EXPLANATION

(विज्ञान एवं प्रोद्योगिकी -2)

(SCIENCE & TECHNOLOGY -2)

अधिकतम अंक :250
Maximum Marks :250

Q.1.Explain the concept of Internet of Things (IoT) with examples. How can IoT play a role in the transformation of India into a digital economy.
इंटरनेट आफ थिंग्स (IoT) संकल्पना की उदाहरण सहित व्याख्या कीजिए। भारत को एक डिजिटल अर्थव्यवस्था में रूपांतरित करने में इंटरनेट आफ थिंग्स किस प्रकार अपनी भूमिका अदा कर सकता है।

(Marks:10, 150 words)

Approach:

- Mention the concept of Internet of Things.
- Highlight various dimensions of it.
- Highlight how IoT can help in transforming India into a digital economy.

Answer:

Internet of Things (IoT) is a system of interrelated computing devices embedded on 'things' such as physical objects, humans, etc. that enables these objects to collect and exchange data. It has been defined as "the infrastructure of the information society". For example, a car running out of fuel can automatically chart the course to nearest fuel station; fill in the appropriate amount of fuel itself and make payment. The application can range from simple health monitoring devices to complex self-adjusting smart grids, smart homes and even smart cities. Internet of Things doesn't necessarily have to be connected to the internet; it can also be a network of things.
IoT has the potential to revolutionize the role of technology in our lives. IoT allows objects to be sensed and controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency, accuracy and economic benefit. Practical applications of IoT can be found in many industries today such as precision agriculture, building management, healthcare, energy and transportation. The IoT connectivity also offers a host of development opportunities to untapped areas, including manufacturing and e-commerce to market local and traditional products.

In India, where millions of people in rural areas are not direct beneficiaries of the changing connectivity scenario, IoT can bring in real revolution. For example, most patients in rural areas do not have access to specialists. Thus, several large hospitals in the metros are beginning to offer remote consulting services in rural villages using media-rich network capabilities. Similarly, farmers can benefit through precision agriculture, balancing climate smart and profitable agriculture.

Also, barriers of communication (such as language, accessibility, etc.) can be overcome to a very large extent through IoT. This will help in sustainable and coordinated development as well as inclusive growth.

In urban areas already many applications can be seen like those where automated bill payments can be made, smart homes, water and electricity distribution, etc. Scaling up of all these will usher in a digitized economy.

IoT's contribution is not only in making accessibility of services easier and faster, but also in manufacturing. As more and more people get connected to the internet, more connected 'things' will have to be made. This provides opportunity for India to become a manufacturing hub for integrated systems and communication devices. Being an emerging market, India has a big potential owing to initiatives like 'Digital India' and 'Smart Cities'.

Q.2.Highlight the features of NAVIC and bring out its significance for India. How is it different from GAGAN? Examine whether NAVIC can be a replacement of GPS for India.
नाविक (NAVIC) की विशेषताओं पर प्रकाश डालिए तथा भारत के लिए इसके महत्व को उजागर कीजिए। यह गगन (GAGAN) से किस प्रकार भिन्न है? परीक्षण कीजिए कि क्या नाविक, भारत के लिए जीपीएस को प्रतिस्थापित कर सकता है?

(Marks:10, 150 words)

Approach:

- First of all write briefly about NAVIC and some of its features.
- Then bring out the significance of NAVIC for India and how it would make India independent in terms of navigation.
- Bring out the difference between GAGAN and NAVIC.
- Examine if NAVIC can replace GPS. Try to bring out shortcomings.

Answer:

The Indian Regional Navigation Satellite system (IRNSS) with an operational name of NAVIC is satellite and ground controller based system that is used to provide accurate real time positioning and timing services over India and regions extending to 1500 km around India.

Some of the features of NAVIC:

- The fully deployed NAVIC system consists of 3 satellites in GEO orbit and 4 satellites in GSO orbit. The full system comprises of 9 satellites including 2 on the ground as stand by.
- The NAVIC would provide two services, with the Standard Positioning Service open for civilian use, and the Restricted Service (an encrypted one) for authorized use.
- The system is intended to provide an absolute position of accuracy of better that 10 m throughout Indian landmass and better than 20 m in the Indian Ocean as well as a region extending approximately 1500 km around India.

It will reduce India's dependence on foreign navigation systems such as US' GPS. This is significant as foreign controlled navigation services may not be available during hostile situations as happened to Indian military during the Kargil War.

NAVIC is different from GAGAN in terms of functionality and dependence on GPS. While both use satellites in Geosynchronous orbits, NAVIC is a standalone navigational system, GAGAN is an implementation of Satellite-Based Augmentation System (SBAS). GAGAN or GPS Aided Geo Augmented Navigation System is a joint effort by ISRO and AAI towards modern air traffic management system over India. It improves the GPS signal by adding information from Indian satellites and ground monitoring stations. Its main use is to help in Air traffic control. It has accuracy of less than 3 m.

NAVIC's downlink signals are in two bands- S and L5. GPS' signals are in L1/L2 band, and are now available in L5 band also. The signals of L5 band can be tracked by the same antenna, and therefore, the switch can be made swiftly. However, currently most of the devices do not have the receiver for L5 band. ISRO is manufacturing the receivers that can be tuned to receive multiple frequencies. It has also encouraged start-ups to do this. Once these devices get integrated with the smartphones, the applications that use map based services only need to change source from which they fetch satellite data. However, since most of the applications already use GPS services, which provide global coverage although with less accuracy, these firms may not find it profitable to switch to NAVIC immediately.

Q.3.What are Carbon Nanotubes (CNTs) and how are they an improvement over carbon fibres? Highlight the various unique properties of CNTs which makes them suitable to the manufacturing industry.
कार्बन नैनोट्यूब क्या होते हैं तथा वे किस प्रकार कार्बन फाइबर से श्रेष्ठ हैं। कार्बन नैनोट्यूब के उन विशिष्ट गुण धर्मों पर प्रकाश डालिए जो इसे विनिर्माण उद्योग हेतु उपयुक्त बनाते हैं।

(Marks:10, 150 words)

Approach:

- Define and explain what Carbon Nanotubes are.
- Mention the difference between carbon fibre and CNT.
- Highlight the unique properties and applications of CNT specific to the manufacturing industry.

Answer:

Carbon nanotubes (CNTs) are an allotrope of carbon- they are cylindrical hollow fibers, comprised of a single sheet of pure graphite (a hexagonal lattice of carbon), having a diameter of 0.7 to 50 nanometers with lengths generally in the range of 10's of microns. Being a hollow tube comprised entirely of carbon, they are also extremely light weight. They have novel properties that make them potentially useful in a wide variety of applications in nanotechnology, electronics, optics and other fields of materials science.

Carbon fibers are fibers about 5–10 micrometres in diameter and composed mostly of carbon atoms. Some important properties of carbon fiber are- high stiffness, high tensile strength, low weight, high chemical resistance, high temperature tolerance and low thermal expansion. These make them very popular in aerospace, civil engineering, military and sports.

Carbon nanotubes, being at the nano scale have enhanced all these properties of carbon fiber. They are used as additives in various structural materials, often mixed with carbon fiber to improve these properties. They are used in golf clubs, car accessories, aerospace vehicles, etc.

