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Classroom Study Material

SCIENCE AND TECHNOLOGY

July 2017 – September 20th 2017

Student Notes:

TABLE OF CONTENTS

Student Notes:

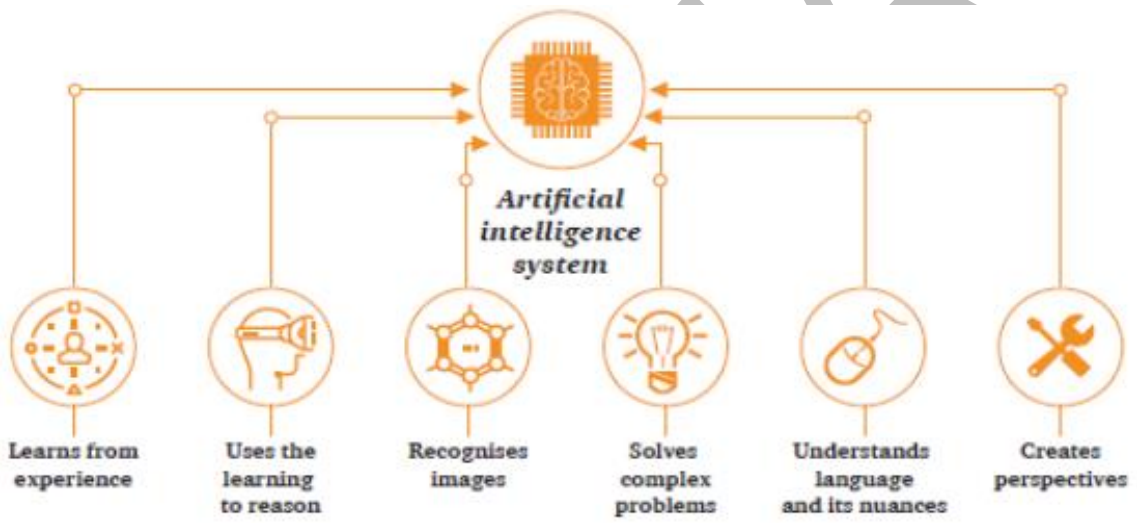
1. ARTIFICIAL INTELLIGENCE

Why in news?

- The **Ministry of Electronics and information** has formed a **"policy group"** to look into **artificial intelligence** and formulate a framework for its adoption.

What is Artificial Intelligence (AI)?

- It refers to the branch of computer science that enables **computer systems or computer enabled robotics to process information and produce outcome that a human would.**
- Artificial intelligence system learns **from experience, uses the learning to reason, recognises images, solves complex problems, understands languages and creates perspectives.**
- The term Artificial Intelligence was first coined in 1956 by Professor John Mc Carthy.
- Although it has evolved overtime in the last 60 years but it recently came to the forefront with huge chunk of data being generated and smarter and faster computer systems to process them.



Source: PwC analysis

Current Status of AI in India

- AI has been subtly adapted by the private sector in India. It is being used for identifying patterns in objects, people, style and preference to advice people on retail, developing better diagnostic services, working of multiple languages and more.
- Although India is moving ahead towards digitization with the Digital India initiative, it is still far away from AI revolution. It lacks the ecosystem fostering innovation for AI. There is no particular policy for the implementation, research and development of AI in India.
- Inadequate home-grown infrastructure for the expansion of AI poses as one of the biggest challenges. For example: cloud computing data which is an essential prerequisite for various AI functions is largely located on servers abroad.
- One of the biggest challenges in India for the AI revolution is the **Job vs automation debate**. It is being argued that if given the window to expand, AI will complete replace the need for manual labour. On the other hand, those in favour of AI believe that will augment human potential to get better results.

Student Notes:

How AI can be used in Various Domains?

