SECTION – B 5 x 15 = 75

Answer all the questions. Answer not exceeding 250 words each

PAPER 2 - UNIT II – SCIENCE AND TECHNOLOGY

11. What are the opportunities and challenges of Artificial Intelligence in India?
இந்தியாவில் செயற்கை நுண்ணறிவில் உள்ள வாய்ப்புகள் மற்றும் சவால்கள் யாவை?

Introduction

Since India is significantly behind many other countries in its technological development, it is natural for technologists and policy makers to look to transplant successful ideas from other contexts into India.

In recent past, with the government's growing interest around AI applications in India, there has been a significant growth in interest levels around AI across all industry sectors in India.

Artificial intelligence (AI) refers to the simulation of human intelligence in machines that are programmed to think like humans and mimic their actions.

Major Challenges

- **Fundamental challenges:** India has a relatively small body of researchers and research output in the field of machine learning.
- The contribution of Indian researchers to top AI conferences constitutes one-fifteenth of the U.S. contribution and one-tenth of that of China.
- India has little local expertise in the new knowledge that is being created every day by others. India do not have people who can train a new cohort of machine-learning engineers and scientists to develop and commercialize technology.
- Despite the opportunities for the present and future, Indian companies have been slow to adopt AI.
- India does not possess enough trained manpower to apply machine learning to our own problems and data, in spite of the number of standard packages available.
- Despite the initial enthusiasm for AI, there were unfulfilled potential and that the country could be doing far more to adopt and integrate AI technologies.
- The cost of failure is much higher in India than the West. This has historically meant a lack of room for innovative experimentation.
- Lack of Collaboration between Industry and Academia: The boom in the Indian IT services sector in the early 90s was partially born out of necessity – India just did not have a good "products ecosystem".

- India has historically not done well with products, there also seems to be a dearth of good talent specifically for design and user-interface functions.

- Talent will be the biggest strength for India with respect to AI. But AI is still new, so current talent in the market is very limited.

- Some challenges that the progress of AI in India faces are limited availability of manpower and of good quality and clean data, as there is no institutional mechanism to maintain high quality data.

- The country's diversity and complexity presents a rich set of challenging problems for artificial intelligence.

- Current AI techniques are limited in their ability to handle complexity, and they'll have to mature to deal with the diversity of life in India.

Challenges are concentrated across common themes of:

- Lack of enabling data ecosystems
- Low intensity of AI research i. Core research in fundamental technologies ii. Transforming core research into market applications
- Inadequate availability of AI expertise, manpower and skilling opportunities
- High resource cost and low awareness for adopting AI in business processes
- Unclear privacy, security and ethical regulations
- Unattractive Intellectual Property regime to incentivise research and adoption of AI

Opportunities

- India forms the IT backbone of the world. The country's companies and talent are the natural contenders to add 'intelligence' to all the digitization.

- Investment in India can help move the whole field ahead.

Indian Services Sector

- India's services sector (call centers, BPOs, etc. – roughly 18% of the Indian GDP) have a significant potential opportunity to cater to the coming demand for data cleaning and human-augmented AI training (data labelling, search engine training, content moderation, etc.).

Space and defense research

- India's Department of Science and Technology could hire program managers to frame hypotheses around problems that could be solved using AI, and then fund research programs for these problems through grants.
- Researchers could bid for these grants in open competition by devising a variety of approaches and solutions to the research problem.

- This would help create large useful labelled data sets and the technology needed for India. Students who work on these projects will naturally go on to create startups around them.
- Government should do impact evaluation for the technologies created and select worth ones for implementation.
- India's space and defense research organizations could enact similar programs involving the AI research community to develop solutions for them.

Policy changes needed

Need for legal definition of AI

- Given the importance of intention in India's criminal law jurisprudence, it is essential to establish the legal personality of AI (which means AI will have a bundle of rights and obligations).

- To answer the question on liability, a strict liability scheme that holds the producer or manufacturer of the product liable for harm, regardless of the fault, might be an approach to consider.

- Since privacy is a fundamental right, certain rules to regulate the usage of data possessed by an AI entity should be framed as part of the Personal Data Protection Bill, 2018.

Data Protection Law

- A data protection law is needed which aims to give more security to consumers of technology.

- Law provides for the processing of personal data, including digital media, by either a natural person or a public or private legal entity, for the purpose of protecting a person's fundamental rights of freedom, privacy, and free development of personality.

Trade Negotiations

- Trade and Development agreement to work together to harness the power of cutting-edge technologies such as AI and blockchain to enhance and improve trade.

- With the growing complexity of international trade agreements, the purpose of the use of AI is to reduce such complexity and help representatives of less favoured nations achieve better results.

Fraud Detection

- The idea is to develop a system to help customs officers identify suspicious customs operations, and to develop a product and foreign exporter information system to help importers in the registration and classification of their products and corresponding exporters.