Structural composites made of carbon fiber (or glass fiber) and a thermoset (e.g.epoxide) have been improved quite substantially by the introduction of carbon nanotubes.

- Stiffness and strength of materials used in load bearing applications is key as they reduce the mass and dimensions of the materials..
- CNTs are dispersed homo-genously through the metal, with strong interfacial adhesion between the CNTs and the metallic matrix.
- CNT metal matrix composites have excellent electrical properties and are used as reinforcement to metals in order to enhance their electrical properties.
- Carbon nanotubes have extremely high thermal conductivity that allows metal matrix carbon nanotubes to be used for thermal management.
- The thermal properties of CNT metal matrix composites can be improved based on the distribution and bonding of CNTs with the matrix.
- CNT metal matrix composites production is economically viable
- Composite coatings have an increase in their corrosion resistance when CNT is added to them
- Metal matrix composites have high thermal conductivity and low coefficient of thermal expansion.

The applications of CNT metal matrix composites in different manufacturing industries are listed below:

- Electronic packaging industry: Solders and heat sinks for thermal management
- Automobile industry: gears, break shoes, piston rings and cylinder liners
- Sports industry: badminton and tennis rackets and lightweight bicycles
- Space applications: structural radiators and high gain antenna boom
- Aerospace industry: landing gears and aircraft brakes
- MEMS and sensors battery and energy storage: hydrogen storage materials, micro-beams and microgears, anodes and anode coatings

Q.4.In recent years India is said to be facing a health epidemic with the rise in number of diabetics. Explain the reasons for prevalence of such a high number of diabetics in India. In which areas should efforts be directed to control this problem?

हाल के वर्षों में मधुमेह के रोगियों की संख्या में वृद्धि का के कारण कहा जा रहा है कि भारत स्वास्थ्य संबंधी एक महामारी का सामना कर रहा है। इतनी अधिक संख्या में भारत में मधुमेह रोगियों की उपस्थिति के कारणों की व्याख्या कीजिए। इस समस्या को नियंत्रित करने हेतु किस दिशा में प्रयास किए जाने चाहिए।

(Marks:10, 150 words)

Approach:

- First of all give a brief introduction about diabetes prevalence and increase in its trend in India in past decades.
- Then bring out various reasons for such high prevalence of the disease in India.
- Lastly bring out the areas where focus should be prioritized to control the epidemic.

Answer:

India is among the top three countries in the world with high diabetic population. It has also been stated therein that the prevalence of diabetes has increased by 80 per cent among women and more than doubled in India between 1980 and 2014. As per International Diabetes Federation, estimated numbers of people with diabetes (20-79 years) in India are approx. 80 million.

Some of the reasons for prevalence of such a high number of diabetes in India can be enumerated as:

- Increase in longevity and population growth have been responsible for the spike in diabetes in India, but going forward it is rising level of obesity that could well be the more significant contributing factor.

- Obesity is the most important risk factor for diabetes.
- Increased consumption of sugar rich and refined food products, central adiposity, sedentary lifestyle and genetic susceptibility are other reasons for diabetes.

The number of years both men and women live with disease and disability has shot up since 1990. In India, diabetes is one of the major causes of disability in adults which has considerable economic burden as well.
Effort must be directed at preventing and delaying the onset of the disease.

- A relatively easy and short term intervention that can go a long way in keeping the disease burden under check is to diagnose and treat gestational diabetes mostly through dietary changes and physical activities.
- Another missed opportunity is early detection of pre-diabetes - when the blood sugar level is higher than normal but not elevated enough to be classified as diabetes. The progression to full blown diabetes can be effectively delayed and even prevented.
- Also public awareness is crucial.

The World Health Day emphasis on the "Halt the Rise Beat Diabetes". Government of India is implementing NPCDCS for interventions up to District level under the National Health Mission. The programme includes creation of awareness in the society for change of lifestyle, dietary patterns, nutrition, etc. which are the major risk factors of diabetes.

Q.5.Fracking is key to shale gas extraction. Explain. Enumerate the steps taken by India for shale gas development. Also discuss the challenges that India faces in shale gas extraction.
फ्रैकिंग, शेल गैस निष्कर्षण हेतु प्रमुख है। व्याख्या कीजिए। भारत द्वारा शेल गैस के विकास के लिए उठाए गए कदमों का वर्णन कीजिए। इसके अतिरिक्त, शेल गैस निष्कर्षण में भारत के समक्ष विद्यमान चुनौतियों की चर्चा कीजिए।

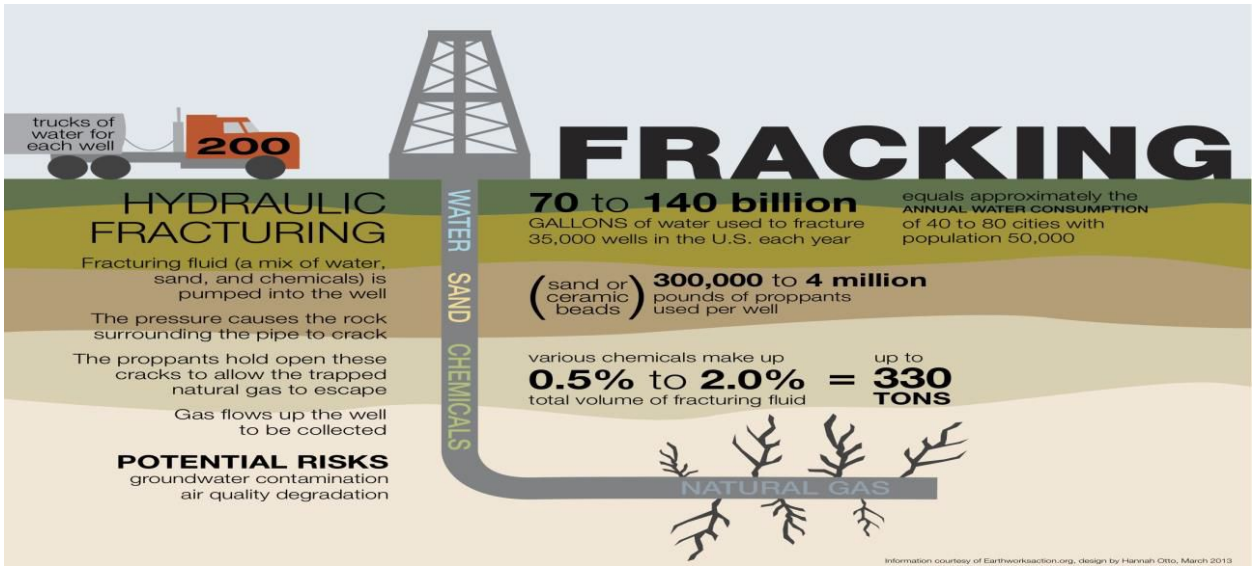
(Marks:10, 150 words)

Approach:

- Explain why fracking is essential for extraction of shale gas.
- Bring out various steps taken by India in recent past to expedite shale development.
- Bring out some challenges that India is facing in this sector.

