

2014

INSIGHTS SCIENCE AND TECHNOLOGY – Q&A – OCTOBER 2014



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Q-What is 'AKRUTI-KRUTIK-FORCE' programme of BARC? Explain its significance.

Technology innovation and its adaptation to the varied local conditions has to be achieved and needs to be applied quickly to enhance the quality of life of larger population. As a step forward in this process, the Bhabha Atomic Research Center (BARC) and Department of Atomic Energy (DAE) has launched Societal Initiative for utilization of Non-Power Applications (NPAs) and Spinoff technologies in the areas of water, land, agriculture, food processing and urban - rural waste management. Within this framework, structured program called "AKRUTI - KRUTIC - FORCE " has been formulated and implemented by BARC for techno - economic growth of rural sector, for large scale deployment of (NPAs) and Spinoffs.

Through this program, AKRUTI node (Advance Knowledge and Rural Technology Implementation) is set up in a village under the guidance of BARC through technically oriented NGOs working in the village, which will park a number of BARC developed technologies for use of villagers.

These technologies are demonstrated and taken to different villages around the AKRUTI node via working centers established in different villages around AKRUTI. These centres are called KRUTIK Kendra viz KRUTIK (Knowledge and Rural Technology Implementation Kendra) which work with villagers and farmers' groups and deploy these technologies in their own villages and fields. These groups are called FORCE (Farmers' Organized group for Rural Creative Entrepreneurship), each member of which are made familiar with the AKRUTI technologies by KRUTIK. AKRUTI and KRUTIK will be managed by technology oriented villagers and NGOs operating in the village.

Significance :

The mission of this programme is to empower villages with Science & Technology (S&T) based eco-friendly work plan for sustainable Techno-Economic growth of rural sector. The basic need of opportunities for innovations, work and entrepreneurship will be accomplished by modern indigenous know-how and technologies through this program.

Q-"J.C. Bose is better called as first modern scientist of India". Explain.

Acharaya Jagadish Chandra Bose, generally known as J C Bose, occupies a unique position in the history of modern Indian science. He is regarded as India's first modern scientist. Bose was a physicist who pioneered the investigation of radio and microwave optics.

-Bose proved by experimentation that plants are also sensitive to heat, cold, light, noise and various other external stimuli. Bose invented a very sophisticated instrument called Crescograph which could record and observe the minute responses of the plants to the external changes.

-Bose authored two illustrious books; 'Response in the Living and Non-living' and 'The Nervous Mechanism of Plants'. He also extensively researched the behavior of radio waves. Mostly known as a plant physiologist, he was actually a physicist.

-Many of his instruments are still on display and remain largely usable now, over 100 years later. They include various antennas, polarizer, and waveguides, which remain in use in

modern forms today. Although Bose filed for a patent for one of his inventions due to peer pressure, his reluctance to any form of patenting was well known.

-IEEE named him one of the fathers of radio science. He is also considered the father of Bengali science fiction. A crater on the moon has been named in his honor. Jagadish Bose National Science Talent Search Scholarship was created to increase scientific temper in students of India. As a pioneer, J.C. Bose has remained an inspiration to thousands of Indian students aspiring to a career in science.

Q-Write short notes on

Atomtronics

Atomtronics is an emerging technology whereby physicists use ensembles of atoms to build analogs to electronic circuit elements. Modern electronics relies on utilizing the charge properties of the electron.

Using lasers and magnetic fields, atomic systems can be engineered to have behavior analogous to that of electrons, making them an exciting platform for studying and generating alternatives to charge-based electronics.

Cryptocurrency

It is a digital or virtual currency that uses cryptography for security. A cryptocurrency is difficult to counterfeit because of this security feature. A defining feature of a cryptocurrency is that it is not issued by any central authority. So it is theoretically immune to government interference or manipulation. The anonymous nature of cryptocurrency transactions makes them well-suited for criminal activities such as money laundering and tax evasion. The first cryptocurrency to capture the public imagination was Bitcoin, which was launched in 2009. Bitcoin's success has spawned a number of competing cryptocurrencies such as Litecoin, Namecoin and PPCoin.

Claytronics

The Claytronics concept combines modular robotics, systems nanotechnology and computer science to create the dynamic, 3-Dimensional display of electronic information.

Claytronics is an abstract future to create individual nanometer-scale computers called claytronic atoms, or catoms, which can interact with each other to form tangible 3D objects that a user can interact with.

Claytronics has the potential to greatly affect many areas of daily life such as telecommunication, human-computer interfaces and entertainment.

Utility Fog

Utility Fog also known as Polymorphic Smart Materials Objects formed of "intelligent" polymorphic (able to change shape) substances, typically having an octet truss structure. Nanotechnology is based on the concept of tiny, self-replicating robots. The Utility Fog is a very simple extension of the idea. Instead of building an object atom by atom, the tiny robots link their arms together to form a solid mass in the shape of the object. This swarm of nanobots ("Foglets") can take the shape of virtually anything.

Q-What is MIRV technology? Explain its significance for India's missile defense technology.

Multiple Independently targetable Re-entry Vehicle (MIRVs) Technology has a vital role in missile technology of 21st century. This technology provides ability to deliver several warheads along separate trajectories, and flexibility of multiple targeting.

-The independent targeting capability enhances penetration and potential of destruction of larger area, effectively and precisely. MIRV provides higher nuclear capability to facilitate hitting hard targets.

Significance to India:

-India should possess MIRV technology to advance its minimum nuclear deterrence policy. Currently, Single missiles carrying more warheads; create hurdles in minimum nuclear deterrence policy and problems of constructing more missile, silos and launchers which lead to more expenditure.

-Further, potential threat from hostile neighboring countries increases the need of incorporation of MIRV. Pakistan's aggressive attitude and China's fairly strong degree of skepticism toward India and its well tested MIRV technology necessitate India's step toward this technology.

-Lastly, MIRV will strengthen India's futuristic nuclear aspiration. Agni-V has capability of launching 4-5 multiple warheads, but their yield is unknown. So deploying MIRV with Agni will give more advantageous position to India.

-Deployment of such technology is complicated and expensive. But India's continues strive for indigenization in its missile technology has kept a profound foundation which believed is significant to materialize its MIRV dream.

Q-What are Essential and Non-Essential Drugs? Discuss the recent issues and controversy with drug price control mechanism of in India.

Essential medicines are defined as those that satisfy the health care needs of the majority of a population. This concept was defined in 1975 by the World Health Organization (WHO). It is based on the premise that a limited list of carefully selected medicines, will improve quality of health care, -provide cost-effective health care and better management of medicines.

-The Government of India, recognizing the importance of the EML, prepared and published National Essential Drugs List and revised it on time to time. The remaining drugs outside the EML are known as non-essential drugs. National Pharmaceutical Pricing Authority (NPPA) issues the guidelines regarding fixing the prices of drugs through Drug (Prices Control) order. The Drug pricing is becoming complex issue in India.

-Non-essential drugs can only be controlled by NPPA in some extraordinary circumstances like the wide differences in prices among the various brands of the same generic drug (dosage, strength, etc, included) in the market. According to NPPA, non-essential drug makers can influence the doctor's prescription and patients have no choice, this is sufficient ground for intervention.

-But due to the intervention of the NPPA, pharma companies have lowered the production of these drugs, thus making supply deficit like recently during J&K flood many drugs supply was not sufficient. This is affecting the consumers most.

-Indian drug makers face reasonable competition in the market and reducing prices will affect them badly and they may tend to counterfeit drugs for cheaper production cost. Frequent changes in the prices also affect the companies' profit margins. NPPA had to finally withdraw the order of price control of non-essential drugs.

-Most of the Indians can't afford expensive medicines and health insurance coverage is also not sufficient. Public healthcare system is poor and not satisfactory to many Indians. Intervention in prices in extraordinary situation is justified only. Govt. can adopt the model of Tamil Nadu and Rajasthan govt. model of buying medicine from the drug companies at lower cost and supply it at affordable prices to the needy.

