# You & Technology-Mar 2019

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## (MARCH-2019)

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## General Studies Paper-3 – S&T – March 2019

### 1. BIOMEDICAL RESEARCH CAREER PROGRAMME

The Union Cabinet has approved the continuation of the Biomedical Research Career Programme (BRCP).

**Key facts:**

• It is an Alliance between the Department of Biotechnology (DBT) and Wellcome Trust (WT).

• The Programme will fulfil the objectives of building and nurturing talent of highest global standards in cuttingedge biomedical research in India, which has led to important scientific breakthroughs and applications to meet societal needs.

• BRCP will make it attractive for high quality Indian scientists working abroad to return to India, and has increased the number of locations geographically within India where world-class biomedical research is undertaken.

• The Programme would continue to build this capacity as also strengthen clinical research and work towards addressing important health challenges for India.

Background:

• The Wellcome Trust is an independent charity funding research to improve human and animal health. Established in 1936 and with an endowment of around £15 billion, it is the largest non-governmental source of funds for biomedical research in the United Kingdom.

### 2) BLOCK CHAIN TECHNOLOGY

Coffee Board Activates Blockchain Based Marketplace in India.

• Blockchain based market place app for trading of Indian coffees is intended to bring in transparency in the trade of Indian coffee, maintain the traceability of Indian coffee from coffee and the grower is paid fairly for his coffee produced.

**What are Blockchains?**

Blockchains are a new data structure that is secure, cryptography-based, and distributed across a network. The technology supports cryptocurrencies such as Bitcoin, and the transfer of any data or digital asset.

• Spearheaded by Bitcoin, blockchains achieve consensus among distributed nodes, allowing the transfer of digital goods without the need for centralized authorisation of transactions. The present blockchain ecosystem is like the early Internet, a permissionless innovation environment in which email, the World Wide Web, Napster, Skype, and Uber were built.

**How it operates?**

• The technology allows transactions to be simultaneously anonymous and secure, peer-to-peer, instant and frictionless. It does this by distributing trust from powerful intermediaries to a large global network, which through mass collaboration, clever code and cryptography, enables a tamper-proof public ledger of every transaction that's ever happened on the network.

• A block is the "current" part of a blockchain which records some or all of the recent transactions, and once completed, goes into the blockchain as permanent database. Each time a block gets completed, a new block is generated. Blocks are linked to each other (like a chain) in proper linear, chronological order with every block containing a hash of the previous block.

**Benefits of blockchain technology:**

• As a public ledger system, blockchain records and validate each and every transaction made, which makes it secure and reliable.

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• All the transactions made are authorized by miners, which makes the transactions immutable and prevent it from the threat of hacking.
• Blockchain technology discards the need of any third-party or central authority for peer-to-peer transactions.
• It allows decentralization of the technology.

## 3) PSLV C-45

Indian Space Research Organisation (ISRO) successfully launched the PSLV-C45 rocket from Satish Dhawan Space Centre SHAR, Sriharikota (Andhra Pradesh), which injected EMISAT and 28 international customer satellites into their designated orbits.

**Unique Features of PSLV-C45**

• It was the first time ISRO launched a rocket that injected satellites in three different orbits.
o Till now, these satellites have been ejected in two different orbits at the most, with only a marginal difference in the vertical distances between the satellites' orbits.
• For placing the satellites in 3 different orbits, the rocket needed to undertake 2 revolutions around the Earth. This was achieved by reigniting the 4th stage engines (employed for the first time). Earlier missions used to be "single-shot" operations in which the engines used to fire just once.
• The 4th and last stage of the rocket will function as a satellite itself for some time, instead of being rendered junk after ejecting its payloads.
o Though it has a lifespan much smaller than a satellite, it carries many instruments for measurements and short-duration experiments like:
✓ AMSAT (Radio Amateur Satellite Corporation) for amateur radio operators use to track and monitor position data
✓ Automatic Identification System for capturing messages transmitted from ships
✓ Advanced Retarding Potential Analyzer for Ionospheric Studies (ARIS) to study composition and structure of ionosphere
• Also, the rocket carried four strap-on motors for first time.
o Strap-ons are booster rockets attached externally to the main rocket, and provide additional thrust, or energy, by firing themselves midway during the flight.
o In earlier flights, ISRO has used two or six strap-on motors. The four extra-large strap-ons used this time reduced the overall weight while still delivering the power equivalent to six motors.

Polar Satellite Launch Vehicle (PSLV)

• It is designed mainly to deliver the "earthobservation" or "remote sensing" satellites with lift-off mass of up to about 1750 Kg to SunSynchronous circular polar orbits of 600-900 Km altitude.
• It is also used to launch the satellites of lower liftoff mass of up to about 1400 Kg to the elliptical Geosynchronous Transfer Orbit (GTO).
• PSLV is a four-staged launch vehicle with alternating solid and liquid stages.
• It is the first Indian launch vehicle to be equipped with liquid stages. It is also equipped with strap-on external motors.
• It has successfully launched Indian Remote Sensing (IRS) satellites, Chandrayaan (2008), Mangalyaan (2013), Astrosat, INRSS etc.