Criminal Investigation

- ❖ The investment is geared towards data science and AI to collect, store, and analyse large volumes of information.

- ❖ The system allows information from different sources and bodies to be collected and also allows a series of real-time data to be collected from suspected criminals

12. Explain the objectives and current achievements of Human Genome Project.
மனித மரபணு திட்டத்தின் நோக்கங்கள் மற்றும் சமீபத்திய சாதனைகள் குறித்து விளக்குக

The idea of sequencing the human genome was first proposed in the USA committee appointed by the US national research council. It refers to the international 13-year effort, formally begun in October 1990 and completed in 2003, to discover all estimated 20,000 to 25000 human genes.

Another goal of projects is to determine the complete sequence of the 3 billion DNA subunits. The first genetic map was completed in September 1994 while the physical map with 30,000 or more STSs was completed in October 1998

The sequencing of 99% of portions of gene-rich regions was completed in April 2003. Meanwhile, identification and characterization of disease-causing genes, sequencing of other model organisms and other uncompleted tasks that were done in the same year.

Aims and objectives of HGP:

The Human genome project was started in the 90s and completed after almost 13 years of hard work by scientists.

The project was designed not only to sequence the whole genome but also to make it readily accessible for scientists across the world. To fulfill the present aim, initially, more than 200 different genetic laboratories from the USA and 18 different countries had taken part to support the project.

Also, the project was a kind of open initiative in which any country can take part to support the human genome project.

The core values or objectives of the present projects are to tailor a physical or genetic map of the whole human as well as mice genome.

To sequence both the genome and other genomes like yeast and microbes in order to use it as a test run for human genome sequencing.

Overall, two broader objectives of it are:

1. Creating a physical map of the human genome
2. To sequence the whole genome of around 3 billion base pairs.

Other objectives are,

- To make the information available for all researchers thereby developing a computational system to store, transfer, process and retrieve the data across the world.
- To identify all the disease-causing genes.
- To understand the function of genes
- To map and tag genes on chromosomes.
- To develop tools to process and analyze data.

Techniques used in HGP:

Initially, the shotgun sequencing technique was used to initiate the human genome project. The present technique was powerful enough to sequence the whole genome at that time.

The whole project using the SGS is divided into two phases; in the initial phase, approximately 90% of DNA (coding genes) would be sequenced while in the later phase, the remaining gaps and breaks would be filled using the data of physical mapping.

The overview of the technique is explained here;

DNA extraction is performed followed by the restriction digestion that makes chumps of larger DNA fragments. The endonucleases cleave DNA into thousands of fragments.

Later the fragments are inserted into the BAC- bacterial artificial chromosomes and a library of fragments are constructed.

Soon after, digested fragments are further divided even smaller fragments are ligated into the plasmid vector.

These smaller fragments are sequenced in amplification reactions. This is a comprehensive overview of the shotgun technique used in sequencing.

Besides the shotgun sequencing technique, secondary techniques like PCR, FISH, restriction digestion and Sanger sequencing are also practiced to achieve various milestones during the human genome project.

For example,

Restriction digestion technique is used to construct the restriction map. HindIII, EcoRI, PstI and other restriction endonucleases are employed to digest the genomic DNA in order to produce sticky end and blunt-end DNA fragments.

The restriction endonuclease cleaves DNA at its known recognition sites. These fragments are either ligated into BAC or plasmid.

The application of polymerase chain reaction here is to amplify the DNA fragments to success in DNA sequencing.

The chromosomal map by sequence-tag sites was also generated by utilizing the PCR technique.

Here the set of known primers were allowed to amplify 500 to 600 bp fragments of DNA-STSs within the vector library. STS- amplification allows mapping DNA sequences on chromosomes.

The fluorescence in situ hybridization technique was also practiced to construct the physical map of chromosomes. It is a hybridization-based technique in which the known DNA probes hybridize on complementary regions of chromosomes.

Moreover, tools like Restriction enzymes, ligases, helicases, BAC, plasmids and other biological tools were also used during the human genome project.

Outcomes of HGP:

After completion of the project, scientists have gained tremendous information regarding the genome of us. A glimpse of some of them are here;

In the human genome, 25,000 – 30,000 protein-coding genes are present which is two times larger than other eukaryotes such as worm and fly. It is obvious that the human genome is more complex with more alternating splicing generating more protein products.

Genes are supposed to be derived from the transposable elements and horizontal gene transfer from bacteria.

Mutation rates are twice as high in males as females.

The cytogenetic analysis also revealed that the 'Gene rich' rich regions stain lighter while 'Gene poor' regions stain darker by G bands.

