the world's biggest X-ray laser has generated its first beam of light.

About XFEL

- The European XFEL is the largest and most powerful of the five X-ray lasers worldwide, with the ability to generate the short pulses of hard X-ray light.
- It is 3.4-kilometre-long and most of it is located in underground tunnels in Germany and kept at a temperature of just 2 degrees above absolute zero.
- The X-ray light has a wavelength of 0.8 nanometre – about 500 times shorter than that of visible light.

LASER: Light Amplification by Stimulated Emission of Radiation

- It is device that generates an intense beam of **coherent monochromatic light** (or other electromagnetic radiation).
- It means unlike the conventional light, LASER has radiation of only one wavelength (Monochromatic) and they are always in same phase in space and time (Coherent).

Free-electron lasers

They create coherent light by constantly accelerating a beam of electrons. Free-electron lasers can produce radiation with a very short-wavelength, down to just a few tenths of a nanometre i.e. to the level of an atom.

12.2. SOHUM-HEARING SCREENING DEVICE LAUNCHED

Why in News?

SOHUM, an indigenously developed newborn hearing screening device has been launched by the **Union Ministry of Science and Technology.**

More about Sohum

- It has been developed by School of International Biodesign (SIB).
- It measures auditory brain waves via three electrodes placed on the baby's head. When stimulated, electrodes detect electrical responses generated by the brain's auditory system. If there is no response, it indicates child cannot hear.
- If detected at early age, other problems such as impaired communication skills and even possible mental illness can be prevented.

School of International Biodesign

- SIB is a flagship Program of the Department of Biotechnology (DBT) aimed to develop innovative and affordable medical devices as per India's unmet clinical needs and to train the next generation of medical technology innovators in India.
- It is implemented jointly at AIIMS and IIT Delhi in collaboration with International partners.
- Under this programme, Department has authorized **Biotech Consortium India Limited** for management of its Intellectual Property and other techno-legal activities.

Noxeno (Developed under SIB)

- It is the first dedicated tool for anterior nasal foreign body (NFB) removal that allows doctors in any setting to quickly and safely remove objects that people (mostly children aged 2-10) put into their noses.
- Noxeno has been 100% invented, designed, engineered and manufactured in India.

12.3. NEW MATTER 'EXCITONIUM' DISCOVERED

Why in news?

Researchers have proven the existence of the new form of matter 'excitonium' which exhibits microscopic quantum phenomenon like a super conductor and is formed of excitons

Excitons

- When an electron which is seated at the edge of the crowded electron valence band gets excited and jumps over the energy gap into an empty conduction band, its leaves behind a hole in the valence band.
- The hole in the valence band acts as a positively charged particle and attracts the escaped electron.
- When the escaped electron with negative charge pairs with the hole, a composite bosonic particle – exciton is formed.

12.4. WORLD'S THINNEST HOLOGRAM

Why in news?

- Australian scientists have created the world's thinnest hologram that can be seen without 3D goggles.

Applications of Holographic Technology

- **In medicine** – Holographic imaging is used in the field of medicine to create a 3D image of a certain interior part of a patient's body (such as the heart) and project it in real time.
- **Tradeshows** – It is highly useful in tradeshows as a holographic display can help launch and present a product without bearing transporting costs.
- **Holographic Telepresence** – Prominent personalities have used it to address people at different places simultaneously keeping the personal connect intact through telepresence.
- **Engineering and Architecture** – Displaying 3D holographic models of buildings and engineering designs gives a real time experience.

12.5. RAMAN EFFECT

Why in News?

Recently, National Science Day was celebrated on February 28, to commemorate the invention of the **Raman Effect** by the Indian physicist Sir **Chandrasekhara Venkata Raman** on February 28, 1928. He has been honored with Bharat Ratna and the Lenin Peace Prize.