- **Governance** – Deep learning, a part of AI which includes pattern recognition, image analysis and language processing can be used to effective achieve targets. For example: officers are bound to upload pictures of toilets built under the Swacch Bharat Abhyan. AI can be implemented to flag out the one that haven't been properly built and also the location they are from.
- **Policy Implementation** – Under the Kisan Call Centre initiative, solutions are provided for the issued raised by farmers in their local language. AI can be of use here by linking the available information. It can help pick soil reports from various government agencies and link them to the environmental conditions prevalent over the years using the data from a remote sensing satellite. This could help come up with the optimal crop for that particular land pocket.
- **Defence and Security** – Application of AI in the field of defence and security is protection of infrastructure such as airports, power plants and economic sector, detecting anomalous behaviour in humans and predict infrastructure disruption. It can also be used in the defence sector to carry out tasks in unsafe areas.
- **Product Manufacturing** – AI can help predict more reliable demand forecasting, a flexible responsive supply chain, and more accurate scheduling and inventory operations.
- **Disaster Management and Recovery** – It shows remarkable potential in providing remedial measures and control in aftermath of man-made and environmental disasters. Unmanned drones and satellite feeds combined with image processing and recognition can be used in infrastructure damage assessments. It can also be used to optimise and restore mobile networks after natural disaster like earthquake.
- **Logistics** – It can be used for adaptive scheduling of deliveries and routing of vehicles. Products can be transported more efficiently through vision-based driver assist and automated/robotic systems.
- **Financial Services** – Application of AI in financial sector include early detection of financial risk and systemic failures, and automation to reduce malicious intent in financial systems, such as market manipulation, fraud, anomalous trading and reduction in market volatility and trading costs.
- **Agriculture** - AI solutions can also help provide site-specific and timely data about crops to enable application of appropriate inputs such as fertilisers and chemicals.
- **Consumer Goods and Services -** Machine learning algorithms are being deployed for better matching of supply with consumer demand.
- **Science and Technology** – It can help scientists and researchers to test hypotheses using robotic systems.

Three ways of Human-AI Collaboration

- Supportive Mode – AI performs alongside humans by facilitating human judgements by providing resources such as predictive outputs.
- AI performs activities that go beyond the cognitive abilities of humans such as large-scale genome study in bioinformatics.
- AI replaces the Humans – This is especially useful where it potentially harmful for humans such as environments and rapid system response in nuclear reactors.

Way Forward

- Research efforts must be concentrated on implementing regulations in AI system design that are updated on a continual basis to respond appropriately to different application fields and actual situations.
- Policy initiatives should explicitly touch upon building an incubatory environment for AI-based research and training. This includes making effective training data sets from various

portals available to academicians and the public at large (e.g. Open Government Data Platform, India).

- The national policy must clearly define standards and benchmarks that can be effectively used to gauge progress in AI innovation and commercialisation in a host of application domains.
- Building expertise, on the other hand, will require governments to evaluate the current educational pathways and curricula and, if required, overhaul the same to provide skill up gradation initiatives for a workforce that seeks to stay relevant in a fast-evolving technology landscape.
- An AI-human collaboration and interaction must be clearly defined so that it is used to augment human productivity and not replace it.

2. 5G

Why in news?

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

Significance of the Forum

- This move to usher in 5G will help companies design and manufacture 5G technologies, products and solutions in India, thus developing some "essential IPR (intellectual property rights) in the 5G standard.
- Using the deployment of 5G technology, the government aims to have 100 per cent coverage of 10 Gbps broadband across urban India and 1Gbps across the rural India.
- By strengthening the domestic telecommunication manufacture market, it will enable local manufacture to capture 50 percent of the domestic market and 10 percent of the global market.

What is 5G?

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

Advantages of 5G

- As per the **OECD (Organization for Economic Cooperation and Development) Committee** on Digital Economic Policy, 5G technologies rollout will help in **increasing GDP, creating employment and digitizing the economy.**
- The 5G technology will offer far greater upload and download speed available today. This will help cloud systems to stream software updates, music, and navigation data to driverless cars. In other words, it will help aid incorporate **Artificial Intelligence** in our lives.
- It will enable Smart devices to exchange data seamlessly providing the ecosystem for **Internet of Things (IoT).**