Answer:

Shale gas is found in shale rocks that are hard and impermeable. Pressure difference created by drilling is not enough to suck them through the rocks. These rocks have to be 'broken' to reach the gas. It is done through a process called 'hydraulic fracturing' or 'fracking', involving a water mixture directed at the shale rocks at very high pressure. Thus, Fracking is key to shale gas extraction.



India, with its increasing energy requirements, is interested in developing its shale gas reserves which are estimated at 500 to 2000 trillion cubic meters. In recent times India has taken many steps for shale development. Some of them can be enumerated as:

- Allowing national oil firms to search for shale reserves on acreage already awarded to them and replacing existing profit sharing formula with revenue sharing formula.
- Adoption of HELP and NELP encourage international firms and private sector.
- The Rock Science and Rock Engineering laboratory at IIT Bombay are working on a project to develop the right technology for fracking and deployment of an advance 'permeameter', a state-of-the-art instrument to study geochemical properties under different temperatures and pressure.
- A number of MOUs have been signed for assessing our Indian Shale gas potential and pilot projects have been undertaken to drill shale gas wells.

Some challenges that shale gas exploration faces in India can be as follows;

- The country's regulatory regime means that only state-owned energy firms, ONGC and Oil India, are exploring for shale gas in India
- In the latest round of the NELP, none of the 16 blocks have been awarded to an international firm. Foreign companies have also complained about prohibitive levels of bureaucracy, which make doing business in the country very difficult.
- Another problem is the lack of technical know-how. Lack of coherent and well-organized legacy drilling data that would make understanding its shale deposits easier.
- The shortage of water – necessary for hydraulic fracturing, which is a very water-intensive process – poses another problem.

Q.6.What do you understand by Net Neutrality? Analyze the perspectives of various stakeholders on the issue. What do TRAI's regulations mean for net neutrality?

नेट तटस्थता (न्यूट्रलिटी) से आप क्या समझते हैं? इस मुद्दे पर विभिन्न हितधारकों के दृष्टिकोणों का विश्लेषण कीजिए। नेट तटस्थता के संदर्भ में ट्राई के विनियमन क्या अर्थ रखते हैं?

(Marks:10, 150 words)

Approach:

- Explain the meaning of net-neutrality.
- Discuss how various stakeholders view the issue of net-neutrality.
- Discuss the implications of TRAI regulations for net-neutrality.

Answer:

Meaning

Net neutrality means Internet that allows everyone to communicate freely.

- Service provider should allow access to all content and applications. Ex: Facebook Basics violated it when certain applications were being provided by service provider selectively.
- It ensures level playing field on the internet i.e. all websites can co-exist without hampering others.
- All websites are accessible at the same speed and no particular website of application is favored. Ex: Airtel's decision to give higher data band to websites like those of business over others for extra charges. Another instance where it was proposed to charge over the internet voice and video calls by service providers.

Perspectives of stakeholders

- **Users**: They strongly favor net-neutrality as it ensures them diverse content and applications available at free of cost.
- **Service Providers:** Want free services using internet should be charged. While application and website developers are generating revenue through advertisements etc. freely using internet, they are not getting the share of pie.
- **Content Providers and Application developers:** Oppose it since it will severely handicap the ability of small business to be online, launching web based applications, IT and ITES startups viability.
- **Business:** Established large corporates support discriminatory treatment as it will lead to specialized and quality services. They draw an analogy with services in other sectors where differentials ensure different quality of services. Facebook argued that its Facebook Basics was an effort to provide internet to poorest who cannot afford internet other-wise.
- **Government:** Favors non-discriminatory access to the internet. In this regard TRAI has issued regulations for net-neutrality.

TRAI's Regulation

- No service provider can offer or charge discriminatory tariffs for data services on the basis of content.
- Reduced tariff for accessing or providing emergency services, or at times of public emergency has been permitted.
- Financial disincentives for contravention of the regulation have also been specified.
- TRAI may review regulations after a period of two years.

Implications

These regulations have settled the debate in favor of net-neutrality. Notwithstanding the concerns of few corporates and service providers, a freely accessible internet is in favor of diverse range of users and business.

The success of Digital India programme will ensure access to internet in the remotest areas. Net neutrality will ensure that they are able to access the internet services like others. As outreach of internet will increase, service providers will gain economy of scale and thus prices are expected to drop and affordability to everyone enhanced.

Q.7.Explain the significance of gravitational waves detected by LIGO. What are the objectives of the envisaged LIGO-India project and what benefits will India accrue from it?

एल.आई.जी.ओ.(लीगो) द्वारा खोजे गए गुरुत्वीय तरंगों के महत्व की व्याख्या कीजिए। लीगो -इंडिया प्रोजेक्ट (लीगो- भारत परियोजना) के उद्देश्य क्या है तथा भारत को इससे क्या लाभ होंगे?

(Marks:10, 150 words)

Approach:

- Explain what gravitational waves are and give their significance.
- Mention the objectives of LIGO-India project and its benefits.

Answer:

Gravitational waves are 'ripples' in the fabric of space-time caused by some of the most violent and energetic processes in the Universe. When an object accelerates, it creates ripples in space-time, just like a boat causes ripples in a pond. These space-time ripples are gravitational waves. They are extremely weak so are very difficult to detect. (Ripples here mean distortions – curvature of space-time)
continuum).

The recent discovery of gravitational waves is truly incredible because of the following reasons:

- It marks three milestones for physics:
    - Direct detection of gravitational waves
    - First detection of a binary black hole system
    - The most convincing evidence to date that nature's black holes are the objects as predicted by Einstein's theory
- Gravitational waves carry 'pure information' about the objects and events that created them because unlike light waves, gravitational waves don't get distorted or altered by interactions with matter as they race through space.

LIGO-India is the prime project under the IndIGO initiative (Indian initiative in Gravitational-wave Observations). LIGO project operates three gravitational-wave (GW) detectors. Two are at Hanford ,USA, and one is at Livingston, USA. The proposed LIGO-India project aims to move one Advanced LIGO detector from Hanford to India.

The scientific benefits of LIGO-India are enormous for the following reasons:

- It will increase the chances of detection of gravitational waves in future.
- It will further inspire frontier research and development projects in India and encourage young scientists and students to join the field.
- It will bring together scientists and engineers from different fields like optics, lasers, gravitational physics, astronomy etc.
- LIGO project has facilitated major industry-academic research partnerships in USA and Europe, and has produced several important technological spin offs. LIGO-India will provide similar opportunities for India considering the high-end requirements of the project.

Q.8.how Unified Payments Interface (UPI) system different from the commen funds transfer systems? Discuss its potential to change the payments landscape in India, with special reference to financial inclusion.

एकीकृत भुगतान इंटरफ़ेस (यू.पी.आई.) प्रणाली, सामान्य निधि अंतरण प्रणालियों से किस प्रकार भिन्न है। वित्तीय समावेशन के विशेष संदर्भ में, इस प्रणाली द्वारा भारत में भुगतान परिदृश्य को बदल सकने की संभावना पर चर्चा कीजिए।

(Marks:10, 150 words)

Approach:

- Describe Unified Payments Interface (UPI).
- Highlight distinguishing features and improvements.
- Discuss its potential in improving payment systems and extending financial inclusion.