Q-Write short notes on:

LiTraCon

LiTraCon stand for Light Transmitting Concrete. It is a trademark for a translucent concrete building material. This concrete is made of 96% concrete and 4% by weight of optical fibers. The concrete comes in precast blocks of different sizes. Because of optical fibre one

can see shadows, colours and light through it. The glass optical fibres allow light to pass through the concrete no matter how thick or thin it is. The pattern is random so you can get some amazing effects with coloured lights. It can be used as a structural component to a building or as an architectural feature, or in landscaping. Three colours are available in white, grey and black.

Though expensive, Litracon appeals to architects because it is stronger than glass and translucent, unlike concrete.

Metamaterials

Metamaterials are artificial materials which are engineered to have properties that may not be found in nature. They are formed by combining multiple individual elements from conventional materials such as metals or plastics, but the materials are usually constructed into repeating patterns, often with microscopic structures. Their precise structure and arrangement can affect waves of light (electromagnetic radiation) or sound in a manner not observed in natural materials.

Potential applications of metamaterials are diverse and include remote aerospace applications, sensor detection and infrastructure monitoring, smart solar power management, public safety, radomes, high-frequency battlefield communication and lenses for high-gain antennas, improving ultrasonic sensors, and even shielding structures from earthquakes.

The research in metamaterials is interdisciplinary and involves such fields as electrical engineering, electromagnetics, classical optics, solid state physics etc.

Carbon nanotubes

Carbon nanotubes (CNTs) are allotropes of carbon with a cylindrical nanostructure. These cylindrical carbon molecules have unusual properties, which are valuable for nanotechnology, electronics, optics and other fields of materials science and technology. In particular, owing to their extraordinary thermal conductivity and mechanical and electrical properties, carbon nanotubes find applications as additives to various structural materials. For instance, nanotubes form a tiny portion of the material(s) in some (primarily carbon fiber) baseball bats, golf clubs, or car parts. Their name is derived from their long, hollow structure with the walls formed by one-atom-thick sheets of carbon, called graphene. These sheets are rolled at specific and discrete ("chiral") angles, and the combination of the rolling angle and radius decides the nanotube properties; for example, whether the individual nanotube shell is a metal or semiconductor.

Q-“China and India have huge responsibilities on climate change issues”. In the light of the statement compare and contrast their efforts at national and international level?

While developed countries like USA and European nations have started bringing down their carbon emission already, the developing countries like India and China are witnessing rise in emissions due to developmental activities and jointly contributes for more than half of the world's emission. Thus both countries have huge responsibilities towards the climate change issues.

-China, being aware of global scrutiny, has started efforts to cut down its emission by efficient technology uses and stricter norms for the industries. Health-related effects of the environmental impacts of rapid industrial growth and civil society's movement have led govt. to demonstrate greater sensitivity.

-China is planning to setup a national emissions trading system by 2016. China has engaged the U.S. at multiple levels and may bring some bilateral agreement 2015 UNFCCC Conference in Paris. It has already agreed with US that the phase down of hydro fluorocarbons (HFCs) should be negotiated under the Montreal Protocol while India wants that HFCs should be discussed under the UNFCCC which deals with greenhouse gases.

-India is also trying to combat the climate change by its 8 action plans under National Action Plan on Climate Change (NAPCC). India also has committed voluntarily to bring down its emission. But keeping the large poverty and unemployment in the view India's priority remains with the developmental projects rather than environmental friendly policies. Recent changes in the environmental protection acts and forest rights acts for speedy clearances to projects also give evidences to this priority.

Q-“There is a need for a new international agreement to secure ocean health and the sustainable and equitable use and conservation of high seas resources”. Discuss

Oceans provide half of the oxygen we breathe, food and livelihoods for millions around the globe, medicines to treat disease and support for our thriving coastal economies. And we look to the oceans to provide even more; new economic opportunities, sustainable seafood, and coastal habitats that reduce our risk from coastal storms and flooding. Marine and coastal resources are around 5% of the world's GDP and worldwide, 350 million jobs are linked to the ocean while 97% of fishers live in developing countries. Balancing these growing demands on ocean sustainably is one of the greatest conservation challenges we face.

But for too long we've taken out too many fish, polluted indiscriminately, and damaged vulnerable habitats on the seabed. We are pushing our ocean system to the point of collapse, and risking our own health and prosperity.

Without the enforcement of strong laws to protect a living ocean, a minority will continue to abuse the freedom of the high seas, plunder the riches that lie beneath the waves, take more than a fair share, and benefit at the expense of the rest of us, especially the poorest. We need a new international agreement (under the UN Convention on the Law of the Sea) to secure ocean health and the sustainable and equitable use and conservation of high seas resources. This will help to:

- a. ensure we have enough food for everyone, equitable access to new medicines from deep sea organisms, resilience in the face of the worst impacts of climate change, and protection of valuable marine habitats from destructive industries.
- b. improve the resilience of vulnerable coastal communities by providing tools for hazard and develop long-range plans for coastlines and identify solutions for risk reduction.
- c. restore corals, mangroves, oyster reefs, seagrasses and other natural habitats that dampen wave energy during storms, support local economies and offer areas for fish and other marine life to thrive.
- d. focus on improved overall governance, policies and management of our oceans at all scales, from individual sites, to regional, national and multinational levels balancing development and conservation needs.

Even though many awareness campaigns like those of melting of ice caps have already been started, there is need for more international collaborative work and inclusive participation.

Q-Write short notes on

Mission Ocean

Mission Ocean is a campaign and program by The Global Ocean Commission focused on the high seas. The mission's mandate covers overfishing, habitat and biodiversity loss, lack of effective management and enforcement, and deficiencies in governance - all issues which have implications for food security, ocean health and resilience, global security, equity and human rights. It is a joint mission to save the ocean, inviting governments, businesses, civil society and individuals to come together and take action.

Ocean Health Index

The Ocean Health Index is the assessment tool that scientifically measures key elements from all dimensions of the ocean's health - biological, physical, economic and social- to assess how sustainably people are using the ocean. It identifies people as part of a human-

ocean ecosystem. Conservation International is a founding partner of the Ocean Health Index and serves as the managing partner. It informs govt. and communities to form policies about the ocean management. The Index measures progress on human goals like food provision, carbon storage, coastal protection, livelihood, tourism and recreation, clean waters and biodiversity etc.

Quantum Dots

Nano crystal particle of semiconductor material that has capable to exhibiting quantum properties like spatial three dimension effect. used for making diode, transistor, LEDs and also for qubit in quantum computing etc. Recently used for used as flat TV screens.

Silicene

2dimensional carbon nanotube structure. Similar to graphene. But can be used as foldable property that has capacity with different frequency.

Can be used not only carbon but also other elements like N-Al-C alloy etc which give edge over others.

Synthetic diamond

Artificial technology to create diamond in laboratory. use graphite with highly ultrasound waves to create similar condition as geolithic diamond occurs. Common application are like aberration application, metling and electrical appliances.

Q-Critically analyze about the institutional problems in environmental governance and the government's approach to problems relating to the environment?

The Environment related clearance is appraised by EAC (Environment Assessment Committee) and forest related clearance by FAC (Forest Assessment Committee). Even though the final clearance is given by Ministry of Environment and Forest which generally don't go against EAC or FAC. It is important to know that the EAC doesn't have all environment experts as member but many are associated with industry as well, the ministry should apply their mind before giving approval which rarely happens due to paucity of time. In fact National Green Tribunal have also criticised the functioning of EAC.

There is also a concern over the way Environment Impact Assessment is carried out, which is generally prepared by people other than environment experts. The assessment is done based on one season only which turns out to be favorable for the project. The report is not completely made available to public but only the draft is provided. Many information like in case of thermal power plant, quality of coal wouldn't be mentioned.