Comparison

Technology / Features	*1G*	*2/2.5G*	*3G*	*4G*	*5G*
Start/ Deployment	1970/ 1984	1980/ 1999	1990/ 2002	2000/ 2010	2010/ 2015
Data Bandwidth	2 kbps	14.4-64 kbps	2 Mbps	200 Mbps to 1 Gbps for low mobility	1 Gbps and higher
Standards	AMPS	2G: TDMA, CDMA, GSM 2.5G: GPRS, EDGE,1xRTT	WCDMA, CDMA-2000	Single unified standard	Single unified standard
Technology	Analog cellular technology	Digital cellular technology	Broad bandwidth CDMA, IP technology	Unified IP and seamless combination of broadband, LAN/WAN/	Unified IP and seamless combination of broadband,

Challenges

- India lacks a strong backhaul to transition to 5G. Backhaul is a network that connects cells sites to central exchange. As of now 80% of cell sites are

connected through microwave backhaul, while under 20% sites are connected through fiber. The former has bandwidth issues as it uses traditional bands while the latter provides low latency and unlimited capacity (a prerequisite for 5G).

- The Indian market is yet to adapt to 4G completely and has not fully evolved to experience an AI revolution.

Way Forward

- Fiberization of Backhaul must be carried out for the smooth adoption of 5G.
- Regulatory issues must be revisited in order to overhaul the spectrum licensing regime.
- 5G capable technology must be deployed on a large scale in order to prepare for its adoption.

3. 3D PRINTING

Why in news?

- Researchers at the Indian Institute of Technology (IIT) Guwahati have successfully created an **implantable bioartificial pancreas model grown within a 3D silk scaffold**. If successful, this implantable pancreas can help treat people with **Type 1 diabetes.**

What is 3D printing?

- 3D printing or additive manufacturing is the process of making three dimensional objections from a digital design by adding one layer at a time.
- Also called **stereo lithography,** it was invented in 1983.
- Technology for 3D printing varies according to the material used. A 3D model can be printed using **plastics, metals, alloys, rubber, sandstone and more.**
- 3D printing enables you to produce complex shapes using less material than traditional methods.

Benefits of 3D Printing

- **Lower Cost** – 3D printing produces models at a lower cost than in the case of traditional ways.
- **Saves Time** – 3D does the job accurately and in less time. This not only increases efficiency of a task but also helps making it economical.
- **Highly Efficient** – Generating prototypes with 3D printing technology is much easier and faster
- **Flexibility** - Different types of materials can be used for 3D printing making it easier to print different types of prototype and models.
- **Durable and of High Quality** – The products do not absorb moisture and are of high quality.
- **Functional Models** – Functional models for various fields can help us get a more real picture of our requirements.

Applications of 3D Printing

- **Architecture and Construction** – 3D are not only being used for model conception but actual construction. Countries around the world are using large 3D printers to construct multi-storied houses layer by layer.
- **Medicine –** It is one of the broader arenas where 3D printing is being used. It is used to build hearing aids, prosthetics, and digital dentistry. Bio printing and artificial organs are being researched to make them implantable.
- **Manufacturing** - Car and aeroplane parts are being built 3D printing. It takes less time and thus adds to the value chain.

- **Maritime Industry** – Prototype and improved spare part management for shipbuilding.
- **Others –** 3D printing also finds applications in sectors such as clothing, engineering, aerospace and more.

4. NANOMATERIALS: COMBATING CLIMATE CHANGE AND PREVENT POLLUTION

Why in news?

Globally scientists are developing nanomaterial which can effectively help to reduce the Carbon Dioxide in the air and trigger bioremediation to get rid of toxic waste such as dyes, oil spill etc.

Details

- **Environment nanotechnology** involves use of nanoscale material for addressing environmental concerns such as bioremediation, water purification, product recycling and recovery, solid waste management.
- These **nanomaterials** have **unique properties** such as **chemical reactivity, electronic properties and antimicrobial activity**. Therefore they hold potential to address issues such as combating Climate Change and reduction of pollution.