**About EMISAT**

• Developed by DRDO under Project Kautilya, it is the primary satellite placed in sun-synchronous polar orbit of 748 km height by PSLV-C45, intended for electromagnetic spectrum measurement.
• It is India's 1st Electronic Intelligence Satellite. It will increase the situational awareness of the armed forces by providing the location and information of hostile radars placed at the borders.

## 4. FORWARD SEARCH EXPERIMENT (FASER)

ERN have approved a new experiment named FASER designed to identify light and weakly interacting particles.

**Forward Search Experiment (FASER)**

• FASER is a proposed experiment dedicated to searching for light, extremely weakly-interacting particles at the Large Hadron Collider (LHC).

• Such particles may be produced in the LHC's high-energy collisions in large numbers in the far-forward region and then travel long distances through concrete and rock without interacting.

• A small and inexpensive detector placed in the far-forward region may therefore be capable of extremely sensitive searches. The FASER program is specifically designed to take advantage of this opportunity.

• These particles may decay to visible particles in FASER, which is placed 480 m downstream of the ATLAS interaction point.

**Significance of FASER Programme**

• FASER has the potential to discover dark photons, dark Higgs bosons, heavy neutral leptons, axion-like particles, neutralinos and many other long-lived particles, as well as provide new information about neutrinos, with potentially far ranging implications for particle physics and cosmology and understanding of dark matter.

• FASER has been designed to be sensitive to the many possible forms of light, weakly-interacting particles, and to differentiate signal from background.

• In addition, the FASER program has strong prospects for providing new insights into neutrinos. It may also provide interesting information about Standard Model (SM) particles by detecting the first neutrinos at the LHC.

**Related Information**

• ATLAS is an enormous multi-purpose detector situated at one of the crossing points of the two oppositely directed proton beams of the Large Hadron Collider's (LHC).

**Large Hadron Collider**

• The LHC accelerator, located at CERN on the French-Swiss border near Geneva, is housed in an enormous tunnel roughly 27 km in circumference and 100 m underground.

• The LHC and its detectors were designed to study the smallest fundamental building blocks that make up our universe – to find out what these building blocks are and how they interact (and don't interact) with one another. **Physics Beyond Colliders (PBC)**

• PBC is an exploratory study aimed at exploiting the full scientific potential of CERN's accelerator complex and its scientific infrastructure in the next two decades through projects complementary to the LHC, High Luminosity LHC (HLLHC) and other possible future colliders.

• FASER Programme is one such component of PBC. Dark Matter

• Composition of the universe: 68% dark energy, 27% dark matter, 5% normal matter.

• The chief property of dark matter is that it is "dark", i.e. that it emits no light.

• In addition, dark matter must interact with visible matter gravitationally. So, the dark matter must be massive enough to cause the gravitational effects that we see in galaxies and clusters of galaxies.

• The two main categories of objects that scientists consider as possibilities for dark matter include MACHOs and WIMPs.

o **MACHOs (Massive Compact Halo Objects):** MACHOs are objects ranging in size from small stars to super massive black holes. MACHOS are made of ordinary matter (like protons, neutrons and electrons). They may be black holes, neutron stars, or brown dwarfs.

o **WIMPs (Weakly Interacting Massive Particles):** WIMPs are the subatomic particles which are not made up of ordinary matter. They are "weakly

interacting" because they can pass through ordinary matter without any effects. They are "massive" in the sense of having mass (whether they are light or heavy depends on the particle). The prime candidates include neutrinos, axions, and neutralinos.

## 5. AURORA

Geostorm offers Northern US rare chance to see aurora borealis.

**What is Aurora?**

• An Aurora is a display of light in the sky predominantly seen in the high latitude regions (Arctic and Antarctic). It is also known as a Polar light.

**Types:**

• There are two types- the aurora borealis and aurora australis – often called the northern lights and southern lights.

**Where do they occur?**

• They commonly occur at high northern and southern latitudes, less frequent at mid-latitudes, and seldom seen near the equator.

**Colors:**

• While usually a milky greenish color, auroras can also show red, blue, violet, pink, and white. These colors appear in a variety of continuously changing shapes.

**Science behind their occurrence:**

• Auroras are a spectacular sign that our planet is electrically connected to the Sun. These light shows are provoked by energy from the Sun and fueled by electrically charged particles trapped in Earth's magnetic field.

• The typical aurora is caused by collisions between fast-moving electrons from space with the oxygen and nitrogen in Earth's upper atmosphere.

• The electrons—which come from the Earth's magnetosphere, the region of space controlled by Earth's magnetic field —transfer their energy to the oxygen and nitrogen atoms and molecules, making them "excited".

• As the gases return to their normal state, they emit photons, small bursts of energy in the form of light.

• When a large number of electrons come from the magnetosphere to bombard the atmosphere, the oxygen and nitrogen can emit enough light for the eye to detect, giving us beautiful auroral displays.

**Where do they origin?**

• They origin at altitudes of 100 to more than 400 km.