All these issues makes the assessment industry friendly but affecting the environment and livelihood of many vulnerable and marginalized section people threatened.

Q-“India is suffering from problem of poor waste management that compound challenge for government to proactively innovate the methods to tackle it”. In the light of the statement explain the causes and consequences of poor waste management in India and steps taken by government to curb it?

India is suffering from problem of poor waste management that compound challenge for government to proactively innovate the methods to tackle it”. In the light of the statement explain the causes and consequences of poor waste management in India and steps taken by government to curb it?

The Indian urban space is suffering badly from the solid waste generated every day, there are multiple causes for this waste menace

- 1) No segregation Plan: The urban households doesn't follow the segregation plan at the point of generation itself which makes it difficult to segregate at later stages.
- 2) No regular collection: All the areas are not covered by municipal regular collection from the doorstep as a result people often dump the garbage on the roadside.
- 3) Plastics: A major component which is non-biodegradable makes it difficult to recycle the waste.

Consequences:

- 1) Health issues: the wastes are generally dumped in landfills which causes health issues to the local population, the other method is the use of incinerator which itself causes carcinogenic effect on the population
- 2) Protest: These people often protest against such landfills which generally goes unheard
- 3) Environment issues: The waste often pollute the water resources, land resources and air and becomes the breeding ground for variety of diseases

The Government have taken a series of steps to stop the impact but so far it has proved to ineffective due to poor implementation

- 1) The Solid waste policy requires the municipal to collect the garbage at the door step, its not properly implemented
- 2) Swatch Bharat: It is another step but its sustainability is in question

Q-“There is a growing concern of Alien Invasive Species in India”. Discuss how it is a threat for ecosystem and mention the steps required to curb this menace.

An Alien invasive species is a plant or animal that is not native to a specific location and has a tendency to spread, which is believed to cause damage to the environment, human economy and human health.

Invasive alien species (IAS) have become an environmental concern in India.

It is understood that invasive alien species (IAS) are the greatest threat to biodiversity around the globe. The introduction of IAS can be intentional or accidental. There are several examples of international introductions of exotics in the agricultural, forestry and fishery sectors. Accidental introduction mainly occurs through travel or imports such as food grains and wood. Some invasive species can affect the structure and function of ecosystems. India has a vast range of biodiversity.

There are nearly 500 wildlife sanctuaries, 101 national parks and 18 biosphere reserves. Invasive species, especially weeds, have been a serious problem for forestry and agriculture. It is estimated that out of about 45 000 species of plants recorded from India, nearly 1 800 are alien and out of the known 54 430 arthropods (including insects), nearly 1 100 are alien. Thus IAS have become an environmental issue of concern.

Both aquatic and terrestrial weeds are of concern, the former causing more problems for farming, fishing and navigation and the later for farming

There are three categories for invasive insects in forest tree crops: (i) exotic insects on exotic plants, (ii) exotic insects on native plants and (iii) native insects on native plants.

Habitat degradation and loss of biodiversity are two major consequences of IAS.

I Suggest the following steps to curb this menace

- 1) The ecosystems concerned are so sensitive that the control strategy to be adopted must be as safe as possible.
- 2) Eradication is usually not feasible but strategies can be evolved to reduce the density and abundance of invasives below the threshold level.
- 3) As a short-term strategy, insecticides and weedicides have been suggested, but they have far-reaching consequences in the long term.
- 4)The main thrust is on biological control of weeds and insects. However, care should be taken when employing exotic pathogens or parasites for biological control
- 5)There must be Coordination and cooperation between forestry and agriculture
- 6)The knowledge and expertise among the agriculture and forestry sectors have to be tapped and how to best integrate the skills of these two groups is crucial.
- 7) Networking among experts in the fields of agriculture and forestry, both at the state level and at the centres is very important.
- 8) prediction methods and risk analysis have to be perfected to suit national needs. 9) India needs to study the approaches of other countries for managing invasive species and the technologies that have been adopted.

There is an urgent need to address the various issues connected with alien weeds and insects in a focused and coordinated manner at the national level.

Q-“The choice of developing a ‘Blue Water Navy’ for India is more strategic than scientific”. Comment

A blue-water navy is a maritime force capable of operating across the deep waters of open oceans.

The choice of developing a ‘Blue Water Navy’ for India is more strategic than scientific because

- 1) India has been growing uneasy about China’s perceived ‘String of Pearls’ strategy in the Indian Ocean.
- 2) It appears to be encirclement by China’s strategic alliances and building of maritime facilities in Sri Lanka, Pakistan, Bangladesh and Myanmar.
- 3) China developing its own blue water navy, India aims to not only secure its own territory but also be able to project power farther than its shores.
- 4) China grows its influence in the Indian Ocean and India sees as its backyard, India in turn targets a strong presence in the eastern South China Sea.
- 5) The tremors of China’s increasing claims in the South China Sea are already being felt across Asia, giving the Indian Navy more reason to beef up its fleet
- 6) Most of wars have been fought on land and air, a strong navy with nuclear deployment capabilities gives India a much-needed strategic edge
- 7) it might not be a primary player in the disputed waters, India would not want to be excluded from exploring assets in the resource-rich South China Sea or elsewhere as it scours far and wide for much-needed energy sources.

As such, both countries aim to have presence in the strategically located Malacca Straits, where 40 percent of the world’s trade and more than 80 percent of China’s oil imports pass through.

A blue water navy would provide muscle for all these strategic imperatives, enhance regional power projection capabilities, more effectively protect India’s expanding energy and trade routes, and enable stronger defense and trade ties with other nations.

Q- Write short notes on

Physical internet

Physical Internet is an open global logistics system founded on physical, digital, and operational interconnectivity, through encapsulation, interfaces and protocols.

The Physical Internet is intended to replace current logistical models. The project currently has funding from the National Science Foundation as well as contributions from some other organisations

The Physical Internet Initiative's manifesto is "Transforming the way physical objects are handled, moved, stored, realized, supplied and used, aiming towards global logistics

efficiency and sustainability."It attempts to achieve this by applying concepts from internet data transfer to real-world shipping processes.

The Digital Internet does not transmit information: it transmits packets with embedded information.

The Physical Internet does not manipulate physical goods directly, whether they are materials, parts, merchandises or yet products. It manipulates exclusively containers that are explicitly designed for the Physical Internet and that encapsulate physical goods within them.

The vision of the Physical Internet involves encapsulating goods in smart, ecofriendly and modular containers ranging from the size of a maritime container to the size of a small box.

Q-India has become a surrogacy haven". Comment on the recent issues and controversies related to surrogacy in India. Do you think Indian laws on surrogacy are strong enough to tackle the issue? What are the proposed changes in ART bill 2014? (250 Words)

Surrogacy is derived from Latin term which means 'to substitute'. Surrogate mother is a process where a woman is hired to carry and deliver a child for another woman or couple with an agreement that child will be given to them after the birth. Generally there are two types of surrogates, gestational surrogates where egg and sperm from intended parents or unknown donors are put together using IVF to create embryo which is then implanted into surrogate mother uterus and Traditional surrogate where the sperm from intended father or unknown donor is implanted into surrogate mother uterus for natural fertilization to take place.

Surrogacy also referred to as artificial insemination, was allegedly believed to have been used by royal families as a way to manage their male fertility that will keep the family blood line intact for many years. What started as an act of love between family members has now turned into commercial business. India created history by being the first country to legalise the commercial surrogacy in 2002. In most of the countries it is still not legal. India has become the preferred destination for foreign couples desiring pregnancy through surrogacy. The relatively low cost to acquire surrogate mother, easy availability of a large pool of surrogates, good medical infrastructure and legal freedom which don't restrict single, gay and unmarried couples from availing this form of ART has taken India to spiralling heights in the field of int'l surrogacy. The technology which was evolved to give joy of parenthood to infertile couples has now become a business leaving behind traditional values and ethics.