What is Raman Effect

- For molecules, two types of scattering can occur
  - Rayleigh scattering, an elastic scattering process in which a photon emerges with the same energy as it entered.
  - Raman scattering, an inelastic scattering process in which the light scattered by a molecule emerges having an energy that is slightly different (more or less) than the incident light. This energy difference is generally dependent on the chemical structure of the molecules involved in the scattering process.
- When light is scattered by matter, almost all of the scattering is an elastic process. Only a very small percentage of scattering is an **inelastic process**
- **Raman Effect** tendency is shown strongest in solid material and weakest in gaseos molecule**.**

Application of Raman Effect: As it helps in understanding molecular properties better it has applications in**:**

- Studying catalysts, monitoring chemical purity etc. in chemical industry
- Studying nanoparticle and developing microelectronic devices
- Conducting Invivo studies of the skin, identification of cancer, bone studies etc. in medical field
- **detecting narcotics and explosives** such as TNT, RDX
- It can be used to create a database of every substance for easy identification.

Achievements of Indians in the Field of Modern S&T

Physics

- **S Chandrashekhar**: He was awarded the 1983 Nobel Prize for Physics for his mathematical theory of black holes and on the basis of this Chandrashekhar Limit was defined.
- **Tessy Thomas**: She is also called the missile woman of India who spearheaded the programme on the Agni IV missile.
- **Jagdish Chandra Bose**: He is a noted scientist who invented microwave components like waveguides, horn antennas etc.

CHEMISTRY

- **Praffula Chandra Ray** - He was a noted chemist who set up the first chemical factory of India - Bengal Chemical and Pharmaceutical Works Ltd.in 1901
- **Har Gobind Khurana** - He was an Indian American who shared the Nobel Prize of Medicine of 1968 for the research on cell's synthesis of proteins.

MATHS

- **S. Ramanujam**: He was the second Indian to become Fellow of Royal Society of London. December 22 is celebrated as National Mathematics Day after him.

12.6. TRIBOELECTRIC NANOGENERATOR

Why in news?

For the first time, wireless transmission of electrical energy has been achieved using triboelectric nanogenrator

About Triboelectric nanogenerator

- It is based on organic material to convert mechanical energy into electricity. It is a sensor that directly converts a mechanical triggering into a self-generated electric signal for detection of motion, vibration, mechanical stimuli, physical touching, and biological movement.
- It can be applied to harvest all kinds of mechanical energy available in our daily life, like motion, walking, rotation, wind, automobile, flowing water, etc.

13. MISCELLANEOUS

13.1. JIGYASA INITIATIVE

- "JIGYASA" (means curiosity) is one of the major initiatives taken up by CSIR at national level, during its **Platinum Jubilee Celebration** Year.
- CSIR is widening and deepening its **Scientific Social Responsibility (SSR)** further with the programme.
- It is a **student- scientist connect programme** which will be **implemented by Council of Scientific and Industrial Research (CSIR) in collaboration with Kendriya Vidyalaya Sangathan (KVS).**

13.2. PROPOSALS FOR HIGH-TECH PUBLIC TRANSPORT

Why in News?

- NITI Ayog cleared six new proposals for public transportation system of India.
- These technologies include metrino, stadler buses, hyper loop, pod taxis, hybrid buses and freight rail road.

About new technology

- **Metrino:** It is fully automatic small pods travel independently suspended over an overhead network
- **Pod Taxis:** Small automated vehicles cable cars or pod cars equipped to carry a small group of passengers.
- **Hyperloop:** Pod-like vehicle is propelled through a near-vacuum tube connecting cities at speeds matching that of an aircraft.
- **Stadler Bus:** Tram like high frequency bus service for end to end connectivity.
- **Hybrid Bus:** Transport system uses hybrid propulsion systems, consisting diesel and electric ones.
- **Freight Rail System:** Under this, Elevated corridors would be built with rail lines where freight trucks can be placed. It would move on rails at high speed, reducing freight time and increasing freight quantity.

Hyperloop

- Recently, **Hyperloop Transportation Technologies (HTT)** has signed an agreement with the **Andhra Pradesh government** to connect the city centres of Amravati and Vijayawada.
- It's the first agreement in India for the new transportation system.

Electric vehicle

- Recently, **Nagpur becomes first city** with electric mass mobility system.
- With this, **Maharashtra** also has become the **first state** to provide various incentives to e-taxis.

13.3. PRIVATE PARTICIPATION IN DEFENCE

Why in news?

- Recently, the Defence Acquisition Council (DAC) has simplified 'Make II' procedure.