Some numbers of HGP:

- The human genome contains 97% repetitive junk DNA content.
- Only 2 to 3% portion of the genome encodes proteins
- The human genome contains 3.2 bbp, which means 6.4 bases which are approximately 3164.7mb.
- Around 25,000 to 30,000 genes are present in the human genome in which the average length of a gene is 3000 base pairs.
- The largest gene is the dystrophin having 2.4Mb in size.
- All the genetic content of a cell is located on 23 pairs of chromosomes.
- The genome of us has 1.4 million known SNPs.

Importance of HGP

The human genome project was established aiming to diagnose genetic disease and to know the predisposition of disease in order to improve the drug delivery system.

Using gene therapy more precisely to treat and cure disease. A mutant gene can be repaired or replaced through gene therapy.

To study the risk of toxic exposure to individuals and how it impacts the genetics of individuals.

To study the evolution through germline gene therapy and migration of races and species. Identification and classification of organisms by DNA sequencing.

Applications of human genome project:

- ❖ Diagnosis of disease:
- ❖ Curing genetic disorders

In vivo, in vitro, germ-line and somatic cell gene therapies are popular types of it.

Gene therapy	Explanation
In vivo	Performed inside body or living cell.
In vitro	Performed outside body or living cell, in the lab.
Somatic cell	Performed on the somatic cells and thus restricted to some tissues or portion of a body.
Germline	Performed on the germ cells thus transfer to the fetus and next generations.

Genetic or molecular medicines:

Again, the futuristic and novel approach to design medicine specific to a particular gene or to influence the function of only a gene or genetic disorder we wish to treat sounds like a fairy tale.

genetic screening will enable rapid and specific diagnostic tests making it possible to test countless maladies. Genetic medicines will enable healthcare workers to treat a disease with a specific treatment.

13. Write a detail note on the India's missile development programme with its salient features.
இந்தியாவின் ஏவுகணை வளர்ச்சித்திட்டங்கள் பற்றி அதன் சிறப்பம்சங்களுடன் விவரித்து எழுதுக

Integrated Guided Missile Development Programme (IGMDP)

- ❖ IGMDP was brain child of renowned scientist Dr. APJ Abdul Kalam.
- ❖ It was intended to attain self-sufficiency in the field of missile technology.
- ❖ After keeping in mind the requirements of various types of missiles by the defense forces, the program recognized the need to develop five missile systems.

- The IGMDP formally got the approval of Indian government on July 26, 1983.
- It brought together the country's scientific community, academic institutions, R&D laboratories, industries and the three defence services in giving shape to the strategic, indigenous missile systems.

The missiles developed under IGMDP are:

- Short-range surface-to-surface ballistic missile – Prithvi
- Intermediate-range surface-to-surface ballistic missile – Agni
- Short-range low-level surface-to-air missile – Trishul
- Medium-range surface-to-air missile – Akash
- Third generation anti-tank missile – Nag

The Agni, which was initially conceived as a technology demonstrator project in the form of a re-entry vehicle, was later upgraded to a ballistic missile with different ranges. Dr. Kalam played a major role in the development and operationalisation of Agni and Prithvi missiles.

After achieving the goal of making India self-reliant in missile technology, DRDO on January 8, 2008, formally announced successful completion of IGMDP.

Missile System of India	
Missile	Features
Agni I	Single stage, solid fuel, Medium Range Ballistic Missile (MRBM). Using solid propulsion booster and a liquid propulsion upper stage. Range of 700-800 km.
Agni II	Intermediate-Range Ballistic Missile (IRBM). Range more than 2000 km.
Agni III	Two stage IRBM Support a wide range of warhead configurations. Strike range of more than 2,500 Km
Agni IV	Two stage missile powered by solid propellant. Can fire from a road mobile launcher. Range is more than 3,500 km. Equipped with indigenously developed ring laser gyro and composite rocket motor.
Agni V	Three-stage solid fueled, indigenous Inter-Continental Ballistic Missile (ICBM). Capable of carrying 1.5 tonnes of nuclear warheads. Latest and most advanced variant in terms of navigation and guidance, warhead and engine.