Answer:

UPI is a payment system that would allow people to people or P2P transactions from any bank account to another, using a mobile phone application. It is an improved version of the existing Immediate Payment Service (IMPS). It will simplify payment systems, provide a single interface across all segments, and help move towards a cashless economy.

Distinguishing Features

- **Instant money transfer**: UPI transfers money in real-time using virtual identity of the beneficiary. Whereas, the prevailing systems take some time in processing the transfers, like NEFT and RTGS, that too only during bank working hours.
- **Destination variability**: UPI enables transfer to multiple kind of destination (individual, vendor, banks etc.). Whereas, current payment systems are restricted to transferring money to bank account of the recipient.
- **Privacy:** In order to ensure privacy of customer's data, there is no account number mapper anywhere other than the customer's own bank. Whereas, the prevailing system needs all these information.
- **Phone-Centric:** UPI is mobile interface and will work on mobile phones only. Whereas, the current payment systems may be done using mobile, laptops etc. with elaborate procedure.

Potential of UPI to change the Payments Landscape and role in Financial Inclusion

- Payments have been one of the biggest hurdles for mass adoption of online shopping in India. UPI brings next innovation such as e-payments on delivery supporting the growth of e-commerce by reducing cash on delivery and wallets.
- Use of UPI would promote cashless transaction thereby reducing counterfeiting of currencies and financial inclusion using the latest technology.
- Important for implementation of the JAM trinity for promoting financial inclusion.
- It will facilitate micropayments and person-to-person payments.
- It will soon become an important payment platform for all merchants and customers for easy payment.
- It would also make transferring remittances easier.

Challenges

- Penetration of affordable telecom services of adequate quality.
- Cyber security and confidence of people on e-transaction.

Therefore, there is need to protecting the system from security breaches and fraudulent transactions and improve grievance redressal systems for such cases. Apart from this, the focus should also be towards bringing in those outside the payments universe and those without smartphones.

Q.9.Discuss the key challenges associated with global internet governance? What is India's stand with respect to it?

वैश्विक इंटरनेट गवर्नेंस के साथ संबद्ध मुख्य चुनौतियों पर चर्चा कीजिए। इस संबंध में भारत का क्या रुख है।

(Marks:10, 150 words)

Approach:

- Discuss key challenges associated with global internet governance.
- Also, explain India's stand with respect to the governance of internet.

Answer:

With access to internet increasingly becoming a key developmental need, defining policies and mechanisms for the governance is crucial for its growth and development. An international legal framework is required to make a user secure in the cyberspace.

Key challenges

- The independence of ICANN whose oversight is effectively with USA leading to possible intervention in ICANN's policy process
- Dominance of certain groups and organisations which ensures lack of democracy in the current system
- Limitations in terms of expertise & transparency with UN, when it comes to decisions related to internet policy.
- Lack of consensus among countries over global internet governance architecture such as multi stakeholder approach or multilateral approach.
- There are complicated and technical legal issues involved in governing and regulating social media such as Facebook.

India's stand with respect to Internet Governance

- India has supported 'multi-stakeholder' model of governance that consults governments, industry, civil society and technical community while making decisions that affect the Internet.
- India declared its support for multi-stakeholder governance of the Internet at the ICANN Summit at Marrakesh in Morocco.
- India has opposed this point of view in the past, favouring the 'multilateral model' in which national governments make decisions through an equal vote, arguing that this is the most equitable model.
- The change in India's stand globally signals potential openness to consultative policy-making.

Q.10.What do you understand by methanol economy? Discuss its environmental and economic advantages. How does methanol compare with other new generational fuels such as ethanol and hydrogen?
मेथेनॉल अर्थव्यवस्था से आप क्या समझते हैं ? इसके पर्यावरणीय और आर्थिक लाभों की चर्चा कीजिए। नई पीढ़ी के अन्य ईंधनों यथा एथेनॉल और हाइड्रोजन से मेथनॉल की तुलना कीजिए।

(Marks:10, 150 words)

Approach:

- Explain the concept of methanol economy.
- Discuss its economic and environmental advantages.
- Compare methanol with other new generation fuels.

Answer:

Methanol economy is a suggested future economy in which methanol and dimethyl ether replace fossil fuels as means of energy storage, ground transportation fuel, and raw material for synthetic hydrocarbons and their products. It offers an alternative to the proposed hydrogen economy or ethanol economy.

Economic advantages

- Efficient energy storage by volume, as compared with compressed hydrogen.
- With small, relatively inexpensive, modifications to the engine, petrol and diesel cars can be made methanol compatible. In fact, if the percentage of methanol is under 15 per cent, even existing engines can run the fuel.
- Methanol produced in India, can be exported to neighbouring countries like Bangladesh, Nepal and Pakistan, which have comparable economies and with similar energy circumstances.

Environmental advantages

- Methanol is the simplest form of alcohol, since it has carbon-carbon single bond and does not emit particulate matter making clean fuel.
- It can be easily produced from renewable sources like agricultural & biomass waste through gasification.
- Its production can be an effective waste management method.
- It provides a feasible and safe way to store energy, makes available a convenient liquid fuel, and assures unlimited source of hydrocarbons while at the same time mitigating the dangers of global warming.

Comparison with ethanol

- There is no need to use food crops and compete with food production.
- The amount of methanol that can be generated from biomass is greater than ethanol.
- It can be blended in gasoline like ethanol.

Comparison with Hydrogen

- It is user friendly while Hydrogen is volatile.

- It can be blended with gasoline.
- Making storage systems hydrogen leakage proof is a lot more difficult than preventing leakage from methanol.

Investing in a methanol economy might be the required push for the energy sector, considering the costs of plunging in new technology and implementing it in a nation as big as India it still is a daunting task.

Q.11.Whereas various policy measures over the years have put emphasis on innovation yet India lags behind globally on the innovation indices. Examining the factors contributing to such a scenario, identify the steps taken in recent years to address the issue.

विविध नीतिगत उपायों ने नवोन्मेष पर बल दिया है, फिर भी भारत नवोन्मेष सूचकांक में वैश्विक रूप से पीछे है। इस परिदृश्य के लिए उत्तरदायी कारकों का परीक्षण करते हुए, इस मुद्दे के समाधान के लिए हाल ही में उठाए गए कदमों की पहचान कीजिए।

(Marks:15, 250 words)

Approach:

- Introduce about poor innovation indices in India
- Lay out factors that are responsible to a lack of environment for innovation.
- Govt. actions in recent times on the improving innovation indices.

Answer:

India has no dearth of innovation initiatives, both in the government and the private sector. Yet, the country continues to lag behind other nations as per many surveys including Global Innovation Report.

Factors Contributing to such a scenario:

- India's intellectual property laws are not in sync with global practices in the developed world.
- Export subsidies do not do enough to promote innovation for SMEs and entrepreneurs.
- Inadequate amount of resources dedicated to developing human capital for education.
- Poor investment in higher education means that India doesn't do well in research outcomes.
- R&D expenditure as a percentage of GDP is far lesser than other countries. Not only is the quantum of research poor, but also the quality of research is lacking
- India does not have a technology transfer legislation that would enable the transfer of know-how from university research labs to the private sector for commercialization
- Inter-movement between academia and industry is not easy, leading to poor collaboration
- Brain-drain to western countries for higher education and among research scholars

Steps taken in recent years to address the issue

- New IPR policy to encourage innovation, awareness and commercialisation of IPRs.
- New ministry to promote entrepreneurship and skill development created Atal Innovation Mission.
- Start-Up India to develop ecosystem where innovation thrives.
- National Knowledge Network to increase collaboration and interaction among educational institutes.
- Improvement in Ease of doing business under Make-in-India, labour reforms and FDI relaxations will lead to more investments and hence more innovation.
- Programs like INSPIRE to promote talent in field of science and technology.
- Imprint India, set up as a single-window mechanism to screen research proposals from India's research and technology institutes.