More on news

- **Make II procedure** will amend the existing 'Make Procedure' in **Defence Procurement Procedure (DPP)-2016.**
- This will allow Ministry of Defence to accept suo-motu proposals from the industry and also allows start-ups to develop equipment for Indian Armed Forces.
- The minimum qualification criteria to participate in 'Make II' projects have been relaxed and projects involving cost of less than three crores will be reserved for MSME.

Other Steps taken by Government in indigenous defence manufacturing

- Under **Defence Procurement Procedure (DPP)-2016,** preference to' Buy (Indian-IDDM)' 'Buy (Indian)', 'Buy & Make (Indian)' & 'Make' categories of acquisition over 'Buy (Global)' category. **IDDM** stands for Indigenously Designed Developed and Manufactured with a minimum of 40% local content.
- The Defence Acquisition Council (DAC) approved the broad contours of the **Strategic Partnership Model (SPM).** The policy is intended to engage the Indian private sector in the manufacture of hi-tech defence equipment in India.
- **Foreign Investment upto 49%** is allowed through automatic route and above 49% under Government route on case-to-case basis. Moreover, Government is thinking of 100 percent FDI in defence through automatic route.

13.4. INDIA'S FIRST PRIVATE MISSILE PRODUCTION FACILITY UNVEILED

Why in news?

Recently, India's first private missile production facility was unveiled near Hyderabad.

India's first private sector small arms manufacturing plant

- It is a **Joint Venture (JV)** between Punj Lloyd and Israel Weapon Industries (IWI) **at Malanpur in Madhya Pradesh.**
- It's the first JV under the Make in India initiative.

Details

- **The missile sub-section manufacturing facility** has been established as a joint venture (51:49) between Kalyani Group and Israel's Rafael Advanced Defence System Ltd.
- The Kalyani Rafael Advanced System Facility will initially manufacture Anti-Tank Guided Missile (ATGM) Spike.
- The facility has been established in line with **'Make in India'** initiative and Defence Procurement Policy, 2016 to **'Make (Indian)'** and **'Buy and Make (Indian)'**.

13.5. LIQUID NITROGEN IN FOOD AND DRINKS

Why in news?

- The Haryana government recently banned the use of liquid nitrogen in drinks and food, reacting to a cocktail accident at a Gurgaon pub that burnt a hole in a man's stomach.
- The Haryana food and drugs administration department issued an order that any eatery found using liquid nitrogen with any drink or food will be booked under Food Safety and Standards Act, 2006.

About Liquid Nitrogen

- Liquid nitrogen (nitrogen in a liquid state at an extremely low temperature) is colourless and has a boiling point of -195.79 °C. It is used in bars to quickly chill glasses, freeze ingredients, provide a smoky effect to drinks.
- Due to its low temperature, liquid nitrogen can be extremely damaging to body tissue, causing frostbite and cryogenic burning on contact. Moreover, if ingested, it could lead to severe internal damage, destroying tissue in the mouth and intestinal tract.
- Liquid nitrogen also has an expansion ratio of 1:694 at 20 degree Celsius, meaning one litre of liquid nitrogen at 20 degree Celsius can expand to 694 litres of nitrogen gas. If it is swallowed and gets into a person's stomach, it could explode
- According to experts, food and drinks that are prepared with liquid nitrogen should be consumed only after all the smokes have evaporated.

13.6. NOVEL MOLECULE TO TREAT CANCER - DISARIB

- Disarib is a novel small molecule, designed and synthesised by Indian researchers which has shown promise in targeted killing of cancer cells.
- The molecule (Disarib) works by binding itself to a protein called **BCL2**, which suppresses the death of cancerous cells while sparing normal cells.
- However, the Disarib molecule would be ineffective in cases where expression of BCL2 is low in cancer cell lines such as breast cancer, cervical cancer etc.

13.7. BACTERIA NAMED AFTER A P J ABDUL KALAM

Why in news?

- Scientists at NASA have named a new organism – a bacteria as ***Solibacillus kalamii*** in honour of **Dr. A P J Abdul Kalam.**
- This form of bacteria has only been found on the **International Space Station** and not on earth as of yet.

13.8. KALAMSAT

- NASA launched the **world's smallest satellite** (weigh= 64 grams), built by 18-year old Tamil Nadu student Rifath Sharook and his team.
- Named as Kalamsat, after former President APJ Abdul Kalam, it's a **3-D printed satellite** and equipped with nano Geiger Muller counter for measuring the radiation in space
- **Objective**: To demonstrate the performance of 3D-printed carbon fibre as it's for the first time that 3-D printing technology is being used in space.