	After induction in the military, India will join an exclusive club of countries like the US, Russia, China, France, and Britain which have intercontinental ballistic missile capability. Canister launches missile system for operational flexibility. Range is more than 5,000 km.
Trishul	Short-range, quick reaction, all weather surface-to-air missile designed to counter a low level attack. Has necessary electronic counter-measures against all known aircraft jammers.
Akash	Medium-range, surface-to-air missile with multi-target engagement capability. Multiple warheads capable. High-energy solid propellant and ram-rocket propulsion system.
Nag	Third generation 'fire-and-forget' anti-tank missile with a range of 4-8km. Developed indigenously as an anti-armour weapon employing sensor fusion technologies for flight guidance. HELINA (Helicopter Launched NAG) is the air-to-surface version of the NAG integrated into Dhruv Helicopters.
Prithvi	First indigenously built ballistic missile under IGMDP. Surface-to-surface battle field missile. Demonstrates higher lethal effects and high level capability with field interchangeable warheads. Range from 150 km to 300 km.
BrahMos	Supersonic cruise missile. Being developed with Russia as a private joint-venture. Multi-platform cruise can strike from various types of platforms. Among the world fastest supersonic cruise missiles with speeds ranging between Mach 2.5 – 2.8. A 'fire and forget' weapon i.e. requiring no further guidance from the control centre once the target has been assigned.
Nirbhay	Subsonic missile, supplement to the BrahMos. Capable of being launched from multiple platforms on land, sea and air. A terrain hugging, stealth missile capable of delivering 24 different types of warheads depending on mission requirements. Can reach up to 1,000 km.
Sagarika	Submarine-Launched Ballistic Missile (SLBM) Being integrated with India's nuclear powered Arihant-class submarine. Range - 700 km.
Shaurya	A variant of the K-15 Sagarika.

	Submarine- nuclear-capable missile. Aims to enhance India's second-strike capability.
Dhanush	Sea-based, short-range, liquid propellant ballistic missile. Naval version of Prithvi II. Maximum range 350 km.
Astra	Beyond-visual-range air-to-air missile using a solid-propellant. In terms of size and weight, one of the smallest weapon developed by the DRDO. Active radar seeker to find targets. Electronic counter-measure capabilities. Designed to intercept and destroy enemy aircraft at supersonic speeds in the head-on mode at a range of 80 km.
Prahaar	India's latest surface-to-surface missile with a range of 150 km. Primary objective is to bridge the gap between the unguided Pinaka multi-barrel rocket launcher and the guided Prithvi missile variants. Have high maneuverability, acceleration and accuracy.

14. Write an essay on Robotics in India.
இந்தியாவில் எந்திரவியல் பற்றி ஒரு கட்டுரை வரைக

ROBOTICS

Awareness in the fields of Robotics

Basically, Robotics deals with the design, construction, operation, and use of robots combined with computer systems for their control, sensory feedback, and information handling. The design of a given robotic system brings together doctrines of electronic engineering, mechanical engineering and computer science. Robots are developed by humans in the perfect image of the Human in the human mind. Robots are very useful to humans as these manmade machines traverse harmful terrain, perform surveillance missions, and perform remote surgery around the world.

History of Robots

The phrase robot was invented by a Czech novelist, Karel Capek in a 1920. Robotics was first used in Runaround, a short story published in 1942, by Isaac Asimov. Issac Asimov introduced his laws of robots and Eric Elenberger, who is considered as the father of robotics, introduced real-time robots to the world. Fundamentally, a robot is a re-programmable machine that is capable of movement in the accomplishment of a task.

Types of robot:

1. Mobile robots
2. Rolling robots
3. Walking robots

4. Stationary Robots
5. Autonomous Robots
6. Remote-control Robots

Benefits

Robots is highly beneficial for workers, industries and countries. If introduced properly, industrial robots can augment the quality of life by freeing workers from dirty, boring, hazardous and heavy labour.

It is a fact that robots can cause unemployment by replacing human workers but robots also create jobs like robot technicians, salesmen, engineers, programmers and supervisors.

The benefits of robots to industry include improved management control and productivity and consistently high quality products.

Industrial robots can work vigorously night and day on an assembly line without a loss in performance. Subsequently, they can greatly reduce the costs of manufactured goods.

As a result of these industrial benefits, nations that successfully use robots in their industries may enhance their economic status at global scale.

Robotics in India: India understands the importance of robotics in numerous fields. This will also open up the possibilities in the field of Research activities, Manufacturing, Academia, Space technology, Defence industries, Medical, and Agriculture industry.

Timeline vision of robotics in India

- 2013-2014 – Agricultural robots
- 2013 – 2017 - Robots that care for Elderly
- 2013-2020 – Nano Robots
- 2015 – To have one third of its fighting capacity provided by Robots
- 2017 – Medical Robots performing low invasive surgery
- 2017-2019 – Household Robots
- 2035 – To have first completely autonomous Robot soldiers on the battlefield

Prospects in Robotics in India: Robotics offers numerous opportunities for both entrepreneurs and students. Industries across a range of sectors such as automotive, atomic energy, defence, space, metals, textiles and manufacturing use Robotic technologies very effusively. Robots are required everywhere to improve productivity. They are also being used in operation theatres and rehabilitation centres to enhance the quality of life. Developed countries like Japan and America are using robots for many functions.

Challenges of robotics in India: In India, Robotics field also pose many challenges. The major issue in using robotics for various functions in India is the high cost of adoption, availability of skilled talent and procurement of hardware components. As Robotics is a multidisciplinary field, acquiring and retaining quality talent is major issue.