Areas where Environment nanotechnology can be used

- **Combating Carbon Emission**
  - The researchers have developed **nanoCO_2 harvester** which can suck CO2 from the atmosphere and convert it into methanol which can further be used as vehicular fuel.
  - The NanoCO2 Harvester can capture more CO2 than usual and is more efficient fuel converter.
- **Cleaning Water**
  - The magnetically charged nanoparticles have been proved potent in researches to have effectively carried on adsorption process to remove heavy metals and dyes from the water bodies and they do not readily degrade.
  - They can also be used to clean the underground water contaminated with toxic materials such as arsenic, lead, chromium and mercury. They can also be used to clean up oil spills by using nanosponges
- **Accelerating Biodegradation (Solid Waste Management)**
  - The method of converting the organic waste into organic manures and fertilizers can also be quickened through use of Nanoparticles.
  - Thus they can reduce the time consumed in solid waste management and increases the production of biogas. According to researchers, Iron oxide particles which are non-toxic can be used for the same.

Challenges

- The Nanoparticles being small in size have tendency to clump up which make them inactive with prolonged use.
- Synthesising useful nanoparticles is also challenging as production of a consistent size is tough.

- The viability of Nanoparticles such as nanosponge still remains a laboratory success and hasn't been tested on large-scale.
- The usage of Nanoparticles also raises health concerns as due to their small size they can be easily transported inside human as well as animal bodies.
- Due to their ability of long persistence, they may raise concerns such as bio-magnification as well.

5. NATIONAL STRATEGIC PLAN FOR MALARIA ELIMINATION

Why in News?

Union Minister of Health and Family Welfare launched **the National Strategic Plan for Malaria Elimination (2017-22)**.

Vector-Borne Diseases

- Caused by pathogens in human populations
- Transmitted by vectors: living organisms that can transmit pathogens between human beings or from animals to humans.
- Transferring the pathogens received during a blood meal from an infected host into a new host during the next blood meal.

Background

- Pathogens travel across continents and new strains continue to emerge, the fight against vector-borne diseases has, once again, become a global public health challenge.
- India that is a breeding ground for at least **six major vector-borne diseases**—malaria, dengue, chikungunya, filariasis, Japanese encephalitis and visceral leishmaniasis.
- India has the third highest malaria burden in the world thus an immediate action plan was long needed.

Efforts to eliminate Vector Born Diseases

- The **National Framework for Malaria Elimination** (NFME) last year outlined India's commitment for eliminating malaria by 2030.
- To implement this commitment the National Strategic Plan for Malaria Elimination was launched in July 2017.
- The government would like to eliminate malaria by 2027 and urged the states for active cooperation. It gives strategies for working towards the ultimate goal of elimination of malaria by 2030.
- The strategies involve strengthening malaria surveillance, establishing a mechanism for early detection and prevention of outbreaks of malaria, promoting the prevention of malaria by the use of Long Lasting Impregnated Nets (LLINs), effective indoor residual spray and augmenting the manpower and capacities for effective implementation.
- Intersectoral coordination is the key, we have to work together with the other Ministries and Municipal Corporations to achieve the desired results.

National Strategic Plan for Malaria Elimination (2017-22)

Following are the provisions of NSPME-

- It divides the country into four categories between 0-3, viz, -
  - Category 1 (0)- includes 75 districts where there has been no case of malaria in last 3 years.
  - Category 2 (1)- has as many as 448 districts in

Based on the **WHO recommendations**, following are **the 4 components of the plan**:

- Diagnosis & case management
- Surveillance & Epidemic Response
- Prevention by Integrated Vector Management
- Cross Cutting interventions including communication, R&D, etc.

which API (Annual Parasite Incidence) in a year is < 1 among every 1000 persons.
  - Category 3 (2)- are the regions where the API is one or above, but <2 per 1000 persons.
  - Category 4 (3)- are the regions where the API is 2 or >2 per 1000 persons.
- The plan aims to eliminate Malaria completely by 2022 in the category 1 and 2 districts, while the other two categories will be brought under pre- elimination or elimination programmes.
- The plan aims at achieving Universal Case Detection and treatment services in the endemic districts to ensure full diagnosis and treatment of all the cases.