Q.12.Give a brief explanation of CRISPR - gene editing technology. Also discuss its significance in modern biology and agriculture.

जीन एडिटिंग प्रौद्योगिकी -सी.आर.आई.एस.पी.आर. (क्रिस्पर) की संक्षिप्त व्याख्या प्रस्तुत कीजिए। आधुनिक जीव विज्ञान तथा कृषि में इसके महत्व पर भी चर्चा कीजिए।

(Marks:15, 250 words)

Approach:

- Explain CRISPR - gene editing technology.
- Explain its significance in modern biology and agriculture.
- Highlight the challenges.

Answer:

CRISPR/CAS9 is a new gene-editing technology that promises to revolutionize the genetics field. Using this technology, genes of any living organism can be edited at a faster and cheaper rate than the present technologies. By comparison, older gene-editing tools are cumbersome, inaccurate and inefficient.

- It utilizes Cas9, an enzyme which acts as "molecular scissors" and helps in cutting the DNA sequence.
- The technology makes it possible to carry out cutting and replacing/pasting of DNA with high degree of flexibility and accuracy.
- It allows for the introduction or removal of more than one gene at a time.
- This technique is not species-specific, but can be used on organisms previously resistant to genetic engineering.

The technology possesses great significance for the field of biology and agriculture.

Biology

- **New treatment -** It is beneficial for developing new treatment of various diseases like:
    - Rare metabolic disorders and infectious diseases, by making more specific antibiotics that target only disease-causing bacteria while sparing beneficial bacteria.
    - New methods in gene therapy to provide remedies for simple genetic disorders like sickle-cell anemia and eventually curing more complex diseases involving multiple genes.
- **Testing methodology -** It can also be used to create transgenic animals such as rats, mice etc. which can be used for testing new medicines.
- **To induce immunity -** The technology is also being used to make human cells immune to diseases like HIV. Also, malaria-resistant mosquitos are also being developed.
- **Create human organs** - Scientists are also working to create human organs from transgenic pigs by use of this technology in conjunction with pluripotent stem cells.

Agriculture

- It will help in design of new variety of grains, roots and fruits which can be resistant to climate change.
- It could "pave the way toward sustainable agriculture" by reversing pesticide resistance in insects and herbicide resistance in weeds.
- It can avoid the introduction of genes from unrelated species into the crop plants, which is the main cause of concern in the present technology.
- It will also improve livestock. For example, this technique has been used by researchers in various countries for meatier pigs, muscular goats, hornless cattle etc.

However, the CRISPR is also likely to face some issues:

- The technology is very inexpensive and is available to any researcher who wants to modify human embryos.
- Scientists including the inventor of the technology are urging for a moratorium on applying the technology to human 'germ-line' cells.
- There are safety concerns as well.
- The technology is still in infancy stage and the consequences are unknown.
- The changes in one part of genome may cause changes elsewhere and it could result in unforeseen consequences.

Q.13.The rise of antibiotic resistant bacteria can be attributed to many factors and is a cause of global concern. Elaborate. Explain how surveillance, research and global cooperation are key in tackling this menace with special reference to India as a global pharmaceutical hub.

प्रतिजैविक-प्रतिरोधी जीवाणुओं (antibiotic-resistant बैक्टीरिया) में वृद्धि के पीछे कई कारण हो सकते हैं तथा यह वैश्विक चिंता का विषय है। सविस्तार बताइए। एक वैश्विक औषधीय केंद्र के रूप में भारत को संदर्भित करते हुए व्याख्या कीजिए कि किस प्रकार निगरानी, शोध तथा वैश्विक सहयोग वस्तुतः इस खतरे से निपटने हेतु आवश्यक है।

(Marks:15, 250 words)

Approach:

- Briefly comment on the increase in antibiotic resistance bacteria.
- Discuss its reason for being a global concern.
- Explain how surveillance, research and global cooperation are a key in tackling this menace with reference to India.

Answer:

Antibiotic resistant bacteria mean bacteria which have become immune to the antibiotics used to control or kill them. There has been a rise in their menace owing to indiscriminate use of antibiotics due to over-prescription by doctors and easy availability. As a result bacteria have developed immunity and even highest doses of antibiotics are failing to treat diseases.

These resistant bacteria pose a major global threat to public health. A new report by the World Health Organization (WHO) analysed data from 114 countries and observed that resistance was happening now in every region of the world. It described a post-antibiotic era, where people die from simple infections that have been treatable for decades. There were likely to be devastating implications unless significant action was taken urgently.

To counter this trend steps mainly surveillance, research and global cooperation are required:

- **Surveillance** - better hygiene, access to clean water, infection control in healthcare facilities, and vaccination to reduce the need for antibiotics. The government needs to introduce incentives for industry to develop new, affordable antibiotics and adapt to the needs of developing countries where the vaccination rates are low and hygiene conditions are poor.
- **Research -** more new antibiotics need to be developed. It is vital that microbiologists and other researchers work together to develop new approaches to tackle antimicrobial resistance. These approaches will include studies to develop new rapid-diagnostic devices, fundamental research to understand how microbes become resistant to drugs, and how human behaviour influences the spread of resistance. India has developed expertise in low cost drugs. Hence, it can be a fulcrum of research and development of cheap and effective antibiotics.
- **International collaboration** - global coordinated efforts by pooling the human, economic and technical resources are required. Learning and sharing from the creative approaches of different countries. For example, red line campaign in India to curb over the counter sale should be followed elsewhere.

Less developed countries are less equipped to handle it due to limited capital and technological development clubbed with poor healthcare infrastructure. Hence, India can provide leadership in fighting the antibiotic resistance as it has already developed innovation and capacities in the pharmacy sector.

Q.14.Explain the principle behind signal propagation in an Optical Fibre. Why is optical fibre network considered critical to meet the goals of Digital India Programme? Discuss the challenges being faced in implementation of Bharatnet and give suggestions to overcome them.

किसी ऑप्टिकल फाइबर में संकेत के प्रसारण के सिद्धांत की व्याख्या कीजिए। डिजिटल भारत कार्यक्रम के लक्ष्यों को प्राप्त करने हेतु ऑप्टिकल फाइबर नेटवर्क को क्यों महत्वपूर्ण समझा जा रहा है? भारतनेट के कार्यान्वयन में सामना की जा रही चुनौतियों पर चर्चा कीजिये तथा उनसे निपटने के लिए सुझाव प्रस्तुत कीजिए।

(Marks:15, 250 words)

Approach:

- Explain the principle of signal propagation in an Optical Fibre.
- Discuss the importance of optical fibre network for Digital India.
- Discuss the challenges being faced in implementation of NOFN/Bharatnet and give suggestions to overcome them.