Industrial Applications of Robots: Industrial robots are found in various locations such as the automobile and manufacturing industries. Robots cut and shape fabricated parts,

assemble machinery and inspect manufactured parts. Robots perform task of load bricks, die cast, drill, fasten, forge, make glass, grind, heat treat, load/unload machines,

Robots in Medicine:

Robots have great importance in the medical field where extreme precision and delicacy is essential, and the margin for error is very low. The main areas of robotics applications in medicine is in surgery. Because robots are able to perform major operations while only making small incisions, patients receive many benefits.

Robots are used to perform heart surgery without opening patient's chests. In Prosthetics, Mechanical replacements for missing limbs and organs that can interact with the human organic system are a long-standing goal of the robotics community.

Robotic devices can also provide help to people with severe restrictions on movement, in many cases allowing them at least some capability to move around or nearby their homes.

Rehabilitation Robots can provide exercise platforms to help restore limb function and can monitor the condition of patients undergoing rehabilitation from the effects of injuries, stroke or other brain or nerve damage.

Application of Robots in Space: Robots can perform well in space arena where it is dangerous for humans to get to space, to be in space and to return from space. But is a major challenge for experts or engineers to fit robots operating reliably. It is easy for manipulator to restore parts, to fix the space ship and to direct the wholes space shuttle.

Underwater Robots: Robotic underwater travellers are used to reconnoitre and gather information about many aspects of marine environment. For example, robots are used for underwater cable inspection, and for telecommunications.

Application of Robots in Military and Security:

Military robots are self-directed or remote-controlled devices designed for military applications. As it is well established that military is a dangerous job, but some of the tasks that soldiers are required to do are more dangerous than others.

Walking through minefields, deactivating unexploded bombs or clearing out hostile buildings are some of the most dangerous tasks a person is asked to perform in the line of duty. In military field, robots are also used to investigate hazardous and dangerous environments.

In these environments robots are used for firefighting, for entering into risky areas and for removing of injured persons in natural disasters. Other major applications of robots in security is for inspection and search for dangerous materials.

In this, robots prevent the harms to humans operating it in case of something explodes during the inspection. Robots are also used during war for mine removal and entering into risky areas where robots use guns as their manipulators.

Domestic robots: The domestic or household robot are available in different types and serves various purposes such as robotic movers, robotic vacuum cleaners, robotic pool cleaners, toys, and floor washing robots. Domestic robots of these types must be setup properly to perform their jobs.

Humanoid robots: A humanoid robot is a robot which has resemblance like human and it is based on that of the human body, allowing interaction with made-for-human tools or environments. In general, humanoid robots have a torso with a head, two arms and two legs, although some forms of humanoid robots may model only part of the body, for example, from the waist up.

INDIA'S ADVANCEMENT IN ROBOTICS

- BARC (Bhabha Atomic Research Centre), Bombay, supported research projects on tele-robots.
- By 2013-14, agricultural robots were introduced in Indian agricultural sectors.
- Nano robots in medical sectors for surgery.
- SASTRA's (It is a robotic private limited company in Kochi, Kerala) SCARA robot can perform repetitive tasks, for uses such as moving products, miling, 3D-paintings and is being used by Bosch to test touch screens.
- 'AcYut' is India's first indigenously developed humanoid robot.
- By the end of 2019, Indian scientists are planning to develop household robots for uses in cooking, and other household works.
- "Daksh" is an electrically powered and remotely controlled robot used for locating, handling, and destroying hazardous objects safely in military war. It was developed by DRDO in December 2011 and by 2035, DRDO is going to have completely autonomous robot soldiers on the battlefield.
- The premier institution in India for Robotic research - Centre for Robotics & Mechatronics, Kanpur.
- Various IITs are offering courses in computer sciences with specialisation in A.I., which is an integral part of robotics.
- Centre for A.I. and Robotics in Banglore has developed a 'Chatur Robot'—an intelligent robot with vision sensor, which can pick up objects in visual field.
- Scientists from University of Ulster and IIT Kanpur have teamed up to investigate how to develop an intelligent robotics devices to help people with severe disabilities, making them achieve greater independence.
- In AIIMS New Delhi, there is successful performing of robotic surgery in which the thymus gland was removed from a patient suffering from 'Myasthenia Gravis'
- India is emerging as a hub for industrial robots and many Americans, Koreans and Japanese are using them.
- Ahmadabad-based 'Grid Bots' launched 'Robo Grad,' a robot that can clean homes and keep an eye on intruders.

DISADVANTAGES

- Employing a robot in factories has fewer limitations, as the humans performing the tasks require creativity, decision-making skills, time for adaptation and learning the job. Thus, the employees having no_ experience in dealing with robots require training programmes to interact with the new robotic equipment, which will take time and cost huge amounts of money in the financial input.