Why do auroras come in different colors and shapes?

• The color of the aurora depends on which gas — oxygen or nitrogen — is being excited by the electrons, and on how excited it becomes. The color also depends upon how fast the electrons are moving, or how much energy they have at the time of their collisions.

• High energy electrons cause oxygen to emit green light (the most familiar color of the aurora), while low energy electrons cause a red light. Nitrogen generally gives off a blue light.

• The blending of these colors can also lead to purples, pinks, and whites. The oxygen and nitrogen also emit ultraviolet light, which can be detected by special cameras on satellites.

**Effects:**

• Auroras affect communication lines, radio lines and power lines.

• It should also be noted here that Sun's energy, in the form of solar wind, is behind the whole process.

## 6. PULSARS

NASA has discovered a pulsar speeding through space.

• This pulsar is dubbed PSR J0002+6216 (J0002 for short) and sports a radio-emitting tail pointing

directly towards the expanding debris of a recent supernova explosion.

• The Nasa found the pulsar hurtling through space at nearly four million kilometres an hour. The speed of the pulsar in the space is so fast that it could travel the distance between the Earth and the Moon in just six minutes.

The discovery:

• Pulsar J0002 was discovered in 2017 by a citizen-science project called Einstein@Home, which uses time on the computers of volunteers to process Fermi gamma-ray data.

**Where is it located?**

• Located about 6,500 light years away in the constellation Cassiopeia, J0002 spins 8.7 times a second, producing a pulse of gamma rays with each rotation. The pulsar lies about 53 light years from the centre of a supernova remnant called CTB 1.

• Its rapid motion through interstellar gas results in shock waves that produce the tail of magnetic energy and accelerated particles detected at radio wavelengths using the Very Large Array (VLA).

**What is a pulsar?**

• Pulsar is a celestial object that emits regular pulses of radio waves and other electromagnetic radiation at rates of up to one thousand pulses per second.

• Pulsars are superdense, rapidly spinning neutron stars left behind when a massive star explodes.

## 7. LUNAR RECONNAISSANCE ORBITER (LRO)

NASA's Lunar Reconnaissance Orbiter (LRO) has observed water molecules moving around the dayside of Moon, an advance that could help us learn about the accessibility of water that can be used by humans in future lunar missions.

• Lyman Alpha Mapping Project (LAMP) — the instrument aboard LRO — measured sparse layer of molecules temporarily stuck to the Moon's surface, which helped characterise lunar hydration changes over the course of a day.

**Uses of lunar water:**

• Lunar water can potentially be used by humans to make fuel or to use for radiation shielding or thermal management; if these materials do not need to be launched from Earth, that makes these future missions more affordable.

**Source of Moon's surface water:**

• Scientists had hypothesised that hydrogen ions in the solar wind may be the source of most of the moon's surface water. As a result, when the moon passes behind the earth and is shielded from the solar wind, the 'water spigot' should essentially turn off.

• However, the water observed by LAMP does not decrease when the moon is shielded by the earth and the region influenced by its magnetic field, suggesting water builds up over time, rather than 'raining' down directly from the solar wind.

**How is lunar water bound to surface materials?**

• Water molecules remain tightly bound to the regolith until surface temperatures peak near lunar noon. Molecules thermally desorb and can bounce to a nearby location that is cold enough for the molecule to stick or populate the moon's extremely tenuous atmosphere or exosphere, until temperatures drop and the molecules return to the surface.

**About Lunar Reconnaissance Orbiter (LRO):**

• LRO is a NASA mission to the moon within the Lunar Precursor and Robotic Program (LPRP) in preparation for future manned missions to the moon and beyond (Mars).

• LRO is the first mission of NASA's `New Vision for Space Exploration', which President Bush announced on January 14, 2004, in sending more robot and human explorers beyond Earth orbit.

**The objectives of LRO are to:**

• Identify potential lunar resources.

• Gather detailed maps of the lunar surface.

• Collect data on the moon's radiation levels.
• Study the moons polar regions for resources that could be used in future manned missions or robotic sample return missions.
• Provide measurements to characterize future robotic explorers, human lunar landing sites and to derive measurements that can be used directly in support of future Lunar Human Exploration Systems.

## 8. GRAPES-3

For the first time in the world, researchers at the GRAPES-3 muon telescope facility in Ooty recently measured the electrical potential, size and height of a thundercloud simultaneously.
• Learning about the properties of thunderclouds can be useful in following ways:
o Navigation of aircraft and preventing short circuits.
o If its energy could be harnessed, it would change the landscape of the energy sector. This thunderstorm cloud carried about 2 gigawatts (GW) of power, making this single cloud more powerful than most powerful nuclear power plants in the world.