13.9. CHESS

- NASA launched a sounding rocket **CHESS (Colorado High-resolution Echelle Stellar Spectrograph)** to study vast interstellar clouds and know about the earliest stages of star formation.
- It studied **Beta Scorpii** — a hot, brightly shining star in the Scorpius constellation to probe the material between the star and our own solar system.

13.10. HWASONG-15

- It is a two-staged, liquid-fuelled intercontinental ballistic missile (ICBM), developed by North Korea.

13.11. ATAGS

- Recently, **Advanced Towed Artillery Gun System (ATAGS),** has set a new world record in range by hitting targets at a distance of 48 km.
- It is being jointly developed by the **Defence Research and Development Organisation (DRDO)** and the private sector.
- ATAGS is a 155mm, 52 calibre towed artillery gun being developed in mission mode by DRDO as a part of the **Army's artillery modernisation programme.**

13.12. KUNLONG

- It's the **world's largest amphibious aircraft** capable of carrying 50 people and can stay airborne for 12 hours.
- It's also known **as AG600** and makes China among the world's few countries capable of developing a large amphibious aircraft.
- **Application:** Millitary, firefighting and marine rescue.

13.13. STRATOLAUNCH PLANE

- It's an airplane with the world's largest wingspan, has successfully completed its initial engine tests.
- It's designed to serve as a launching platform for **sending rockets** into low-Earth orbit.

13.14. SMART ROBO COP

- A life-sized robot, **claimed to be the world's first smart policing robot** was launched in Hyderabad by **H-BOTS**, a Hyderabad-based start-up
- 'Robocop' can assist police in handling law and order, and traffic management.
- It can move, recognizes people, takes complaints, detects bombs, identified suspects, interacted with people, and answers peoples queries.

13.15. GOOGLE LUNAR XPRIZE

- Recently, $30-million **Google Lunar XPRIZE (GLXP)** organizer has called off its 10-year-old challenge, as no team competing will make a launch attempt to reach the moon by March 31.
- Competing Team: **SPACEIL** from Israel, **Moon Express** from USA, **Synergy Moon**, an international team, **Hakuto** from Japan and **Team Indus** from India.
- **Team Indus** is India's first privately funded start-up and if its moon mission is successful, then it would have become the first private Indian startup to land a craft on the moon. It had planned to send a lander-rover to the moon on an ISRO launcher.

13.16. CHANG'E 4

- It is China's lunar probe on the dark side of the moon.
- It incorporates a orbiter, lander and rover.

13.17. GAIA MISSION

- It is a mission of European Space Agency which aims to chart a three-dimensional map of about 1 billion stars throughout our Galaxy, the Milky Way and beyond.

13.18. TABBY'S STAR

- It is also known as Boyajian's star
- It is a part of the Cygnus constellation which shows anomalously large **fluctuations of light intensity** i.e its light intensity drops by more than 20% at times, with regular smaller fluctuations which are also in excess of that seen in many other stars.

13.19. KIMBERLY PROCESS CERTIFICATION SCHEME

Why in news?

Recently, Kimberly Process Certification Scheme Plenary was held at Brisbane which resolved to create an Ad hoc Committee on Review and Reform with India as the chair.

About Kimberly Process Certification Scheme (KPCS)

- It is a joint Government, International Diamond Industry and Civil Society initiative to stem the flow of Conflict Diamonds (rough diamonds used to finance the conflicts and topple the established government).
- It was started in 2003 after the United Nations General Assembly adopted a landmark resolution in 2000 supporting the creation of an international certification scheme for rough diamond. It also finds mention in the United Nations Security Council resolutions.
- India is one of the founding member of KPCS. At present, KPCS has 54 members representing 81 countries including the EU with 28 members.
- KPCS enables the participating countries to certify the shipment in rough diamonds as 'conflict-free' and prevent entrance of conflict diamonds in legitimate trade.
- According to the KPCS terms, member states have to meet the 'minimum requirements' and also put in place national legislations and institutions, export, import and internal controls, commit to transparency and exchange of statistical data.