- The robot helps in the workers' protection from various hazards. But, they themselves can create safety problems, thereby causing new danger, which need to be taken into consideration.
- The preference of industries in the utilisation of robots instead of human workers will increase unemployment rate, hence creating social disturbances.
- Robots are costly in terms of both production and purchasing. Robots in the home could also cause conflicts because not everyone is going to financially be able to own it. Due to regular use of robots, the humans will become physically lazy, which might lead to many diseases.
- The major drawback of a robot is that it has no emotions. So, it cannot understand human values, ethics and cannot take decision based on philosophical or social values. It has no 'thinking power of analysing what is wrong or right and a day will come, when robots will be more powerful than humans and rule the whole world.

BIONIC MAN

The term "Bionic Man" was the stuff of science fiction in the 1970s, when a popular TV show called "The Six Million Dollar Man" chronicled the adventures of Steve Austin, a former astronaut whose body was rebuilt using artificial parts after he nearly died. Now, a team of engineers has assembled a robot using artificial organs, limbs and other body - parts that comes tantalisingly close to a true "bionic man". Bionic Man is the world's first robot human made entirely of prosthetic parts.

He walks, talks and has a beating heart, but he is not human — he is the world's first fully bionic man. The Bionic Man also has a nearly complete set of artificial organs, including an artificial heart, blood, lungs (and windpipe), pancreas, spleen, kidney and functional circulatory system.

SOPHIA

The "Humanoid Artificially Intelligent Robot" known as "Sophia" is considered one of the world's most advanced robots. Described as an "evolving genius machine", 'Sophia' was developed by Hanson Robotics (Hong Kong-based engineering and robotics company involved in the study of Artificial Intelligence to develop human-like robots).

The aim was to use technological entities like SOPHIA to incorporate human experience into robots. This is considered a new evolution in the world of AI. Aside from the algorithmic intelligence and communicative abilities, 'Sophia' is renowned for its realistic appearances and facial expressions, along with how the robot responds to the real questions asked by the interviewer.

Recently, Sophia made waves in the news when it became the first robotic entity to be granted full citizenship by another world country. Saudi Arabia is the country, which granted its full citizenship to Sophia.

After making the news of having acquiring citizenship, Sophia made her first trip to INDIA (Land of diverse and rich culture). She made appearances at IIT-B and WCIT (World

Congress on Information Technology) held at Hyderabad. The entire conversation in IIT-B fest was based on problems in different parts of the world, to how robots can bring evolution in human world. Apart from this, she made her stand on women and her status around the globe. Here, she made it with her witty replies to the questions asked by the audience and showed the capabilities of humans embarking on a journey of AI.

This development has made way for bright future of AI era, which has arrived. Development of robots in future can serve a huge purpose.

BIOROBOTICS

With an understanding of biomechanics, engineers can develop biologically-inspired robots, with improved and enhanced capabilities over traditional robots, which are robotic! Biologically- inspired robots have greater mobility and flexibility than traditional robots and often possess sensory abilities. Biorobotic technologies are often utilised to provide assistance to accommodate a deficiency—either as fully-functioning robots or highly advanced prosthetics; the latter represents one area in which neural engineering and biorobotics intersect, as both disciplines are required in order to first signal and then generate movement. Such devices may also be used to measure the state of disease, track progress or offer interactive training experiences that can speed recovery from an injury or stroke.

15. Enumerate the application and uses of Nano Technology.
நானோ தொழில்நுட்பத்தின் பயன்பாடுகள் குறித்து விவரித்து எழுதுக

Nano Technology

The term Nanotechnology came from nanometre, which is a length unit in the metric system, equivalent to one billionth of a meter (10-9). It is the manipulating matter study on an atomic scale.

APPROACHES IN NANOTECHNOLOGY

Bottom Up

In this approach, the manufacturing of different materials and products is done from their own molecular components. They accumulate themselves in a chemical manner through their own breed recognition. The bottom-up approach calls for assembly of nano-structures from atoms and molecules. Self-assembly of nano tubes has been round to be a useful feature.

Top down

In this approach, the nanomaterials and objects are produced by bigger bodies without its atomic

APPLICATION OF NANOTECHNOLOGY

Nanotechnology in Drugs (Cancer)

- ✓ It provides innovative methods for drug delivery and therapies.
- ✓ It assists in the accurate delivery of drugs in the body to the right location and further for controlling the infection; the drug doses are released on a fixed schedule for treatment.
- ✓ The drug will be delivered through a nanosized carrier for becoming concentrated at the site of disease, i.e., cancer tumour. At the final destination, at a specific location, they release the medicine and kill the tumour cells in human body. This type of treatment is popular for drug targeting. Recent treatment is given through radiotherapy or chemotherapy, which not only kill cancerous, cells but also kill normal cells that are necessary to the human life.
- ✓ Nanobots can clear the blockage in arteries and solve heart attack risk in human body.
- ✓ Nano-optics could allow for an increase in precision of pupil repair and other type of laser eye surgery.