**How was it detected?**

• Clouds have negative charges along their lower side and positive charges on top and can be several kilometres thick.
• Muons and other particles are produced when cosmic rays bombard air particles surrounding the earth. The muons produced can have positive or negative charge. These particles have about half the spin of electrons but 200 times the weight, and are very good at penetrating matter.
o When a positively charged muon falls through a cloud, it loses energy; while a negatively charged muon gains energy when falling through the cloud and gets detected. Since there are more positive than negative muons produced in nature, the two effects don't cancel out, and a net change in intensity is detected.
• Using an array of muon-detecting sensors and four electric field monitors spread over several miles, the researchers measured the average drop in energy between muons that passed through the thundercloud and those that didn't pass through it. From this energy loss, it was calculated how much electric potential the particles had passed through in the thunder cloud.

**GRAPES-3 Muon Telescope**

• Gamma Ray Astronomy PeV EnergieS phase-3 (GRAPES-3) is designed to study cosmic rays with an array of air shower detectors and a large area muon detector.
• It is a collaboration of the Tata Institute of Fundamental Research, Mumbai, India and the Osaka City University, Osaka, Japan.

## 9. CHINA'S ARTIFICIAL SUN

China has recently reported that it is close to completing its "artificial sun"- Experimental Advanced Superconducting Tokamak (EAST) reactor, after it achieved an ion temperature of 100 million degrees Celsius.

**Background**

• Nuclear fusion has been the focus of the researchers as the solution for clean energy, which can replace the conventional sources of energy like coal, oil, gas etc.
• But the application and control of fusion process is not easy to harness. A very high pressure and temperature is required to initiate the fusion process. Even if those conditions are created, then the energy generated during the process is prone to bursts, which can be deadly.
• The scientists have been working on harnessing this process from a long time, the most prominent among them being the International Thermonuclear Experimental Reactor (ITER).
• China is working on an Experimental Advanced Superconducting Tokamak (EAST) reactor — an "artificial sun" designed to mimic the nuclear

fusion process the real Sun uses to generate energy.

• The machine, called HL-2M Tokamak, is being constructed at the Southwestern Institute of Physics in China.

**Nuclear Fusion Process**

• It involves light elements, such as hydrogen, smashing together to form heavier elements, such as helium. For fusion to occur, hydrogen atoms are placed under high heat and pressure until they fuse together. When this happens, a tremendous amount of energy is released in the process.

• Reaction between two hydrogen isotopes, deuterium (D) and tritium (T) has been identified as the most efficient fusion reaction in the laboratory setting. The DT fusion reaction produces the highest energy gain at the "lowest" temperatures.

• At extreme temperatures, electrons are separated from nuclei and a gas becomes a plasma—an ionized state of matter similar to a gas.

• Composed of electrons and ions, plasmas are very tenuous environments, nearly one million times less dense than the air we breathe. Fusion plasmas provide the environment in which light elements can fuse and yield energy.

• The tokamak device uses magnetic fields to contain and control the hot plasma, to keep the plasma away from the reactor's walls, so that it doesn't cool down and lose its energy potential.

• Three conditions must be fulfilled to achieve fusion in a laboratory:

o Very high temperature (on the order of 15million Celsius);

o Sufficient plasma particle density (to increase the likelihood that collisions do occur);

o Sufficient confinement time for fusion to occur

**Significance of Nuclear Fusion**

• Large amount of energy- Fusing atoms together in a controlled way releases nearly four million times more energy than a chemical reaction such as the burning of coal, oil or gas and four times as much as nuclear fission reactions.

• Sustainability- Fusion fuels are widely available and nearly inexhaustible. Deuterium can be distilled from all forms of water, while tritium will be produced during the fusion reaction as fusion neutrons interact with lithium.

• Environment friendly- Fusion doesn't emit harmful toxins like carbon dioxide or other greenhouse gases into the atmosphere

• Limited risk of proliferation: Fusion doesn't employ fissile materials like uranium and plutonium

• No risk of meltdown: A Fukushima-type nuclear accident is not possible in a tokamak fusion device. It is difficult enough to reach and maintain the precise conditions necessary for fusion—if any disturbance occurs, the plasma cools within seconds and the reaction stops.

## 10. NEW RULES FOR DRUGS & CLINICAL TRIALS

The Ministry of Health & Family Welfare has notified the Drugs and Clinical Trials Rules, 2019 with the aim of promoting clinical research in the country.

**About the new rules**

• The new rules reduce the time for approving applications to 30 days for drugs manufactured in India and 90 days for those developed outside the country.

• Patients would be enlisted for trials with an informed consent and an ethics committee will monitor the trials and decide on the amount of compensation in cases of adverse events

• In case of injury to clinical trial subject, medical management will be provided by the sponsor as long as required as per the opinion of the investigator or till such time it is established that the injury is not related to the clinical trial. • Compensation in cases of death and permanent

disability to a trial subject will be decided by the Drug Controller General.

• Local clinical trial may be waived for approval of a new drug if it is approved and marketed in any of the countries (EU, UK, Australia, Japan and US) specified by the Drugs Controller General with the approval of the government.

**Existing regulatory requirements for Clinical Trials in India**

• Clinical trials in India are primarily regulated through the provisions of the Drugs and Cosmetics Act, 1940. Further, the Medical Council of India Act, 1956 and the Central Council for Indian Medicine Act, 1970 also regulate the conduct of clinical trials in India.