Concerns

There are various concerns that plague the efforts to fight such diseases, like:

- A weak and fragmented health system unable to reach all populations at risk is a handicap in the implementation of the programmes to fight vector born diseases.
- There is a poor collaboration across agencies, sectors, and levels of government that calls for an improved inter-sectoral work that can facilitate the adoption of integrated approaches.
- The root causes of the problem, such as genetic changes in pathogens, insecticide and drug resistance, the challenges of poor urban planning, are not given enough attention.
- Lack of funding and underutilization of released funds makes the efforts inaffective. For example, last year, the Central government released only 68% of budgeted funds under the national vector-borne disease control programme, and an even smaller percentage of that was utilized, according to the CSE's State of India's Environment 2017.
- The lack of adequate healthcare workers who can carry out a prevention programme on a war footing is also a challenge. This includes not just field workers but also entomologists who can research all aspects of vector populations and recommend how these can be kept below the "critical mass".
- A weak, inadequate, and in some cases inexistent, surveillance system to monitor cases, risk factors and determinants of VBDs, to provide intelligence for strategic decisions.
- Finally, the prospects for vaccines against vector-borne diseases seem to be poor. A dengue vaccine that is being used in about a dozen other countries is not yet allowed in India.

Way forward

- In India, the challenge is to ensure the implementation of programmes and ensure they universally reach all populations, ensuring action across the central, state and local levels involving all concerned stakeholders.
- The Research & Development facilities in the country must be boosted to find novel ways to fight such diseases.
- Precautions on part of people is one of the crucial factor that can ultimately make the efforts of government fruitful.

6. ROLE OF INFORMATION AND TECHNOLOGY IN THE HEALTHCARE SECTOR

Why in news?

- A **telemedicine** project of the Odisha government that enables e-health centres to be opened up at government **primary healthcare centres (PHCs)** has been taken up by the central government as a pilot programme. It is being run in Gujarat, Jharakhand, Bihar, Uttar Pradesh and Himachal Pradesh.

Student Notes:

E-health Initiatives of the Government

- **Sehat -** It is a pan-India initiative launched in 2015. It aims to connect 60,000 common service centres across the country and provide healthcare access to citizens irrespective of their geographical location.
- **E-Aushadhi** - It is web based application which deals with the management of stocks of various drugs, sutures and surgical items required by different district drug warehouses of Rajasthan state.
- **ASHA Soft** – It is an online system launched by the Rajasthan government to monitor the activities under ASHA (a component of **National Rural Health Mission**). It facilitates the user to capture beneficiary wise details of services given by ASHA to the community, online payment of ASHA to their bank accounts, generate various reports to monitor the progress of the programme and to ensure their timely and seamless online payment.
- **National Health Portal** for health awareness.
- **MCTS (Mother and Child Tracking System)** is a name based tracking system to ensure all pregnant women receive their ante-natal care check-ups and children receive free immunisation.
- **Mera Aspataal (Patient Feedback) Application**
- **SUGAM -** Launched by Central Drugs Control Standard Organisation, it enables online submission of applications, their tracking, processing & grant of approvals online mainly for drugs, clinical trials, ethics committee, medical devices, vaccines and cosmetics.
- **Kilkari -** It delivers free, weekly, time-appropriate 72 audio messages about pregnancy, child birth and child care delivery to families' mobile phones.
- TB monitoring system "Nikshay":

What is e-health?

- The **World Health Organization (WHO)** broadly defines e-Health as **"the transfer of health resources and health care by electronic means"**. It entails healthcare components supported, enabled and delivered through the means of information and technology.
- With the digital technology coming of age, e-health is a reality today and is helping improve the productivity of clinical physicians and hospital systems to provide patient centred co-ordinated care.
- One of the dimensions of e-health is m-health (mobile based healthcare solutions).
- M-health solutions address problems in remotest areas where there is scarcity of doctors.

Why e-health?