There continues to be much debates and controversies surrounding surrogacy. The process is emotionally and physically stressful for surrogate mother and it is possible to develop emotional attachment with the child she is carrying that can create great amount of suffering on all the sides. There are also debates over the infringement of baby's fundamental right to mother's milk. The citizenship of the child born via indian surrogate mother but whose

biological parents are foreign nationals has created much debated and concerns because several countries have banned surrogacy and do not recognise the children born through assisted means as their citizens.

The booming baby industry is highly unregulated with lack of adequate legislation and guidelines. Presently the only existing guidelines are non statutory ones issued by ICMR in 2005. Today there exist no stipulation if the contract between the commissioned parents and surrogate mother is violated. Ministry of Health and Family Welfare, Government of India has drafted The Assisted Reproductive Technologies (Regulation) Bill . The bill proposes that the surrogate should be of 21 to 35 years of age and she should not have had more than five successful live births in her life, including her own children. The woman should be medically examined and tested for sexually transmitted and communicable diseases which might be hazardous for the baby. She is also expected to declare in writing that she has not been the recipient of blood or blood products in the past 6 months. Anyone can act as a surrogate in India-known or unknown, related or unrelated. There is a stand among experts to disallow foreign national to have children through surrogates which stems from the concerns over the citizenship of the child.

Surrogacy is a complex and challenging subject plagued with several controversies and debates over the past decades. On the one hand there is a pain of infertility and craving parenthood whereas on the other side commodization of reproductive capacity and exploitation of women and children. However it needs to be reiterated that of viewed in correct perspective, surrogacy is areproductive treatment which can provide many an instance of happiness, fulfilment and satisfaction to infertile couple.

Q-What is 'Terrestrial Observation and Predicting System'? Explain its significance.

A: Terrestrial Observation and Prediction System (TOPS) is a data and modeling software system designed to seamlessly integrate data from satellite, aircraft, and ground sensors with weather/climate and application models to expeditiously produce operational nowcasts and forecasts of ecological conditions.

Significance:

- 1) TOPS Developing ecological nowcasts and forecasts by integrating surface, satellite and climate data with simulation models.
- 2) TOPS provides reliable data on current and predicted ecosystem conditions through automation of the data retrieval, pre-processing, integration, and modeling steps, allowing TOPS data products to be used in an operational setting for a range of applications.
- 3) Implementation of TOPS over a region consists of first developing the parameterization scheme for the area of interest. Parameterization inputs include data on soils, topography, and satellite derived vegetation variables.
- 4) Observational weather data, gridded from point data or downscaled from previously gridded data to the appropriate resolution, are then used to run a land surface model.

5) Weather and climate forecasts are brought into the system as gridded fields and downscaled to the appropriate resolution to drive the land surface model and generate predictions of future ecosystem states.

6) TOPS has been engineered to automatically ingest various data fields required for model simulations. Ingested data go through a number of preprocessing filters in which each parameter is mapped to a list of attributes.

TOPS component models such that any number of land surface models can be run without extensive manual interfacing. Similarly, the model outputs also pass through a specification interface, facilitating post-processing so that model outputs can be presented as actionable information, as opposed to just another stream of data.

The Terrestrial Observation and Predicting System (TOPS) project aims to give risk determination of crop insurance, crop assessment, sampling of crop yield, early assessment of crop loss, categorizing the risk regions and more significantly forecasting the climatic conditions.

Q-Write short notes on

E-Nose

- Electronic-nose is similar to how we smell, hence termed as “E-Nose”. Electronic sensing or E-nose is a device that first identifies specific component of an odour & later analyse its chemical properties. It uses electronic sensor & pattern recognition mechanism to detect the chemicals. They are in line with biological function as in sensor receives molecules of odour & then triggers the signal to program for processing.

Though they have been found several years back, currently research is going on to make small, less expensive & more sensitive device.

They are used in sundry fields like:-

- Intelligence & security - to detect drugs or bombs.
- Health care - to detect any disease such as lung or brain cancer or any bacteria.
- Environment - to detect harmful pollutants or any gas leak.
- Others- to identify quality of food, beverages, cosmetic products, etc.

IRNSS Project

Indian Regional Navigational Satellite System (IRNSS) is autonomous regional navigation system developed by ISRO & to be launched by 2016. Objective of the project is to implement independent space borne navigation system for national application. It will not only positively impact common people but also strategically play a game changer role.

1) Services: - It has two types of services.

- Standards Positioning Service – for civil usage.
 - Restricted service – encrypted service for authorised users for security & intelligent organisation.
- 2) Segments: - divided on three segments.
- Space segment- comprising 7 satellites
 - Ground segment- in charge of estimating & predicting positioning & running navigation software.
 - User segment- able to receive & process navigation data.
- 3) Benefits :-
- Expected to provide accurate real time position, velocity & time observables for users on variety of platform 24*7 under all weather conditions.
 - No need to depend on foreign countries in time of external threat to sought GPS data.
 - Spread across 1500 km range thereby able to extend benefit to friendly neighbours & remain vigilant from cross border hostile action.
 - Useful in land, sea, air navigation, disaster management, visual & voice navigation, vehicle & fleet tracking.

Q-What are Date Tape Drugs? Discuss the issues and implications involved in cases of 'Date Tape Drugs'.

Date Tape Drugs or Predator drugs are intentionally used to commit sexual assault or crime like robbery or any other physical assault. They are also 'club drugs' as they are mostly used in dance clubs, concerts or raves. They come in pill, powder or liquid form with no odour, taste or colour thus getting easily slipped in any drink, water or food. They are invisible weapons as they immobilise victim physically & mentally such that victim is unable to refuse sex or defend, become weak, even pass out & unable to remember what has happened. Rohyphol, GHB & Ketamine are commonly found drugs. Alcohol can also be consider as drug as they too disturbed judgement & behaviour.

There are various issues & implications in such victim's case such as:-

1) Medical issue:-

- Hospital staff & physicians are often untrained to handle such drug cases.
- There is lack of specific screening knowledge to detect drugs effect.
- Moreover, these drugs easily metabolised thereafter draining out from the body. Hence, an early, say max 72 hours post event, may give positive report.
- Often there is no objection in such assault hence it's difficult to prove crime.

2) Judicial issue:-

- Victim can't narrate the incident as the memory is erased so struggle to file FIR.
- Cops always need to collate missing pieces of evidence thus stressed to solve the puzzle.
- There are hardly any witnesses, hence it becomes challenging to prove lack of consent.
- These drugs are easily available in market making more vulnerable.

3) Cultural issue:-

- Many a time's victims don't come forward as they blame themselves for such crime, also

fear no one would believe them.

- Victim are often considered guilty until proven innocent.
- It may cause death of victim.

Though evidence may be gather from cctv, phone, cars, etc. plus trained physicians & responsive society & judicial system deals with the matter meticulously, bottom line is to be vigilant as such event can be caused by stranger or acquaintance to either of the gender.

Q-What is the significance of ITER fusion experiment? Explain the difference between fusion and fission based nuclear energy mentioning the roadblocks in achieving fusion energy.

ITER is an experimental Fusion Reactor being constructed presently in France for future production of electricity from fusion energy. ITER is expected to produce at least ten times more energy than the energy required to operate it. In future demo or commercial reactors based on fusion, this energy can be converted to electricity.

The main difference between fusion and fission reactions is that fission is the splitting of an atom into two or more smaller ones while fusion is the fusing of two or more smaller atoms into a larger one. They are two different types of energy-releasing reactions in which energy is released from powerful atomic bonds between the particles within the nucleus.

Currently all nuclear power plants on the earth are using nuclear fission technology. But the fission produces much radioactive waste and less energy compared to a fusion process. The ITER, if successful, will open new windows for the world to gain energy security.