Answer:

Optical fibre is made up of semiconducting materials and usually has a cylindrical structure. In inner core there is material of higher refractive index than in outer core resulting in Total Internal Reflection (TIR).

Thus signal keeps moving along the axis and never passes out from curved surface while there is almost no loss of energy during transmission.

Optical fibre are roots of Digital India as they provide end connectivity to users in the remotest part of the country and establish G2C and C2C interface at all levels and almost all spheres of life. Government is moving towards total e-governance and digital infrastructure is vital to realize such goals.

National Optical Fibre Network (NOFN), also known as Bharatnet, is a project to provide broadband connectivity to 2.5 lakh gram panchayats across the country. However, laying down optical fibre has multiple challenges:

- Bharatnet or NOFN is to be executed based on PPP model where a SPV, Bharat Broadband Network Ltd (BBNL) has been constituted. However, the evolution of viable PPP models in various regions is a problem.

- Problem of autonomy, flexibility and quick decision making of BBNL has been reported.
- Land acquisition and construction on private lands and populated areas is an issue.
- Right of Way (RoW) has not been sorted out yet. Some states are charging exorbitant charges while some are demanding free bandwidth for government establishments. Indian Telegraph Act, 1885 does not notify the rules on Right of Way which is a sensitive area involving centre-state jurisdiction. As per the act, only the Centre can legislate over such subjects, but provides for reasonable conditions that local authorities can impose while granting Right of Way permissions.

Thus there is a need of sound cooperation between the centre and states. Moreover,

- All the stakeholders i.e. states, local governments and people must be taken along and awareness about the project be increased to reduce resistance by people.
- Besides, we should also come up with a robust PPP policy which facilitates single easy exit and negotiations during and after the execution of projects.
- We can allow private sector to generate revenue from extra capacity. For instance, if the private company builds up the fibre network and 50 per cent of it is used by BharatNet, it can make money the way it wants from the remaining unutilised 50 per cent.
- BBNL must be provided with greater autonomy and flexibility.

Q.15.Discuss the grounds on which introduction of genetically modified crops are resisted in India. Can focus on traditional farming practices provide an alternative to GM crops in dealing with the problem of food shortage?

भारत में अनुवांशिक रूप से संशोधित फसलों की कृषि का प्रारंभ में जिन आधारों पर प्रतिरोध किया जाता है, उनकी चर्चा कीजिए। क्या खाद्य की कमी की समस्या के समाधान हेतु पारंपरिक कृषि प्रथाओं पर बल देना, जी.एम. फसलों का एक विकल्प हो सकता है?

(Marks:15, 250 words)

Approach:

- Briefly mention the status of GM crops in India - their acceptance in commercial crops and their non-acceptance in food crops.
- Then mention the reasons for their non-acceptance in India.
- Explain the relevance of traditional farming practices. Focus on food shortage as an issue.

Answer:

India has the world's fourth largest GM crop acreage due to Bt-cotton. However, GM food crops have not gained the same acceptance. Moratorium was imposed on commercialization of Bt-Brinjal following opposition from civil society groups and brinjal growing states.

- Multiple studies have shown no human or ecological ill-effects of GM crops, as well as increased yields and resistance to pests among other benefits. But authenticity of such studies has been questioned by some civil society groups alleging them to be at the behest of GM corporates.
- Bt cotton has been blamed for economic distress and farmer suicides and questions raised on biodiversity and horizontal gene transfer.
- Regulatory regime was pointed out as being inadequate by the Supreme Court.
- Fears of market monopolies in seeds and danger to food sovereignty.

Many suggest replacing traditional farming practices as a solution to the issues posed by GM crops.

- Instead of synthetic pesticides or fertilizers, organic farmers should rely on biological diversity in the field to naturally reduce habitat for pest organisms. Organic farmers also purposefully maintain and replenish the fertility of the soil. Weeds are controlled naturally (crop rotation, hand weeding, mulching, and tilling). Insects are controlled using natural methods (birds, good insects, traps).
- Traditional farmers use traditional varieties which are more suited to the local climate and region.

However, a major criticism is the low yield of such crops, which may not be enough to feed the needs of a rapidly growing population. Given agricultural distress calls for utilising the potential of GM crops to supplement broad reforms. Sustainable systems require smart combinations of all areas of science. In India, GM crops need regulation, not moratorium. Biotechnology Regulatory Authority of India Bill should be taken up again. It will create regulatory certainty, scientific testing and encourage the entry of competitors that could check monopolistic conditions thus allaying most of the fears.

Q.16.In context of space technology, what is a Reusable Launch Vehicle? Examine the rationale behind its development. Discuss the technological and economic challenges that RLV development faces in India.
अंतरिक्ष प्रौद्योगिकी के संदर्भ में, पुनर्प्रयोज्य प्रक्षेपण यान (रीयूजेबल लॉन्च व्हीकल) से आपका आशय क्या है? इसके विकास के पीछे अन्तर्निहित उद्देश्य का परीक्षण कीजिए। भारत में, रीयूजेबल लांच व्हीकल के विकास के समक्ष आने वाली प्रौद्योगिकीय तथा आर्थिक चुनौतियों पर चर्चा कीजिए।

(Marks:15, 250 words)

Approach:
Explain the technology of Reusable Launch Vehicle in the context of ISRO's experiment.
Compare it with the present launch technology.
Write about the technological and economic challenges. Give a positive and futuristic conclusion.

Answer:

A reusable launch vehicle (RLV) is a launch system which is capable of launching a payload into space more than once. This contrasts with expendable launch systems which are of the use-and-throw kind, which mostly fall into sea after their job, or sometimes float in space adding to space debris.
Reusable rockets can save the costs of building a new vehicle for every launch, and also the manufacturing time, thus enabling more frequent launches. ISRO has successfully demonstrated the technology.

Technological Challenges:

- It demands re-entry of a fast moving satellite in earth's atmosphere at an appropriate angle which can be achieved only by high maneuvering technology.
- On re-entry the temperature as high as 2000 degree C is generated and thus a material to withstand this temperature is needed.

Economic Challenges:

- It is estimated that RLV, once fully developed in about a decade, could bring down launch costs 8-10 times. However, since no RLVs have been used except in NASA's space shuttle programme, there is little direct evidence for cost reductions.
- The cost advantage of a reusable vehicle can become evident only over several launches. That is because the development cost of RLV far exceeds the manufacturing cost of an existing launch vehicle.
- The cost advantage also depends on the degree of reusability built into the vehicle. There are different stages to the flight of a launch vehicle. At each stage, a part of the rocket breaks off, while providing thrust to the remainder to keep going. A partially reusable launch vehicle is uneconomical.

However, in ISRO's launch, critical technologies such as autonomous navigation, guidance & control, reusable thermal protection system and re-entry mission management have been successfully validated. Thus, ISRO's successful experiment this year is a baby step towards acquiring the technology and making India an important space research power.