- E-health can help enhance health outcomes (like life expectancy at birth) and improve system efficiency.
- It can be used for as an alternative where infrastructure is inappropriate or and medical attention cannot reach in time.
- It offers a clinical communications platform for healthcare providers. It can be used for online referrals, electronic prescribing and sharing of electronic health records.
- Cloud platforms can help in streamlining and maintenance of patient record. The data thus collect can be further used for R&D.
- It helps modernize medical care, reduce costs, avoid redundant or duplicate tests/procedures and automate manual processes. For example, electronic health records can help providers keep a track of patient information and can even alert those automatically to possible problems.
- It can also be used to raise awareness for effective dissemination of diseases.
- Aid policymaking and the government's target of providing quality healthcare services to one and all.

Student Notes:

7. HOSPITAL ACQUIRED INFECTIONS

Why in news?

- The **Gorakhpur Tragedy** of 84 children dying in **BRD medical college** followed by **49 others dying in Farrukhabad and 24 other dying in Vidisha District** of MP have raised serious concerns regarding India's healthcare infrastructure and **hospital acquired infections (HAI).**

What are Hospital Acquired Infections?

- Also called **nosocomial infections,** HAI are passed onto the patients after being admitted at the hospital facility.
- It usually goes by unacknowledged unless an epidemic situation such as Gorakhpur tragedy happens.

International Nosocomial Infection Control Consortium is an international scientific organisation that works to fight against healthcare associated infections.

Current Status in India

- Despite being unacknowledged by the healthcare system in India, it is very much a reality according to a report published by the **International Nosocomial Infection Control Consortium** in 2015.
- Another study published in the **British Medical Journal** indicates that that the **burden of healthcare associated infections in countries like India is high, with an estimated pooled prevalence of 15.5 per 100 patients, more than double the prevalence in Europe and the US.**
- Inability to improve health outcomes is one of the reasons that India is not able to achieve the millennium development goal of "Good well being and Health".
- India does have various guidelines for patient safety, waste disposal or other standard hospitals procedures. However, they are seldom followed.

Causes of HAI

- **Lack of proper Equipment**: This includes both **clinical and non-clinical equipments** such as oxygen cylinders in the case of Gorakhpur Tragedy. This **leads to inappropriate methods of treatments** such as putting two infants in the same incubators. According to **a CAG (Comptroller and Auditor General)**, there is 27.21% shortage for clinical equipment and 56.33% for non-clinical equipment,.
- **Poor knowledge and application of basic infection control measures:** This includes absence of sanitisation of the hospital premises such as visitor chair as well as strict rules regarding visitation especially in intensive care units (ICUs).
- **Poor Infrastructure**: Poor infrastructure in general includes proper beddings for patients, separate and disinfected lavatories for visitors and patients.
- **Understaffing and Overcrowding:** This is one of the root causes of non-compliance of the most basic hygiene standards by hospitals.
- **Lack of Procedure:** Lack of standard procedure for dealing with communicable disease patients increases the risk of HAI exponentially.
- **Lack of knowledge of injection and blood transfusion safety:** Lack of proper training for such procedures increases risk of contracting infection such as HIV and Hepatitis B. Moreover, with quackery highly prevalent in India (especially in rural areas), this becomes all the more relevant.

Student Notes:

- **Inadequate environmental hygienic and waste disposal mechanisms:** There have been numerous cases of aborted foetuses and hospitals waste being thrown in nearby water bodies. Inadequate waste disposal not only increases chances of HAI but also puts the environment at risk.
- **Absence of local and national guidelines**: Absence of proper guidelines for hospital maintenance, accreditation and laws puts patients at risk.
- **Prolonged and inappropriate use of invasive devices and antibiotics:** Resistant strains have been found in India even for third- and fourth-generation antibiotics like cephalosporin and carbapenem making it difficult to treat patients.
- **Immune-suppression and other severe underlying patient conditions**
- **Insufficient application of standard and isolation procedures**