There are many hurdles that must be overcome to operate a working nuclear fusion power plant to generate electricity. Fusion power is in the form of fast neutrons that are released. Special materials need to be developed to withstand extremely high heat flux in a neutron environment.

The fusion process requires high temperature. Presently, scientists are trying to heat samples to the high temperature through two ways - magnetic fields and lasers. Neither one has yet achieved the necessary temperature. The reliability of operation of fusion reactors is also a big challenge.

Fusion energy has the potential to become a radical alternative power source, with zero carbon emissions during operation and minimal waste, but the technical difficulties in demonstrating fusion in the lab have so far proved overwhelming. These difficulties need to be doing away for the world energy security.

BIOPOLYMER

Biopolymers are polymers which are naturally found in nature.

Like polymers biopolymers are chain-like molecules made up of repeating chemical blocks and can be very long in length. The prefix bio means that they are produced by living organisms and thus are biodegradable.

Biopolymers can be classified in three groups, depending on the nature of the repeating unit they are made of: (i) polysaccharides are made of sugars, (ii) proteins of amino acids, and (iii) nucleic acids of nucleotides. The following substances are example-biopolymers for each group: cellulose (found in plants), myoglobin (muscle tissues), and DNA (genetic material of a given organism).

Q-Critically comment on the performance of NAPCC.

NAPCC was adopted in 2008 by Indian govt. to frame a comprehensive policy framework to deal with climate change. It has 8 mission plans like green India mission, solar energy mission, energy efficiency and others.

-Though it represents a significant step forward, many believe that it is insufficient and lacking in vision and real measurable targets. The NAPCC just takes the govt. existing national plans for water, solar, agriculture etc. with few new ones. But it does not formulate a well thought strategy for low carbon pathway for India.

-NAPCC does not suggest a long term agenda. Integration among missions is lacking. Segregation into missions has led to viewing the problems and solutions with sector specific lenses.

-NAPCC lays blame on developed countries without taking enough ownership for the problems. It has lack of clear targets and timelines for the actions thereby showing a lack of seriousness in the govt. commitment to dealing with climate change. The only target is vague like India's per capita emissions will not surpass those of developed world.

-The focus is on afforestation but not on the forest conservation. The Government has not clearly stated how it will finance the plan, it does not talk of any concrete financial mechanisms nor does it set out a budgetary allocation process.

-Keeping the multi-dimensionality of climate impacts in the view, India should adopt an approach that is interdisciplinary in its character, breaks traditional ministerial boundaries, and learns rapidly from the effects of warming and our successes and failures in dealing with them. Further, India should set more clear vision and targets for these missions.

Q-Write short notes on

MACE Telescope

Major Atmospheric Cerenkov Experiment Telescope (MACE) is the world's largest telescope at the highest altitude being established at Ladakh in India. It is expected to complete by 2016 and will be operated remotely by solar power.

The telescope will be the second-largest gamma ray telescope in the world and will help the scientific community enhance its understanding in the fields of astrophysics, fundamental physics, and particle acceleration mechanisms. The length of this Telescope is 21 meters.

MACE telescope has been designed with indigenous technology by ECIL with the support of BARC. Once the MACE system is operational, India will find its place in the elite scientific community working in field of Gamma Ray Study.

Square Kilometer Array

The Square Kilometer Array will be the world's largest and most sensitive radio telescope. It will be powerful enough to sense radio waves from objects millions or even billions of light years away from Earth.

The collecting areas of all the receivers that make up the SKA add up to one square kilometre - that is why the instrument is called the "Square Kilometre Array". Once complete, the thousands of SKA dishes and other types of radio receivers will work together as one gigantic, virtual instrument.

The radio telescope functions good in remote location. That's why it is being built in South Africa and West Australia and expected to be completed by 2024. Scientist will use it to help us understand how the Universe evolved, how stars and galaxies form and change, and what "dark matter" really is.

Many different countries are working together to build - and pay for - the SKA. At least 13 countries and close to 100 organizations are already involved, and more are joining the project. India is also associate member in this project and will be a full member soon.

Bio-spleen

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Q-"Space Debris can make future missions impossible". Comment on the statement explaining the phenomenon of 'Kessler Syndrome'.

Space debris or space junk/waste is the collection of unwanted and defunct parts of the old satellite, rockets etc. They orbit around the earth with very high velocity [thousands of miles per hour]. Hence even if they are 1cm in size, their impact on other valuable objects orbiting earth [satellites] is huge. They can collide and damage them. They pose even a greater threat to space crews

ITS HARMFUL EFFECTS

The amount of space debris present in the lower earth orbit [LEO] has already exceeded the critical point. They are damaging the other valuable objects like satellite, since their orbits are generally overlapping in nature.

The amount of debris is so high that the chances of collision are very high. These collisions are further increasing the debris. Hence the probability of collision keeps on increasing with more debris. This scenario is referred to as KESSELER SYNDROME.

Also, they will make all future mission impossible. Increasing amount of space junk will make space inaccessible for future generation.

Even if all the space launches are cancelled, the space debris will continue to grow because of collisions between the existing debris.

#Apart from orbit correction, there are no effective ways of protecting spacecraft from debris flying at nearly 8 km a second.

the problem is the most serious in geostationary orbits used by communications and weather satellites because junk could stay there for millions of years. "Geostationary orbits, which are a unique resource, may be lost in the next 20 years because of manmade pollution"

SOLUTIONS

To tackle the problem , the Hunter killer probe is being designed to destroy all the defunct satellites. The e.DeOrbit probe would deploy a Roman gladiator-style array of nets and harpoons to first trap rogue satellites and then drag them downwards until they burn up in

the atmosphere. Removing between five and 10 large satellites from space each year would be enough to stop the debris cloud growing.

Q-What are the potential significance of GSLV and GSLV Mark III over PSLV?

India has already proved its credentials as emerging space power with the launch of PSLV & GSLV and now with the upcoming development of GSLV Mark III, our country will join the basket of highly competitive global market for launching commercial satellites.

Though PSLV has outstanding track records & is considered as world's most reliable launch vehicle, it has a basic configuration & thus does not hold a Cryogenic engine thereby restricting it to carry bigger payloads into orbit.

In contrast, GSLV is equipped with a Cryogenic engine giving it a drive for the same volume of fuel & able to carry heavy satellites into Geostationary orbit. With this launch we are now less dependent on foreign countries to supplement our requirements for space research. GSLV is a reliable medium class launcher. It can hold the weight up to 2 tons. Whereas, GSLV Mark III development will facilitate a 4-ton launch of satellite to Geosynchronous transfer orbit. This programme is a major leap in complex technology compared to former. It's a next step for India to join the elite group of Russia & US for crew space program. It is expected to benefit all sections of the society including remote areas.

Thus GSLV has more potential in terms of advanced science & technology but PSLV's potential can be mentioned with the success of Mangalyaan and its invaluable & essential information for the benefit of future missions.

BLUE BRAIN PROJECT

The Blue Brain Project is an attempt to create a synthetic brain by reverse-engineering the mammalian brain down to the molecular level. The aim of the project is to study the brain's architectural and functional principles.

Reconstructing the brain piece by piece and building a virtual brain in a supercomputer are some of the goals of the Blue Brain Project. The virtual brain will be an exceptional tool giving neuroscientists a new understanding of the brain and a better understanding of neurological diseases.

As a first step, the project succeeded in simulating a rat cortical column. Aims currently pursued by the project are:

1. construction of a simulation on the molecular level, which will allow study of the effects of gene expression;
2. simplification of the already completed column simulation to allow for parallel simulation of large numbers of connected columns, with the ultimate goal of simulating a whole neocortex

DESIGNER BABIES

Designer babies refers to the use of genetic engineering to select desired qualities of a child. This can be done by modifying the genes of human gametes, zygotes or embryos. Parents can choose to screen embryos for sex or diseases, known as pre-implantation genetic diagnosis. This can have potential benefits in eliminating genetic diseases in the embryo leading to a healthy life for the child-to-be. However, the idea of designer babies raises a lot of ethical questions. It could help parents choose the traits that they want in their children, in future. This includes the sex of the child, which could add to the persistent sexual discrimination continuing in most societies in the world. With parents choosing their children's traits, they would have even higher expectations from the children leading to added pressure on them. This might have major negative impacts.