• The Indian Council of Medical Research (ICMR), the apex regulatory body for clinical trials, was set up to promote research culture in India and develop infrastructure for clinical trials.

• A clinical study in India has to be registered with Clinical Trial Registry of India (CTRI) before recruiting any volunteer. It is an open repository of all clinical studies for public use. It has been established by ICMR.

• Drug Controller General of India (DCGI) is responsible for giving regulatory permissions for the conduct of clinical trials and is responsible for approval of marketing licenses for drugs in India.

• Ethics Committees (EC) are designated to approve, monitor & review biomedical and behavioral research involving humans. They follow International Conference on Harmonization-Good Clinical Practice (ICH-GCP) guidelines. They can be affiliated with the study sites (e.g. hospitals/clinics) or can be independent.

o National Accreditation board for hospitals and Healthcare Providers (NABH) a part of Quality council of India has developed a system of accreditation for Ethics Committee (EC).

**Issues with Clinical Trial (CT) regulations in India**

India has had favorable prerequisites for conducting clinical research and drug development – a large and diverse patient pool (trial participants), a highly skilled workforce of qualified scientists (investigators), medical colleges (sites) etc. Yet, an unfavorable ecosystem has undermined its potential. India has 17% of the world's population & 20% of the world disease burden, but conducts less than 1.4% of global clinical trials.

**Following are the issues associated with the process of clinical trials in India:**

• Issues in deciding culpability in case of deaths due to clinical trials.

• Over-representation of vulnerable sections among trial subjects.

• Selective recruitment by Contract Research Organizations (CROs) exploiting financial needs and medical ignorance.

• Public opinion in India is not in favor of CTs as several CROs have been blamed for conducting trials without due concern for procedural and ethical issues.

• Issue of over-volunteering in bioequivalence studies where volunteers deceive the investigators by faking medical history and simultaneously enrolling in multiple trials. It poses a risk to volunteer health and may lead to unsafe drugs in market.

• Regulatory inadequacies lead to severe delays in the approval process.

• Absence of adequate regulatory guidance on specific issues, lack of clarity on legal terminologies and dearth of a proper standardization by CDSCO.

• Lack of expertise and capacity to undertake accreditation and absence of periodic revaluation mechanism.

**Significance of the new rules**

The new rules take a step forward in making Clinical Trial (CT) process in India compliant with

Supreme Court directives and Ranjit Roy Chaudhury Expert Committee recommendations.

• The new rules will speed up the availability of drugs in India.

• Adherence to certain quality standards will instill confidence in patients who will be trial subjects.

• It will boost clinical trials industry in India by giving certainty to undertake trials to research groups/ companies.

• It will promote innovation in indigenous drug development to meet growing need for medicines in the country. • It can generate employment in the clinical trials industry.

**Way Forward**

• Empowering Ethics Committees: o NABH and Forum for Ethics Review Committees in India (FERCI) should develop an IT enabled platform that enables ECs to manage a research project throughout its life cycle o Training of every EC member in GCPs o NABH should draft model Standard Operating Procedures (SOPs) for ECs o NABH should sign MOUs with other agencies of standing to aid faster accreditation of ECs in India

• Making consent more informed:

o Meaningful translation of Informed Consent Forms (ICF) into vernacular languages

o Development of audio-visual aids for clinical research participants

• Compensating for injury or death related to a clinical trial:

o CDSCO should adopt a more focused approach towards passing timely orders for compensation for injury or death related to a trial.

o Mandatory provision for ancillary care to cater to patients suffering from any other illness during the trial.

• Addressing uncertainty: CDSCO should devise a comprehensive strategy to communicate its policies, decisions and regulatory thinking to the market.

• Incentivizing research: The Government of India, state governments and institutions should create a fund in order to encourage academic and clinical research.

## 11. NANO-PHARMACEUTICALS

Department of Biotechnology under Ministry of Science and Technology has prepared draft guidelines for evaluation of nano-pharmaceuticals in India.

**Background**

• Nanoscience is the study of materials which are in nanoscale range. o Conversion of any material in nanoscale results in alteration of its physicochemical, biological, mechanical, optical, electronic, etc. properties which can be utilized for different useful activities.

• Nano-pharmaceutical is an emerging field that combines nanotechnology with pharmaceutical and biomedical science with the goal of targeted drug delivery which may improve efficacy and safety profile.

• There are no uniform internationally acceptable guidelines for nanopharmaceuticals.

• The main challenges faced by regulatory institutions in India include: regulatory capacity, information asymmetry, Inter-agency coordination, overlapping roles and mandates etc. Need for regulation of nano- pharmaceuticals

• Possible adverse effects of nanotechnology on the environment and humans: For example nanoparticles of sizes comparable to that of human cells can be deposited in lungs and may cause damage by acting directly at the site of deposition or by translocating to other organs or by being absorbed through the blood .

• Their use as undetectable weapon in warfare.

• Incorporation of nano-devices as performance enhancers in human beings.

• Ethical and social issues associated with nano pharmaceuticals.

• Need for orderly growth of the sector and commercialization of nano technology innovations.