Implications

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

Way Forward

- **Identification of local determinants –** Hospitals should have a set protocol in order to identify HAI and curb them.
- **Improving reporting and surveillance systems:** Health is a state subject but the government must come forward with a national surveillance plan for HAI.
- **Standard procedures for infection control** must be adhered at both private and public health care centres. Although **ICMR (Indian Council for Medical Research)** does holds workshops for the same but the lack of standardization creates practical difficulties.
- Strict Adherence to standard precautions such as **hand hygiene** by hospital staff
- **Improving staff education and accountability:** Training for dealing with critical care patients must be provided for all hospital staff especially informal healthcare providers such as nurses as quacks. This can help improve case management.
- Quacks must be surveyed and laws must be put in place to avert them from providing treatment that they are not trained for.
- **Awareness campaigns** must be held for patients and their families for **timely reportage of HAIs.**
- **Immunization and vaccination of staff** must be made mandatory for influenza and other communicable diseases.
- Antibiotics must only be sold as **perspiration drugs only**. India's **Red Line campaign** is a step in this direction
- India has done ample work on the policy front when it comes to tackle antimicrobial resistance. However, what we need to do is to buck up the administrative setup to implement those policies.
- This could be done **through public-private partnerships.** This will also solve the problem of insufficient funding and human resources.
- Hospitals not following standard treatment procedures, waste disposal methods and other protocols must be held accountable and duly fined.
- The **Indian Medical Association** has proposed that all government hospitals too must be accredited from NABH in line with the private hospitals.
- All blood samples collected for blood transfusion must be tested. **Nucliec Acid Test (NAT)** must be mandatory in order to reduce HIV infections. NAT detects HIV infections of 11 days

to two weeks while the currently prevalent ELISA detects the infections of 30 to 40 days of six weeks.

8. FOOD IRRADIATION

Why in news?

- **Bhabha Atomic Research Centre (BARC) – Department of Atomic Energy** has been engaged in R&D work on the technology of preservation and hygienization of food and agri-products by radiation

What is it?

- Food irradiation refers to **process of exposing food to a controlled amount of ionizing radiation.** This can be done using one of the three different types of radiation: **Gamma rays, X-rays and electron beam radiation.**
- Food Irradiation is carried out to effectively **get rid of bacteria, viruses and pests from food produce, increases shelf life and prevent spoilage**.

Difference between Irradiated food and Radioactive Foods

- **Radiation processed foods** are those that have been exposed to radiation as prescribed above to bring about the desired effect in food.
- **Radioactive foods**, on the other hand, are those that become contaminated with radionuclides. This type of contamination never occurs during food irradiation.

Need for Food Irradiation

- The seasonal nature of production, long distances between production and consumption centres and rising gap between demand and supply increases the odds of post-harvest losses.
- The hot and humid climate of a country like India is quite favourable for growth of numerous insects and microorganisms that destroy stored crops and cause spoilage of food every year.
- **Post-harvest losses** in food and food grains in India is around 40-50 per cent, primarily **due to insect infestation, microbiological contamination, physiological changes due to sprouting and ripening, and poor shelf life.**
- Sea-foods, meat and poultry may carry harmful microbes and parasitic organisms that cause illnesses associated with their consumption.

Food Irradiation in India

- The **Atomic Energy (Control of Irradiation of Food) Rules 1991**, governs food irradiation in the country. It was amended in 2012.
- Irradiation of food is also governed under the Food Safety and Standards Act, 2006 and the Regulations issued under it. The regulation of this Act has been amended (Food Safety and Standards (Food Products Standards and Food Additives) Sixth Amendment Regulations, 2016) to bring it in harmony with the international regulation.

Advantages of Food Irradiation

- The process is energy efficient and it does not leave any residue.
- In comparison with heat or chemical treatment, irradiation is considered a more effective and appropriate technology to destroy food borne pathogens.
- Being a cold process, the nutritional loss due to irradiation is way small than other chemical treatments such as canning, drying and heat pasteurization.
- Macro nutrients such as carbohydrates, proteins and fats undergo no change during radiation processing.
- Treatment is done after final packing so no repacking is required.

9. SCIENTISTS MAKE METHANOL USING OXYGEN

Why in news?

Scientists from Cardiff University (U.K), have produced methanol from methane through simple catalytic process using oxygen and hydrogen peroxide.