Q.17.Differentiating between Augmented Reality and Virtual Reality, explain why it is argued by many that these technologies are not just about gaming but can also change our lives.
ऑगमेंटेड रियलिटी और वर्चुअल रियलिटी (संवर्धित वास्तविकता और आभासी वास्तविकता) के बीच अंतर स्पष्ट कीजिए । व्याख्या कीजिए कि अनेक व्यक्तियों द्वारा यह तर्क क्यों दिया जाता है कि ये प्रौद्योगिकियां केवल गेमिंग के लिए ही नहीं है बल्कि हमारे जीवन को भी परिवर्तित कर सकती हैं।

(Marks:15, 250 words)

Approach:

- Briefly explain what Virtual Reality (VR) and Augmented Reality (AR) are.
- Differentiate between both of them.
- Explain how they can impact human life by giving an account of their applications.

Answer:

VR is use of computer technology to create a simulated environment where, users are immersed and able to interact with the 3D world. It replaces real world with stimulated world. AR is a live direct or indirect view of a physical, real-world environment whose elements are augmented or supplemented by computer-generated sensory input such as sound, video, graphics or GPS data.

Both these technologies are very much useful in the gaming world as they enhance the user interface. However, there are many other uses of these technologies like:

- **Military:** Allows recruits to train under a controlled environment where they are to respond to different types of combat situations and wide variety of terrains.
- **Medical personnel** are able to train through these to deal with wider variety of injuries.
- **Engineering:** Useful in product engineering and manufacturing engineering. These enable engineers, management and investors to see virtual prototypes prior to physical prototypes.
- **Heritage sites** to be recreated: Original sites are often inaccessible to the public due to poor state of their preservation. They can be used to develop virtual replicas of caves, natural environment, old towns, monuments, sculptures and archaeological elements.
- **Navigation:** AR can augment effectiveness of navigation devices. Information can be displayed on an automobile's windshield indicating destination directions and meter, weather, terrain, road conditions and traffic information as well as alerts to potential hazards in their path.
- **Architects and Real Estate agents** can use VR/AR to build designs.
- **Education:** AR/VR applications can complement a standard curriculum. Text, graphics, video and audio can be superimposed into a student's real time environment.
- **Therapeutic role** through application to exposure therapy, including phobia treatments.
- **Urban planning and transportation projects** through incorporated precision spatial information.
- **Business, retailers** have developed systems that allow their products to be seen in virtual reality giving consumers a better idea of how product will fit into their homes.
- **Charitable work:** Panoramic 360 views of conflict in Syria have been used in experiential activations and shared online to both educate and gain financial support for such charitable work
- **Broadcasting** live events like sports in 360-degree virtual reality.

However, the problem with the present situation is that the whole system of VR/AR is very expensive, which makes its access difficult for poor. Apart from that the changing nature of technology makes it difficult for the elderly people. Further, AR requires high speed internet, which is still limited.

Q.18.Digital technologies have the potential to dramatically transform higher education. Giving a special emphasis to MOOCs, analyse the statement in the context of India.

डिजिटल प्रौद्योगिकीयों में उच्च शिक्षा को नाटकीय ढंग से रूपांतरित करने की क्षमता है। MOOCs पर विशेष बल देते हुए, भारत के संदर्भ में इस कथन का विश्लेषण कीजिए।

(Marks:15, 250 words)

Approach:

- Briefly discuss the issues in Indian higher education and how digital technologies can help to address these.
- List the strengths and weaknesses of MOOCs in Indian context and recent initiatives of the government in this regard.

Answer:

Use of digital technologies can be appropriately leveraged to provide online learning platforms (like MOOCs), digital libraries, digital labs, adaptive learning technologies and analytic services for teachers and students.

Digital technologies have the potential to address a number of qualitative and quantitative issues plaguing higher education:

- Limitation of public funding, high costs of physical infrastructure translating into higher fees.
- Vacancy of faculty in Central Universities .
- Lack of engagement of universities with industry and alumni.
- Accessibility and equity issues

Potential of MOOCs in India

MOOCs offer a potential revolution in education that will make the highest quality education available to everyone regardless of their socio-economic background. Various benefits of MOOCs include:

- They could pave the way for increasing speed, scale and efficiency of teaching in the higher education system.

- Address dynamic demand for training and re-training professionals throughout their careers which cannot be addressed through university education.
- Crucial for Skill India and Make in India (many MOOCs provide certification for courses undertaken).
- Online instruction supplemented by periodic classroom interaction could provide a solution for retaining essential elements of traditional pedagogy.
- They can act as a bridge between universities, industry and alumni.
- Potential for job creation in education, IT and related sectors.
- They will help India in its transition to a knowledge-based economy.
- Access to courses offered by foreign universities.

Various challenges in delivering higher education through MOOCs in India

- Technological barriers: technological infrastructure - computers, mobile devices, and high-speed internet need to be further developed.
- Untapped Mobile phone potential-needs to be tapped.
- Overcoming Digital Divide- between urban, semi-urban and rural areas.
- Educational barriers: In addition to offering traditional university-level content, MOOC providers should offer more pre-university level courses that can supplement primary and secondary education.
- Fear of exacerbating educational inequality by allowing privileged elite access to personalized education in physical universities while confining majority to virtual education, which might lower cost but also quality.

Globally MOOCs have become a popular tool in revolutionizing education with MOOCs enrolling students from India and around the globe. Following steps in this regard are noteworthy:

- AICTE has mandated that 10% of curriculum in country's technical institutes should come from MOOCs.
- MOOCs are being offered by some IITs as well.

If the hurdles restricting access to these courses can be overcome, millions of Indians can have better access to quality higher education, dramatically changing higher education in India and the world.

Q.19.Explain in brief the three staged nuclear program of India. What are the advantages of thorium over other nuclear fuels? Examine the hurdles in the way of large-scale deployment of thorium-fuelled reactors in India.

संक्षेप में भारत के तीन चरणों वाले नाभिकीय कार्यक्रम की व्याख्या कीजिए। थोरियम अन्य नाभिकीय ईंधनों से किस मायने में बेहतर है? भारत में वृहद पैमाने पर थोरियम- ईंधन आधारित रिएक्टरों को स्थापित करने के मार्ग में उपस्थित चुनौतियों का परीक्षण कीजिए।

(Marks:15, 250 words)