**Salient features of the Draft guidelines**

• They aim to ensure the quality, safety and efficacy as well as encourage the commercialization of nanotechnology based innovation with high benefit and low risk ratio.

• Defines nano-pharmaceuticals: as a pharmaceutical preparation containing nanomaterials (size scale range of 1 to 100nm) intended for internal or external application on the body for the purpose of therapeutics, diagnostics and any health benefit. o It also includes preparations with the particle size is >100nm and <1000 nm as nano pharmaceuticals under certain circumstances.

• Categorises nano pharmaceuticals:

**o According to degradability of nanomaterial:**

✓ Biodegradable nanoparticles have been used frequently as drug delivery vehicles due to its improved bioavailability, better encapsulation, control release and reduction of toxic potential. Examples: albumin, chitosan, gelatin, polycaprolactone etc.

✓ Nonbiodegradable nanoparticles are relatively less used in pharmaceutical products (though these systems are more commonly used in cosmeceuticals). Almost all non-biodegradable nanoparticles have potential to toxic effects. Examples: titanium oxide, iron oxide, and metals such as gold, silver, platinum, etc. o According to nature of nanomaterial: Nanomaterial may be organic or inorganic in nature. It may also be multicomponent nanoparticle. ✓ Organic Nanoparticles: are the nanomaterials or nanoparticles composed of organic compounds like lipids, proteins, carbohydrates. They have been primarily developed for drug delivery to reduce or overcome the risk of toxicity.

✓ Inorganic Nanoparticles: are more stable than organic nanostructures. They are easier to prepare with a defined size and a very narrow size distribution. However, most of the inorganic nanoparticles may not be biodegradable. ✓ Multicomponent nanoparticles are the nanoparticles composed of two or more different materials.

o **According to nanoform of the ingredient:**

✓ A nanocarrier is a nanomaterial being used as a transport module for another substance like a drug.

✓ Some of the conventional/traditional drugs may be converted into nanocrystals, thereby increasing their potential for improved dissolution and bioavailability.

**o According to the approval status of drug and nanomaterial.**

• It mandates that the stability testing of nanopharmaceuticals should be done according to the general requirements specified in Drugs and Cosmetics Rules, 1945.

## 12. GLOBAL INFLUENZA STRATEGY

Recently, WHO has released a Global Influenza Strategy for 2019-2030 aimed at protecting people in all countries from the threat of Influenza.

**Why it is needed?**

Influenza remains one of the world's greatest public health challenges. Every year across the globe, there are an estimated 1 billion case sresulting in 2,90,000 to 6,50,000 influenza-related respiratory deaths. The most effective way to prevent the disease is through annual Influenza vaccination.

**More about the move**

• Developed through a consultative process, it is in line with the mandate of WHO to build core capacities for public health and enhance global preparedness.

• The Goal of the strategy-

o to prevent seasonal influenza,

o control the spread of influenza from animals to humans,
o Prepare for the next influenza pandemic.
• Focus of the strategy
o Work closely with countries to improve their capacities for disease surveillance, response, prevention and control.
o Calls every country to have a tailored influenza programme that contributes to national and global preparedness and health security.
o Expand partnerships to increase research, innovation and availability of new and improved Global Influenza tools (vaccines, antivirals, and treatments) to benefit all countries.

## 13. BAN ON E-CIGARETTES

12 states banned e-cigarettes recently, and health ministry has urged all to follow.

**What are Electronic Nicotine Delivery Systems (ENDS)?**

• They are devices that heat a solution to create an aerosol by vaporizing thesolution, which also frequently contains flavours, usually dissolved into propylene glycol and glycerin. They aim to provide a similar sensation to inhaling tobacco smoke, without the smoke and are sold as aids to reduce or quit smoking.
• E-cigarettes, the most common prototype of ENDS, claim to emit nicotine without other harmful chemicals that are present in normal cigarettes. However, there is no convincing evidence proving that e-cigarettes help quit smoking.

**Present Scenario in India**

• Its increasing popularity has undermined the recent progress of tobacco control in India.
• 12 states in India including Punjab, Maharashtra, Karnataka, Kerala, Bihar, Uttar Pradesh, Jammu & Kashmir, Himachal Pradesh, Tamil Nadu, Puducherry and Jharkhand have taken steps to ban the use of ENDS.
• The Central Drugs Standard Control Organization (CDSCO) has directed all drug controllers in states and Union territories to not allow the manufacture, sale, import and advertisement of Electronic Nicotine Delivery Systems, in their jurisdictions.
• No ENDS have been approved under the Drugs and Cosmetics Act 1940. However, there is no specific legislation to regulate the sale of e-cigarettes in the country.
• The Ministry of Electronics and Information Technology proposed an amendment to the Information Technology (Intermediary Guidelines) Rules 2018 to ban the advertisement of e-cigarettes.
• The Central Board of Indirect Taxes and Customs also issued a circular recently, directing that all import consignments of e-cigarettes must be cleared first by the drug controller.