More about the news

- About 90% of the current methanol production takes by breaking down natural gas at high temperature and pressure into Hydrogen gas and carbon mono-oxide (collectively known as **Synthetic Gas/Syngas**). Syngas is then further converted into methanol by Steam Reforming process and Methanol Synthesis process which are extremely energy intensive.

Methanol as an alternative Fuel for India

- Methanol, the simplest single carbon compound so it is highly efficient, clean and it can serve as the best alternative fuel for India.
- It can be blended with gasoline/diesel, emits lesser NOx, Particulate matter and no SOx .
- It can be further converted to **Dimethyl ether (DME)** which is a clean diesel alternative and can be blended with LPG as well.

- The newly discovered chemical process is based on using methane, oxygen and hydrogen peroxide and Nano particles of gold as catalysts.
- The entire process can be done at 50^0C temperature and with much less energy.

Though Commercialisation of the technology will take time but it has major implications for the preservation of natural gas reserves as fossil fuel stocks.

Why Methanol production is important for India?

- As per **NITI Aayog's India Energy Security Scenarios** (IESS) the primary energy consumption of India grew at a CAGR of 5% over the last decade.
- Along with this India is targeting 10% reduction in oil and gas imports by 2022 from 2014-15 levels.
- In this scenario Methanol can serve as the alternative green fuel for India.
- NITI Aayog is already working on a roadmap for a commercially viable method for indigenous methanol production as India is importing methanol from Saudi Arabia and Iran at present.

A roadmap for methanol Economy in India

- **Coal to methanol** is a proven technology in world (not yet in India). So India can tap its coal reserves to produce methanol and gradually move to its production from natural gas, biomass or even through Chemical process mentioned in the beginning.
- The methanol/DME can be **blended with petrol/diesel** and has the potential to completely substitute them in future. It will reduce our import dependence on crude oil and also enhance vehicular efficiency
- **Current internal combustion(IC) engines** till M15 (15% methanol-85% gasoline/diesel) mixtures require minimal modifications and conversion kits for them are easily available globally
- It can be the **primary fuel for ferries/ships** on Inland waterways as it causes less pollution on water bodies. **Sagarmala initiative** gives an opportunity for the same.
- Methanol/DME can be blended with LPG with slight modifications in existing cookstoves and can also substitute LPG completely with new cookstoves. China is already blending 20% DME with LPG. India directly imports 50%of its total LPG requirement thus methanol blending can curtail LPG imports also.

Student Notes:

China has already leapfrogged to methanol in a big way. China accounts for 55% of the global methanol production and has been using it as a drop-in fuel for transportation vehicles and blending it with LPG. India must use this as an opportunity to invest in alternate fuels, methanol production can be a good method to achieve it.

10. PROPOSALS FOR HIGH-TECH PUBLIC TRANSPORT

Why in News?

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

Why new public transportation is needed?

- Present levels of urban mobility are already generating many problems such as; high levels of congestion, environmental pollution, traffic fatalities.
- Present infrastructure for transportation is focused on mobility of vehicle rather than that of people.
- Nearly, 30 and 60% of a metropolitan area may be devoted to transportation, an outcome of the over-reliance on some forms of urban transportation.
- The scheme would provide a holistic solution for urban transportation problems ranging from parking policy, congestion pricing to **transit oriented development.**

Metrino
- It is fully automatic small pods travel independently suspended over an overhead network

Pod Taxis
- Small automated vehicles cable cars or pod cars equipped to carry a small group of passengers.

Hyperloop
- Pod-like vehicle is propelled through a near-vacuum tube connecting cities at speeds matching that of an aircraft.

Stadler Bus
- Tram like high frequency bus service for end to end connectivity.

Hybrid Bus
- Transport system uses hybrid propulsion systems, consisting diesel and electric ones.

Freight Rail System
- Elevated corridors would be built with rail lines where freight trucks can be placed.
- It would move on rails at high speed, reducing freight time and increasing freight quantity.

Metrino

Hyper loop

Student Notes:

Pod-Taxi

Stadler Bus

Hybrid Bus

Freight Rail System