OUTER SPACE TREATY

The Outer Space Treaty, also known as the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, is a treaty that forms the basis of international space law.

The Outer Space Treaty represents the basic legal framework of international space law. Among its principles, it bars states party to the treaty from placing nuclear weapons or any other weapons of mass destruction in orbit of Earth, installing them on the Moon or any other celestial body. It exclusively limits the use of the Moon and other celestial bodies to peaceful purposes and expressly prohibits their use for testing weapons of any kind, conducting military manoeuvres, or establishing military bases, installations, and fortifications. However, the Treaty does not prohibit the placement of conventional weapons in orbit. The treaty also states that the exploration of outer space shall be done to benefit all countries and shall be free for exploration and use by all the States.

The treaty explicitly forbids any government from claiming a celestial resource such as the Moon or a planet, claiming that they are the common heritage of mankind.

The State that launches a space object retains jurisdiction and control over that object. The State is also liable for damages caused by their space object.

Q-Discuss the differences between LED, Mercury vapour lamps and incandescent lamps. Which among them should be more widely used and why? (200 Words)

LEDs (Light Emitting Diodes) basically consist of a junction of p-type (electron deficient or hole rich) and n-type (electron rich) semiconductors. When a voltage is applied across this junction, the holes and electrons flow across the junction and recombine, in the process, releasing light.

-They do not use mercury or any such gas as is used in the fluorescent light. This makes them environment friendly. They do not require a filament to get heated and glow to shed light unlike the case of the tungsten light bulb.

-In contrast to the incandescent bulbs and fluorescent lamps, the LEDs directly convert electricity to light particles. As a result, there is greater efficiency; in the other two cases, a great part of the electricity gets converted to heat.

-LEDs provide even distribution of light which creates a better environment and the visibility improves tremendously. Along with higher energy efficiency, Life Span of a LED is 3-4 time compare to Mercury Lamp.

-Mercury vapour lamp puts out bluish light, because it contains some amount of toxic mercury content. High-pressure sodium lamps produce light from the yellow, red and orange spectrums. The LED based efficient lighting puts out white light because consists of various colors, which undergo varying degrees of refraction and diffusion.

-LEDs are more advantageous as they produce directional light - light emitted in one direction, rather than a diffused glow - they can be used to direct light on specific areas. Unlike compact fluorescent lamps, they can be dimmed, allowing for more flexibility in controlling light levels. LEDs can also be used to blink rapidly to signal to emergency responders where they are needed.

Q-Write a note on the science behind working of an LED lamp.

LEDs are light emitting diodes. The semiconductor material used in LEDs is pure and all the atoms bond perfectly to neighbors. So impurities are added by doping to the material and additional atoms change the balance either adding free electrons or creating holes where electron can go. This makes the material more conductive.

-LED consist P-type (hole rich) and n-type (electron rich) semiconductor. When potential applied at both ends of the material, free electrons move from high density to low density area thus making current flow. The interaction between electrons and holes in this setup has an interesting side effect - it generates light.

-Photons are released as a result of moving electrons. These Photons are packets of the light. These many photons produce light simultaneously and give visible light. Green, Blue and Red Lights together produce visible white light.

Q- SHORT NOTES:

ISS-Rapid Scat:

ISS -Rapid Scat is an Earth observing instrument launched by NASA. It will monitor ocean winds for climate research as well as for weather predictions, hurricane and cyclone monitoring.

This is launched aboard the spaceXCRS-4 mission September and it has become the first to collect data in a very short time after its launch.

According to the information by NASA, ISS RapidScat has a different orbit than other remote sensing platforms and it is closer to earth. It sees Earth at different times of the day with a different schedule which will help other Earth sensing instruments in orbit today.

The testing and preparation level of this ISS-Rapid Scat is clearly reflecting through the data collected by it and it will be followed by another observatory instrument namely Global Precipitation measurement core observatory .currently there are 17 NASA earth observing missions providing data on the dynamic and complex earth system but the ISS Rapid Scat is quite different from them.

It is helpful to have such advanced observatories to reduce the hazard disaster of nature like hurricane and strong sea winds. If we had such advanced earth observatories a little earlier we could have reduce at least minimum level of loosing of lives by the cyclone Hudhud cyclone which is devastating around bay of Bengal. Hope in future such natural disasters will be observed prior to their devastating activities with the help of advanced earth observatories such as ISS-Rapid Scat.

Comet siding spring

This is an oort cloud comet discovered in January 2013. It has taken million years of years to come out from the oort cloud.

It is predicted that the comet siding spring will pass the planet Mars very closely on October 014 and it had a chance of collision with Mars immediately after it appeared however this possibility was excluded when the orbit was subsequently determined better.

The comet siding spring is expected to speed within 82000 miles of mars on October 19 2014 and dust particles in the comet's tail will be moving about 35 miles/sec. It will damage to the ISRO's MOM and NASA's many orbiter missions. So NASA planning to shift its mission farther side of planet to avoid damage and ISRO's MoM will also duck for cover behind Mars.

For mom and NASA missions this comet is both a spectacle and a hazard as it departs, siding spring's large dust trail can potential wreak do havoc on the sensitive electronic devices of earthly spacecraft and disable them.

As for the sources from ISRO, MOM will try get snapshots of this spring with its study of Mars. But it is very important to taking care of MOM 's body from exposure to large cloud of dust .

The comet which is passing through the solar system for the first time and that will approach Mars at tenth distance of the any comet has visited earth and the level of dust particles will be high.

c) Naga, Pangti and wokha amur falcons:

Amur falcon is a small raptor of the falcon family. It breeds in south eastern Siberia and northern China before migrating in large flocks across India over the Arabian sea to winter in southern Africa.

These Amur falcons are coming over India from Mongolia due to strong sea winds blowing westward. These winds are strong at an altitude of about 3000m and these birds are to fly at height of above 1000m during migration.

Naga, Pangti and wokha are the three Amur falcons which were satellite –tagged and released in the Nagaland's doyanga forest in 2013. However they migrated south Africa via bay of Bengal and some other south eastern states of India. And they again restarted their journey from south Africa in the month of April 2014.

Every year from October to November a large number of falcon arrive in the north east Nagaland for roosting from Mongolia enroute of their destination south Africa. The falcon travels upto 22000 km a year known to be one of the longest distance migration of birds.

In India the Nagaland wildlife and bio diversity conservation trust is conducting nature camps under its "Friends the Amur falcon" programme for building awareness on conservation of biodiversity among the children and villagers in the areas which Amur falcons visit for the third consecutive year.

Recently scientist discovered that perfect storm of urban change that began in 1920s Kinshasa led to the catastrophic spread of HIV across Africa and into the wider world. Elaborate.

The recent records about the origin of Pandemic HIV have shown that the perfect storm of urban change that began in 1920s Kinshasa led to the catastrophic spread of HIV across Africa and into the wider world.

Though virus was probably crossed by chimpanzees to humans in southern Cameroon years earlier, HIV was remained regional infection until it entered the capital which is now called as the democratic republic of Congo.

From 1920s till 1960 the pandemic HIV strain was because of many factors such as spread from Kinshasa, railway, and river etc. it has infected 75 million people worldwide till date.

Kinshasa was the largest and fastest growing city of the virus in the region with transport links reaching up and down the country. The Congo river is also having share in the spread of pandemic HIV strain as it was curved north and east to Kinshasa more than 600 miles away.