Nanotechnology in Fabrics

- ✓ Some cloth producers are developing clothing which is strain and water-repellent through the usage of nano-sized whiskers in the fabric, thereby causing water to drop from the cloths' surface.
- ✓ These fabrics can also be used in manufacturing bulletproof jackets.
- ✓ It makes spill and dirt-resistant clothes and also develops antimicrobial and antibacterial fabrics.

Nanotechnology in Mobile

- ✓ Nokia Research Centre (NRC) and the University of Cambridge (UK) combinedly developed 'Morph', a nanotechnology concept based device. Morph is hydrophobic and dirt repellent in nature. It also has the capability to charge itself with accessible light sources due to the covering of photovoltaic nanowire on its surface.
- ✓ Nano-scale electronics technology also allows to stretch the handset. These nano-scale fibre mesh allows our mobile handsets to change into different shapes such as stretched, bent and folded into any number of imaginable shapes.

Nanotechnology in Electronics

- ✓ The electrodes made up of nanowires assist the flat panel displays to be flexible as well as skinny.
- ✓ Chip fabrication can be done by Nanolithography (this technology involves fabricating nano-scale structures).
- ✓ The transistors are made up of nanowires, which brought revolution in communication and information technology.
- ✓ In the manufacturing of e-paper, displays on sunglasses, etc.
- ✓ Recently available solar cells have much lower efficiencies (15-20%). Nanotechnology could help in increase this efficiency up to 40 per cent.
- ✓ Nanobatteries are rechargeable batteries and the nanomaterials used here could be helpful for the battery disposal.

Nanotechnology in Computers

- ✓ Transistors based on carbon nanotubes can replace silicon transistors in computers.
- ✓ Nanorods for display technique are the future technology, which consume less electricity and emit less heat.
- ✓ Due to nanotechnology, microprocessors' size has been reduced to a great extent.
- ✓ According to the researchers at North Carolina State University, nanodots are growing magnetic nanoparticle arrays.
- ✓ Nanowires coated with titanium dioxide can be used as memory devices.
- ✓ Memristor-made memory chips can achieve higher memory density due to their small size.
- ✓ Before "i" series processors, intel used chips of size ranging between 65nm and 45nm. Later on. due to nanotechnolgy, the size of chip reduced to 22 nm, which itself is a milestone.

Other Uses

- ✓ As cutting tools, nano-crystalline materials, such as tungsten carbide, tantalum carbide and titanium carbide, are more wear and erosion-resistant, and have good life than other conventional counterparts.
- ✓ Silver nano-crystal materials kill bacteria and prevent infection.
- ✓ Synthetic bone has been developed by the molecular level manipulation of calcium and phosphate through the nano-particulate.
- ✓ The usage of lightest identified solid material, termed as 'Aerogels' in space suits and further proposed its usage in space craft due to good insulating properties are also importance of nanotechnology.

NANOTECHNOLOGY IN INDIA

Today, nanotechnology has great relevance, as it has the potential to address the/needs of all innovative technological solutions.

Significance

The Indian government is looking towards nanotechnology as a means of accelerating agricultural productivity in the country. According to the Planning Commission, nanotechnologies such as nano-sensors and nano-based smart delivery systems could help ensure natural resources like water, nutrients and chemicals; those are used efficiently in the field of agriculture. Now-a-days, nano-barcodes and nano-processing could also be used to help in monitoring the quality of agricultural produce.

Nanotechnology can help India in ensuring food security with increasing crop yields and reducing consumption. Nanotechnology can be used to supply water and nutrients to crops, thereby increasing the yield and reducing wastage. It can be used in preventing damage to stored food grains.

Nanotechnology can be used in public health, in India, with better medical practices and affordability. With the advancement of nanomedicine, researchers had developed nano-bioceramics that repair bone and tissue and an aerosol spray that uses nanoparticles to deliver lung cancer drugs. A nano-based water filter and the 'Sens' (a sensor) are also developed in India as an affordable and user-friendly nanodiagnostic tool that anticipates heart attacks. It is expected

to become commercially available soon. With its vast scientific and industrial base, India can become a leader in nanoscience and nanotechnology research.

GOVERNMENT EFFORTS

Nanotechnology is a knowledge-intensive and "enabling technology" that can influence a wide range of products and processes with far-reaching implications for national economy and development. The government has been taking various initiatives to promote nanotechnology. Some of the prominent initiatives are:

1. **Nano Science and Technology Initiative (NSTI):** The Department of Science and Technology, in October 2001, had launched a modest programme in Nano Science and Technology, called the Nano Science and Technology Initiative (NSTI). Under the NSTI, the DST supported a number of activities in Nano Science and Technology. Based on the success of the NSTI, the second phase of DST's efforts was launched as the Nano Mission.