## 14. ATMOSPHERIC WAVES EXPERIMENT (AWE)

National Aeronautics and Space Administration has selected a new mission- Atmospheric Waves Experiment (AWE)- that will help scientists understand and ultimately, forecast the vast space weather system around the Earth.

**About Atmospheric Waves Experiment (AWE):**

• It will be launched in August 2022 and will be attached to exterior of Earth-orbiting International Space Station (ISS).
• Objective of AWE is to study and focus on airglow, a colourful bands of light in Earth's atmosphere to determine what combination of forces drive space weather in upper atmosphere.
• It will be the first such experiment to obtain global observations of important driver of space weather in dynamic region of Earth's upper atmosphere that can cause interference with radio and GPS communications.
• AWE is a Mission of Opportunity under NASA's Heliophysics Explorers Program, which conducts

focused scientific research and develops instrumentation to fill the scientific gaps between the agency's larger missions.

**Need for this mission:**

• Studying space weather is significant as it can have profound impacts, affecting technology and astronauts in space, disrupting radio communications and at its most severe, overwhelming power grids.

• It was earlier thought that only Sun's constant outflow of ultraviolet (UV) light and particles, solar wind, could affect airglow region. However, now researchers have learned that solar variability is not enough to drive changes observed at this region and Earth's weather also having effect on it.

• Hence to understand this deeper, AWE mission will investigate how waves in lower atmosphere, caused by variations in densities of different packets of air, impact upper atmosphere.

## 15. MATTER-ANTIMATTER

Physicists from the Large Hadron Collider beauty (LHCb) Collaboration at CERN have observed, for the first time, the matter-antimatter asymmetry known as charge-parity (CP) violation in the decays of a D0 meson, a subatomic particle made up of a charm quark and an up antiquark.

**What is charge parity and cp violation?**

The term CP refers to the transformation that swaps a particle with the mirror image of its antiparticle.

• The weak interactions of the Standard Model of particle physics are known to induce a difference in the behavior of some particles and of their CP counterparts, an asymmetry known as CP violation.

• This asymmetry is one of the key ingredients required to explain why today's Universe is only composed of matter particles, with essentially no residual presence of antimatter.

**What you need to know about matter and antimatter?**

• The universe consists of a massive imbalance between matter and antimatter. Antimatter and matter are actually the same, but have opposite charges, but there's hardly any antimatter in the observable universe, including the stars and other galaxies. In theory, there should be large amounts of antimatter, but the observable universe is mostly matter.

• This great imbalance between matter and antimatter is all tangible matter, including life forms, exists, but scientists don't understand why.

**What happens when matter and antimatter meet?**

• When antimatter and matter meet, they annihilate, and the result is light and nothing else. Given equal amounts of matter and antimatter, nothing would remain once the reaction was completed. As long as we don't know why more matter exists, we can't know why the building blocks of anything else exist, either.

• This is one of the biggest unsolved problems in physics. Researchers call this the "baryon asymmetry" problem. Baryons are subatomic particles, including protons and neutrons. All baryons have a corresponding antibaryon, which is mysteriously rare. The standard model of physics explains several aspects of the forces of nature. It explains how atoms become molecules, and it explains the particles that make up atoms.

## 16. COMBAT CASUALTY DRUGS

DRDO's medical laboratory has come up with a range of 'combat casualty drugs' that can extend the golden hour of gravely wounded security personnel till the trooper is shifted to hospital.

• It has been developed at the Institute of Nuclear Medicine and Allied Sciences, a laboratory of the Defence Research and Development Organisation.

**Combat Casualty Drugs:**

• The spectrum includes bleeding wound sealants, super absorptive dressings and glycerated salines, all of which can save lives in the event of warfare in jungle and high altitude areas as well as in terror attacks.

• Glycerated saline is a battlefield intravenous fluid that does not freeze till -18 degrees Celsius and is useful in handling trauma cases in high altitude areas. Glycerated saline, unlike normal saline, reduces inflammation. The drug can be lifesaving, particularly if the traumatic edema, collection of fluid in tissues and cavities of the body, is in the brain or lungs.

• A special medicated dressing material, in the kit, is 200 times more absorptive than normal dressings during bleeding wounds. These cellulose fibre-based dressings are more effective in stopping bleeding and keeping the wound clean. Additionally, antiseptics, antibiotics and curcumin can be impregnated in the dressing which acts as a slow drug release system.

• Chitosan gel helps in preventing blood loss by forming a film over the wound. Coupled with platelets and red blood cells aggregation, it stops the bleeding. Its antibacterial and wound health properties are of added benefit. Chitosan gel is suitable for sealing wounds by twin action: haemostasis by chemical action and filing action. It can be used for wounds on the limbs and also cavities such as abdomen and thorax.

• Part of the range is hypocholorous acid (HOCL), a disinfectant for troopers involved in jungle warfare. It is helpful in treating necrotising fascitis, a rapidly progressing bacterial infection of soft tissues. Bacterial toxins cause local tissue damage and necrosis, as well as blunt immune system responses.

**Why do we need such kits?**

• The challenges are many. There is only one medical person and limited equipment to take care of soldiers during combat in most cases. This is compounded by battlefield conditions such as forests, hilly terrain and inaccessibility of vehicles.