The railway travel by mining labours from southeast to Katanga also was the way of spreading this pandemic HIV and records show that by the 1940s more than a million people a year passed through Kinshasa on the railway alone and by 1960 the rate of new pandemic HIV infections outpaced the growth of the regional population.

Boats and trains were the hub of spreading pandemic HIV with this some other factors like Kinshasa had a high proportion of men and a consequent demand for sex-workers and some doctors may have unwittingly spread the virus further by using unsterilized jabs at sexual health centres.

As for the research done by oxford university about the reconstruction of the history of HIV pandemic, the origin of the pandemic HIV was took place in 1920s Kinshasa.

People with HIV in central Africa at the time didn't have the been written down in their specific symptoms that would have been written down their medical records. The virus causes the immune system to collapse leaving people to open to all manners of infections.

The genetic data suggests that pandemic HIV spread rapidly through the democratic republic of the Congo, a country the size western Europe spread. From the late 1930s to the early 1950s the virus spread by rail and river to Mbuji-mayi and Lumbabashi in the south and Kinshasa in the north. There the virus took hold and formed secondary reservoirs from where it spread to countries in northern India.

At first HIV was an infection confined to specific groups of people but the virus seemed to break into the general population and spread around the world after what was then known as the republic of the Congo achieved independence in 1960.

Different strains of HIV have almost certainly jumped from apes to humans through hunting or handling bushmeat scores of times throughout history. Only dozen or so incidents have left their traces in the DNA of HIV strains around today. Some outbreaks infected hundreds of thousands of people but went no further only one known as HIV -1 group went pandemic.

Q-What is 'augmented reality'? Explain it applications and benefits. (200 Words)

Augmented Reality is viewing real things in virtual environment in a computer. AR duplicates the real world's environment in a virtual reality in a computer with the help of sensory input such as sound, video, graphics or GPS data.

-Augmented reality system generates a composite view for the user. The view is the combination of the real scene viewed by the user and a virtual scene generated by the computer with some additional information. All of this takes place in real time, producing extraordinary experiences.

-The goal of Augmented Reality is to create a system in which the user cannot tell the difference between the real world and the virtual augmentation of it. Today Augmented Reality is used in entertainment, games, military training, engineering design, education, robotics, manufacturing and other industries.

-The biggest advantage of Augmented Reality is the bridge between the digital and real worlds. The promotion and marketing of products give user exceptional options and bring users a variety of truly exciting experiences.

-It provides virtual fitting room for e-commerce websites, geolocations like hotels, airports, offices etc, and 3-D graphics for education etc. It can help in validation of designs and plans through detailed 3-D maps in industrial and military purposes.

Osseointegration -

-Osseointegration is the process of formation of a direct interface between an implant and bone without intervening soft tissue. In this process, when an artificial implant like tooth or prosthetic hand or leg is connected with the bone, it makes direct structural and functional connection.

-The implants are predominantly made of titanium, a metal that is bio-compatible and offers strength and durability as well as a unique property of fusing directly to bone.

Phantom limb pain -

-Phantom limb pain refers to mild to extreme pain felt in the area where a limb has been amputated. It is like one doesn't have leg but feeling pain or itching in a toe.

Although the limb is no longer there but the nerve endings at the site of the amputation continue to send pain signals to the brain that make the brain think that the limb is still there. Sometime people also feel cold, heat, cramps etc.

Successful treatment of phantom limb pain is difficult. Some treatments include heat application, relaxation techniques, massage, physical therapy, medications and surgery to remove scar tissues etc.

Q-Write a note on the capabilities achieved and future targets set for India and Russia's BrahMos missile program. (200 Words)

Brahmos is a two stage missile developed by a joint program of India and Russia. In first stage a solid propellant booster engine brings it to supersonic speed and then gets separated. In 2nd stage, the liquid fuel takes the missile much speed in cruise phase.

Capabilities-

The missile has flight range nearly 300 Km with supersonic speed and shorter flight time. Its destructive power is enhanced due to large kinetic energy on impact. The shorter flight time gives it lower target dispersion and quicker engagement. It has pin point accuracy with high lethal power aided by large kinetic energy. It uses 'Fire and forget' principle of operation.

The missile has capabilities and configuration to be installed on Transport Launch Canister (TLC) for transportation, storage and launch for naval, air and land use.

Future developments-

Scientists are working to develop variant of BrahMos to expand its target engagement envelope by attaining a 'near vertical dive capability' to shock the enemy hidden behind mountains. The missile's air version is also under development which will be deployed on a modified Su-30 fighter next year.

Dr. A.P.J Kalam asked to develop an advanced hypersonic version of BrahMos which can be reused is needed, which will be able to deliver its payload and return to base. The scientist are currently developing BrahMos-II, a hypersonic cruise missile. While BrahMos-I has speed of 3 Mach, it will have Mach 7 speed. It will be fastest missile of the world.

Q-Write a note on how human waste can be used to produce clean energy. (150 Words)

In today's explosive population there is loud need of energy for sustainability & we human tend to exploit resource & forest to address the same. However, to acknowledge human waste as energy source is quite restricting. Using technologies we can turn this waste problem into opportunity as below:-

- Converting waste into energy not only provides sanitation solution but also gives alternative to burning wood charcoal. Charcoal briquettes produced from human faecal waste has no odour & pathogens as it is destroyed in carbonisation process. They can be promoted as domestic or industrial fuel.
- Solid waste is used to create methane gas via bioreactor which when combined with water & heated creates negative & positive charge which in turn acts as fuel to power plant sector. Also emission from this energy are carbon neutral means release less harmful by-products in atmosphere. They can also be used as fertiliser once dried via centrifugal process.
- Liquid water can also be treated in wastewater plant & thus diverted towards irrigation or gardening as it is rich in nitrogen, potassium & phosphorous.

Advantage of human waste is beyond doubt if we eliminate social barriers & include research & financial viability

Q-Write a note on technical aspects and strategic significance of Geosynchronous Satellite Launch Vehicle (GSLV) Mark III. (200 Words)

The GSLV-III or Geosynchronous Satellite Launch Vehicle Mark III is a launch vehicle under development by the ISRO. It is intended to launch satellites into geostationary orbit and as a launcher for an Indian crew vehicle. The GSLV MK-3 will feature an Indian-built cryogenic third stage and a higher payload capacity than the current GSLV.

It is being designed to make ISRO fully self reliant in launching heavier communication satellites of INSAT-4 class, which weighs 4500 to 5000 kg. It is one of the heaviest indigenous launch vehicles that is been developed till date.

The launch of GSLV Mark III will enhance India's capability to be a competitive player in the multimillion dollar commercial launch market. The vehicle envisages multi-mission launch capability for GTO (geo transfer orbit), LEO (low earth orbit), Polar and intermediate circular orbits.

Q-Examine the characteristics of Savannah biome and explain the role of natural factors within this biome in maintaining its ecosystem intact.

The main characteristic feature of the tropical savannah biome is that the large expanse of grassland is punctuated with trees and shrubs. This biome lies in the transition belt between tropical rainforest and tropical steppes and deserts.

The trees are characteristically flat topped. Savannah shrubs and trees are generally xerophytic, or drought resistant. As a natural device to protect them from seasonal dryness, nature has provided those small thick leaves, rough bark, or waxy leaf surfaces.

The largest region of this biome is found in the Sahel region and the famous Serengeti Plains of Africa. B Certain areas of Savannah biome are also found in Australia, South America and India.

Role of natural factors within this biome in maintaining its ecosystem:

The savannah has a large range of highly specialized plants and animals. They all depend on the each other to keep the environment in balance. There are over 40 different species of hoofed mammals that live on the savannas of Africa. Up to 16 different species of browsers (those who eat leaves of trees) and grazers can coexist in one area. They do this by having their own food preferences, browsing/ grazing at different heights, time of day or year to use a given area, and different places to go during the dry season.