2. **Nano Mission:** The Government of India, in May 2007, has approved the launch of .a Mission on Nano Science and Technology (Nano Mission.) It is a five-year initiative for promoting nanotechnology in India.

   The Department of Science and Technology (DST) is the nodal agency for the implementation of Nano Mission in India. An allocation of ? 1000 crore for 5 years has been made by DST for this research work. Two advisory groups guide the technical programmes of the Nano Mission:

   (NSAG): Nano Science Advisory. Group
   (NATAG): Nano Applications and Technology Advisory Group

3. Nanotechnology Initiatives Programme: The Department of Information Technology (DIT), Ministry of Communications and Information Technology (MCIT), has inaugurated the Nanotechnology Initiatives Programme in 2004. It is mainly concentrating on nano-electronics aspects of the nanotechnology. The focus of the programme initially is on capacity building and human resource development, infrastructure creation and research and development in nano-electronics and nanotechnology and nanometrology. This programme emphasises on the establishment of major centres on nanoelectronics and nanometrology in India. This programme brings a number of research and development projects at the academic level of R and D organisations across the country and also involve in Indian nanoelectronics user programmes.

4. National Nanotechnology Institutes: The government has identified 3 cities - Bangalore, Mumbai and Kolkata - for the promotion and development of nanotechnology, by setting up the Indian Institute of Nano Sciences (IINS) at these three locations. The institutes will primarily focus on advanced scientific research in nanotechnology.

5. Vision Group for developing a National Nanotechnology Policy: India formed a Vision Group in January 2008, consisting of about a dozen researchers from academics, industries and research spheres to develop a National Nanotechnology Policy in India.

6. Bangalore Nano: Bangalore Nano is organised by the Government of Karnataka and the Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR). Bangalore. It is a biannual event. The event comprises exhibition and conference and provides a meeting place for global scientists, industry, academia and government.

7. International Collaboration: Besides launching the Nano Science and Technology Initiative and Nano Mission, India has also put its step into bilateral nanotechnology programmes with the European Union, Germany, Italy, Taiwan and the United States. India is a participant in the IBSA (India-Brazil-South Africa) nanotechnology initiative. It was started as a collaborative programme between the Department of Science and Technology of three participating countries, with a goal of developing trilateral collaborative projects of common relevance and interest.

8. Nanotechnology Regulatory Board: In February 2010, the Nano Mission Council stated that India will have a Nanotechnolog) Regulatory Board to regulate the industrial nanotech products that are used in day-to-day life. It is felt that India should have an efficient regulatory body and well-defined protocols for dealing with the deployment of nanotechnology like handling, movement and approval of nano products and also to maintain an adequate database on its toxicity.

OBJECTIVES OF NANOTECHNOLOGY

- ✓ Promotion of basic research in nanotechnology)
- ✓ To provide infrastructure for Nanoscience and technology research
- ✓ Should enhance Nano-applications and technology through promotion of application-oriented research and development project.- with special efforts, either directly through industrial sector into nanotechnology research and development or through Public Private Partnership (PPP) ventures.
- ✓ Human Resource Development - Nano Mission should focus on providing effective education and training to researchers and professionals in diversified fields those enhance Interdisciplinary culture for nanoscale science, engineering and technology.
- ✓ International Collaborations through exploratory visits of scientists and involve in various workshops and conferences under various joint research projects.

POSSIBILITIES FORTHE FUTURE

- ✓ With the help of nanotechnology, there comes the possibility of manufacturing lighter, stronger, and programmable materials, which require less energy than conventional material to generate and guarantee greater fuel efficiency in land, ships, aircrafts, transportation and space vehicles.
- ✓ Nanorobotics has a good future I in medicine as a drug targeting and gene therapy.
- ✓ The nanorobots are capable of undertaking human tasks as well as tasks that are not being performed by the humans. The reconstruction of the depleted ozone layer could potentially be performed.
- ✓ Nano surgical field helps in the treatment of everything from natural aging to diabetes, etc. Everything will be repaired easily with the introduction of Nano surgery.

PITFALLS OF NANOTECHNOLOGY

Nanoparticles can easily enter into the human body through food, skin or lungs and produce free radicals, thereby causing cell damage. If nanoparticles e Nanoparticles can easily enter into the human body through food, skin or lungs and produce free radicals, thereby causing cell damage. If nanoparticles enter the bloodstream and cross the blood-brain barrier, they will become more dangerous to human life. Nano-bomb is the most dangerous outcome of the use of nanotechnology that contains engineered self-multiplying deadly viruses that are dangerous at different levels, like community, country or even an entire civilization. and cross the blood-brain barrier, they will become