**Significance and the need:**

• 90% of gravely wounded security personnel succumb to injuries within a few hours. And the availability of proper medical facilities can extend this golden period and help save lives. Chances of survival and minimum disability are highest when effective first aid care is given within the golden hour.

• The main battlefield emergencies are excess bleeding, sepsis, shock, hypovolemia (decreased blood volume) and pain. DRDO's indigenously made medicines will be a boon for paramilitary and defence personnel during warfare.

## 17. CLOUD SEEDING

The Rural Development and Panchayati Raj Department of Karnataka has called tender for cloud seeding operations during the monsoons of 2019 and 2020. It seeks to replicate the success of Project Varshadhare, executed by the state in the year 2017.

**About Cloud seeding**

• It is a weather modification process that aims to cause additional rainfall by dispersing substance chemicals (like silver iodide, potassium chloride, and sodium chloride or dry ice) into the clouds that serves as ice nuclei or condensation nuclei for moisture to form rain droplets.

• There are certain challenges associated with cloud seeding as well:

o Depends on environmental conditions like temperature and cloud composition and hence, not reliable.

o Exposure of animals and humans to silver iodide toxicity and soil contamination.

o Expensive as it requires Doppler radars for identifying rain bearing clouds and special aircrafts for seeding.

o No established mechanism to verify and determine the success of technique.

**Cloud Seeding in India**

• In India, Tamil Nadu became the first state to attempt cloud seeding in 1970s. Maharashtra and Karnataka followed in 2003, 2008 and 2017 as and when drought conditions prevailed.

• IITM's Cloud Aerosol Interaction and Precipitation Enhancement Experiment (CAIPEEX) has been involved in Cloud Seeding efforts in Maharashtra.

## 18. GRAPHENE

Researchers at Delhi's National Physical Laboratory (CSIR-NPL) have designed a low-pressure chemical vapour deposition (LPCVD) device that allows high quality, single-layer graphene to be grown.

**About Graphene**

• It is a single layer (monolayer) of carbon atoms, tightly bound in a hexagonal honeycomb lattice.

• It is an allotrope (property of some chemical elements to exist in two or more different forms, in the same physical state) of carbon.

• Graphene is the thinnest compound known to man at one atom thick, the lightest material known, the best conductor of heat at room temperature and also the best conductor of electricity known.

• It is also 100-300 times stronger than steel.

• Other notable properties of graphene are its uniform absorption of light across the visible and near-infrared parts of the spectrum and its potential suitability for use in spin transport (where electron spin is manipulated instead of charge for information processing).

**Chemical Vapour Deposition**

• It is a chemical process for depositing thin films of various materials. In a typical CVD process the substrate is exposed to one or more volatile precursors, which react and/or decompose on the substrate surface to produce the desired deposit.

• The process is often used in the semiconductor industry to produce thin films.

• Low-pressure CVD (LPCVD) involved CVD at subatmospheric pressures. Reduced pressures tend to reduce unwanted gas-phase reactions and improve film uniformity across the wafer.

## 19. CABINET NOD FOR JOINING NICE, VIENNA, LOCARNO AGREEMENTS

Recently the Union Cabinet approved the proposal for Accession of India to the Nice, Vienna and Locarno Agreements, related to the World Intellectual Property Organization's (WIPO) international classification systems.

**Background**

• Applicants for national or international IP protection are required to determine whether their creation is new or owned/claimed by someone else. To determine this, huge amounts of information must be searched.

• International classifications facilitate such searches by organizing information concerning inventions, trademarks and industrial designs into indexed, manageable structures for easy retrieval.

• WIPO administers various Classification treaties/agreements for this purpose.

**Significance of India's Accession**

• Harmonisation: These agreements will help the Intellectual Property Office in India to harmonise the classification systems for examination of trademark and design applications, in line with the classification systems followed globally.

• Facilitates ease of doing business: The move will boost foreign investor confidence in relation to protection of intellectual property (IP) in India.

• Increased rights with regard to IPR protection: The accession would also facilitate in exercising rights in decision-making processes regarding review and revision of the classifications under the agreement. It will give an opportunity to

include Indian designs, figurative elements and goods in the international classification systems.

**About WIPO**

• It is one of the 15 specialized agencies of the United Nations (UN), and is headquartered in Geneva, Switzerland. • It was created in 1967 "to encourage creative activity, to promote the protection of intellectual property throughout the world"

• It currently has 192 member states and administers 26 international treaties.

**WIPO-Administered Treaties for Classifications:**

• The Nice Agreement (1957) establishes a classification of goods and services for the purposes of registering trademarks and service marks (the Nice Classification).

• The Locarno Agreement (1968) establishes a classification for industrial designs (the Locarno Classification).

• The Vienna Agreement (1973) establishes a classification (the Vienna Classification) for marks that consist of, or contain, figurative elements.

• The International Patent Classification (1971) is used to classify patents and utility models according to the different areas of technology to which they pertain. It was established by the Strasbourg Agreement.

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