Q-In India, setting up a new synchrotron must be seen as part of the larger national scientific endeavour. Examine why. (200 Words)

The progress registered using X-ray diffraction during the past century has been truly spectacular. Much of what we know about the structure of matter has been revealed using X-ray crystallography. A large number of Nobel Prizes have been awarded for these efforts. The first structure to be determined using X-ray crystallography contained just two independent atoms.

India has a long and distinguished tradition in crystallography, starting with the pioneering efforts of K. Banerjee, a student of C.V. Raman, in Calcutta (now Kolkata) in the 1930s. The pioneers in the area in the country included G.N. Ramachandran

and S. Ramaseshan, both students of Raman at the Indian Institute of Science (IISc) in Bangalore, and Ajit Ram Verma.

Crystallographic research now constitutes an important component of the scientific efforts in India. It encompasses inorganic and organic chemistry, materials science and biology. X-ray spectroscopy also has grown hand in hand with crystallography. X-rays have other widespread industrial and medical applications, too.

The most spectacular applications of X-ray crystallography in recent decades have been in the field of structural biology, which is concerned with the structure and structure-function relationships of biological macromolecules like proteins. These applications are often collectively referred to as macromolecular crystallography.

These different herbivores provide a wide range of food for carnivores, like lions, leopards, cheetahs, jackals and hyenas. Each species has its own preference, making it possible to live side by side and not be in competition for food.

Write short notes on the following (100 Words)

IceCube lab

It is a massive second generation observatory deployed at the South Pole for viewing high energy neutrinos.

For this it utilises numerous digital optic detectors in order to capture the phenomenon. Moreover, the gigantic size and structure is also built over almost 3 km polar ice surface. The benefit of such a location is that the ice reduces any background light which might cause interference into the faint signals emitted by the charged particles produced by high energy neutrinos.

Earth Overshoot Day

An estimate of the moment in a 12-month period when humans have consumed more natural resources than the biosphere can replace and created more waste than it can absorb.

The annual supply of land, water and trees and the planet's ability to deal with waste products, including carbon dioxide, have been used up. This means that humanity is already living off next year's supplies, which in turn means that next year's supplies will end even sooner than this year's. No wonder Earth Overshoot Day is also called Ecological Debt Day.

Earth Overshoot Day does not follow the standard practice of having a fixed commemorative day and is more of a countdown.

BrainFlight Project

The recent advances and breakthrough in the field of Neuro-science has lead researchers to take the BFP. It aims to control aircraft functions with the help of neural signals from the brain.

Brain waves are measured using EEG (electroencephalography) , which would enable seamless communication between brainwaves & aircraft equipment.

The project bears a lot of significance in the field of aviation as it will make flying a lot more easier and offer much more freedom of movement to pilots to manage other manual tasks in cockpit .

It would also reduce the work load of pilots. Safe handling ,take offs ,better placed in adverse weather situations BFP will increase flight safety. At the same time it will give a chance for novice to handle and fly planes.

Q-Write a note on the significance of climate change deal agreed by EU countries at Brussels in October 2014. (200 Words)

In new agreement in Brussels on climate change 28 members of EU countries have committed to reduce green house gas emission level by 40% upto 2030 as compared to 1990 levels.

The EU also agreed to increase the use of renewable energy to 27 per cent in the total energy mix and improve energy efficiency to at least 27 per cent. With this deal, the EU has built for itself a strong position going into the UN climate change conference in Paris in 2015.

this agreement has many great significance in terms of bold decision taken by developed countries at this point of time when many developed countries like USA,UK etc are ignoring this space of green house gas emission cut and only pressurising developing countries for taking sole responsibility.

Q-Write a note on the adverse effects of ocean acidification. (150 Words)

Ocean acidification is a global environmental issue caused by the man-made release of carbon dioxide into the atmosphere. Ocean acidification is often called the "evil twin" to climate change, because both issues are rooted in carbon dioxide emissions.

The oceans absorb almost 30 percent of the carbon dioxide from the atmosphere, but the rising amount of carbon dioxide emissions being created by human activity has surpassed what the oceans can healthfully absorb, changing ocean chemistry and making them more acidic.

Effects on Ocean acidification are:

- 1.The shift in the natural balance of the ocean's chemistry will have major adverse effects on tropical as well as cold-water corals,and the loss of many coral species will negatively impact a variety of marine life and ocean-dependent economies, such as fishing and tourism.

2. Ocean acidification may have negative impacts for many other marine species, especially those that produce shells, they have the potential to disrupt entire ocean ecosystems and disrupt food webs.

The effective way of combating ocean acidification and climate change is to reduce our carbon dioxide emissions. If action is not taken now, ocean acidification may cause widespread disruption to marine ecosystems and a massive decline of corals within this century.

Q-Write short notes on the following (100 Words)

1) Rotterdam Convention

The objective of this Convention is to promote shared responsibility and cooperative efforts among Parties in the international trade of certain hazardous chemicals in order to protect human health and the environment from potential harm and to contribute to their environmentally sound use, by facilitating information exchange about their characteristics, by providing for a national decision-making process on their import and export and by disseminating these decisions to Parties (states).

This Convention applies to:

- (a) Banned or severely restricted chemicals; and
- (b) Severely hazardous pesticide formulations.

2) Androgen Test

Androgen tests are conducted for testing of athletes for sex determination. This test is adopted by IAAF to weed out male interlopers in women's competitions.

Adopted in 2011 by IAAF and ratified by the International Olympic Committee a year later, the tests use testosterone levels to decide whether an athlete is feminine enough to take part in women's competitions. A female athlete can compete in this women category only if her testosterone levels are below the normal male range – a little over 3 mg/ml. Both men and women's bodies require androgens, the latter in smaller quantities. Androgen hormones are responsible for masculine features such as beard and deep voice. But they are also responsible for positive protein balance, sexual desire, and general well being. They hold the key to muscle strength – a function that IAAF has latched on to in its latest approach to ensure a level playing field in women's competitions.

But several medical practitioners and people involved in research area in medical science term this test as lacking the reality of truth.

3) Air Quality Index

Air quality index is an index measuring the level of pollutants in air.it is already in use in some countries like U.S.A, china and recently introduced in India.in india it takes into account the levels of PM2.5,PM10,carbon monoxide,oxides of sulphur and nitrogen and ozone.based on the level of pollutants air will be graded as good, satisfactory, moderate, poor,very poor and severe. colour coding system is also included. It will be displayed on daily basis and necessary action will be taken accordingly. Along with short term measures India should also chalk out medium and long term strategy for controlling air pollution.

Being one of the major emitters of green house gases index like this needed in our country.it will bring awareness among people and also motivates them towards climate sensitive behaviour.

Q-Examine the importance of the U.S. National Defence Authorisation Act, 2013 for India. (200 Words)

The U.S. National Defence Authorisation Act, 2013 gives the authority to to bring the export controls applicable to commercial satellites and related components and technology, which had been administered by the DoS since 1999, under the jurisdiction of the DoC. the new rules transfer commercial satellites and related components from the U.S. Munitions List (USML) of the International Traffic in Arms Regulations (ITAR) of the DoS to the Commerce Control List (CCL) of the Export Administration Regulations (EAR) of the DoC. This implies that commercial satellites and related items and technologies will no longer be treated as weapons or defence articles and defence services but as “dual-use” items. previously that old rule had significantly affected its international competitiveness.

Significance on india-----

relaxed controls on spacecraft components and subsystems, which ISRO has until now been sourcing from Europe and Japan could lead to the organisation looking at U.S. sources as well. ISRO/ Antrix would do well to go over their international shopping lists carefully to see how U.S. companies can now be a source for specific subsystems and components in terms of cost and performance advantages. But, most importantly, ISRO can now explore new opportunities for joint fabrication of satellites in association with U.S. companies.