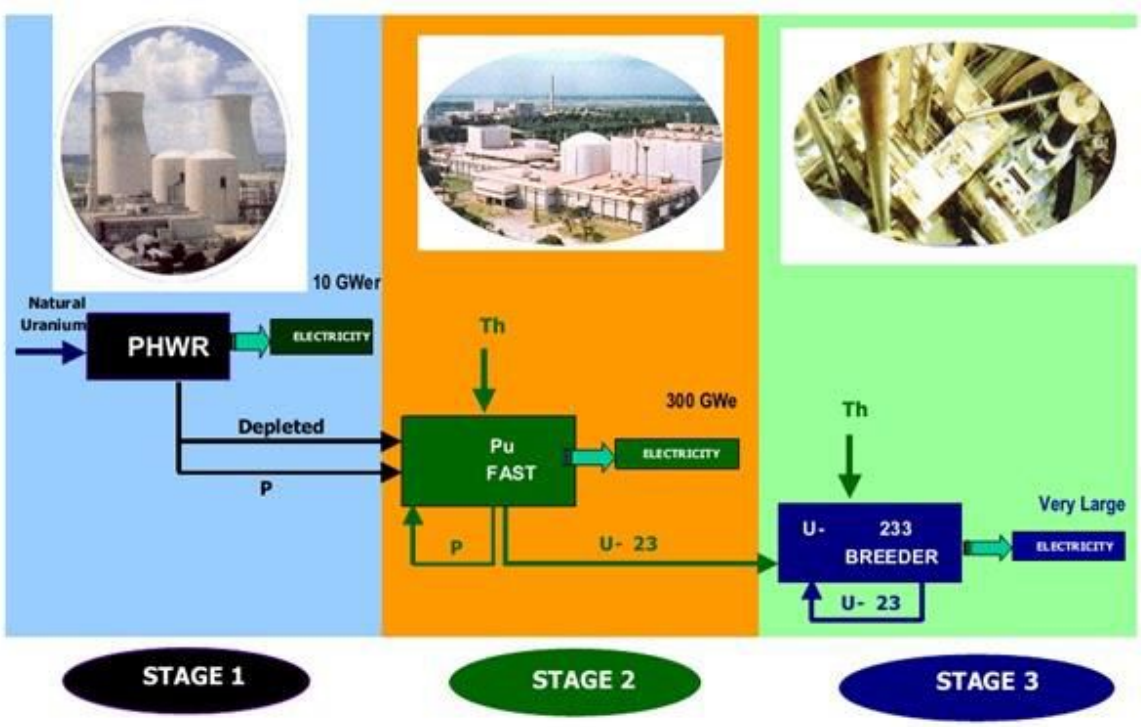
Approach:

- Bringing out reasons for adopting the 3 stage nuclear program and elaborate briefly the three stages.
- Then bring out advantages of Thorium over other nuclear fuels.
- Finally, bring out the reason why large scale deployment of thorium fuelled reactors in India is impeded.

Answer:

In order to utilize the abundance availability of thorium (3.6-lakh-tonne reserves) and to be able to generate nuclear power beyond 30 years, India drew up a three-stage atomic power programme.

- The first stage involved using natural uranium to fuel Pressurized Heavy Water Reactors to produce electricity and producing plutonium-239 as a byproduct
- The second stage involves using plutonium-239 to produce mixed-oxide fuel, which would be used in Fast Breeder Reactors. These reactors have two processes. Firstly, plutonium 293 undergoes fission to produce energy, and enriched uranium reacts with mixed-oxide fuel to produce more plutonium- 239. Furthermore, once a sufficient amount of plutonium-239 is built up, thorium will be used in the reactor, to produce Uranium-233. This uranium is crucial for the third stage.
- The main purpose of stage-3 is to achieve a sustainable nuclear fuel cycle. The advance nuclear system would be using a combination of Uranium-233 and Thorium.



Advantages of thorium over other nuclear fuels can be enumerated as:

- Thorium cycles exclusively allow thermal breeder reactors (as opposed to fast breeders which don't use moderators). More neutrons are released per neutron absorbed in the fuel in a traditional (thermal) type of reactor. This means that if the fuel is reprocessed, reactors could be fuelled without mining any additional U-235 for reactivity boosts, which means the nuclear fuel resources on Earth can be extended by 2 orders of magnitude.
- Thorium reactors produce far less waste than present-day reactors.
- The Th-U fuel cycle does not irradiate Uranium-238 and therefore does not produce transuranic (bigger than uranium) atoms like Plutonium, Americium, Curium, etc. These transuranics are the major health concern of long-term nuclear waste.
- Thorium is more abundant in Earth's crust than Uranium and Thorium reactors are cheaper because they have higher burn up.
- Thorium is generally accepted as proliferation resistant compared to Uranium-Plutonium cycles.

Challenges:

- The single greatest hurdle is the critical shortage of fissile material. A fissile material is one that can sustain a chain reaction upon bombardment by neutrons. Thorium is by itself fertile, meaning that it can transmute into a fissile radioisotope but cannot itself keep a chain reaction going.
- Also, it would take India many more Fast Breeder Reactors and at least another four decades before it has built up a sufficient fissile material inventory to launch the third stage.

But given the high costs of nuclear material imports and India's growing independence in nuclear technologies, we must keep pursuing our 3-stage nuclear reactor programme which will make India energy secure in the long-term.

Q.20.What do you understand by Big-data? Using SDGs as an example, discuss its role in effective implementation of public policy. Also mention challenges faced in using Big-Data and measures to overcome them.

बिग-डाटा से आप क्या समझते हैं? एस.डी.जी. को एक उदाहरण के रूप में प्रस्तुत करते हुए सार्वजनिक नीतियों के प्रभावी कार्यान्वयन में इसके महत्व पर चर्चा कीजिए। इसके अतिरिक्त, बिग-डाटा के प्रयोग में आने वाली चुनौतियां तथा उनके समाधान के उपायों पर भी चर्चा कीजिए।

(Marks:15, 250 words)

Approach:

- Explain the meaning of Big Data.
- Discuss how it can be used in policy implementation using the example of SDGs.
- Mention the challenges in the use of Big Data.
- Discuss the measures to overcome them.

Answer:

Big Data refers to data sets that are so large or complex that traditional data processing applications are inadequate. It can refer to data generated from all sources conceivable and is characterized by:

- **Volume**: Quantity of data.
- **Variety:** Type and nature.
- **Velocity**: Speed of generation and processing.
- **Variability**: Inconsistency of data hampering processes to handle it.
- **Veracity:** Variation in quality of captured data, affecting accurate analysis.

However, it's not the amount of data, but what organizations do with it that is important. Big data can be analyzed for insights that lead to better decisions and strategic policy moves.

Use in Public Policy implementation

Public policy implementation is a cyclic process that involves the implementation, evaluation, feedback and improvements based on feedback. For example, it can be used in achieving SDG goals, say health, in the following ways:

- Collate data from various places like hospitals, doctors, insurance companies etc.
- Observe the trend of diseases w.r.t. type, gender, regions and social groups. Predicting disease outbreaks.
- Analyzing numbers w.r.t access to healthcare and treatment. Discerning patients visiting primary, Secondary and Tertiary Services.
- Analyzing use of Government facilities and schemes.
- Analyzing patterns of expenditure.
- Analyzing complaints and feedback on services provided by agencies.
- Sort out the best practices world-wide and domestically.

This will enable the government to continuously monitor, evaluate and improve its services vis-à-vis healthcare.

Challenges

- Capturing, analyzing, and sharing data is difficult as it needs high level of technology both in terms of software and hardware as well as personnel capacity.
- It is an expensive process.
- In India all data is not digitized, thus an over dependence on big data can mislead policy makers and policy can be exclusionary.
- Non-access to IT tools and limited skill at all levels limits the generation of authentic data.
- Privacy concerns due to storage and integration of personally identifiable information.

Overcoming challenges

- Implementation of Digital India will increase the access of IT at all levels, both to service providers (Government and private agencies) and consumers.
- Development of IT skill of public personnel to improve quality and exclusivity of data.
- Investing in Big data infrastructure and analytics to improve reliability of analysis.
- R&D to bring down the cost of big data storage and analysis.
- Developing secure cyber ecosystem through proper legislations, policies and institutions
- Ensuring protection of AADHAR based information from falling into hands of private individuals or enemy states.