SURESH' IAS ACADEMY

13th TEST

Marks : 300
Time : 3 Hrs

TARGETING TNPSC GROUP-II 2023

QUESTION WITH SIMPLIFIED ANSWER

Science & Technology

MAINS WRITTEN EXAM

- Govt. policy - Organization on Science and Technology
- Role, Achievement & Impact of Science and Technology
- Energy - Self Sufficiency
- Oil Exploration
- Genetics - The Science of Heredity

English Medium

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TEST 13 வெற்றி ஒன்றே இலக்கு

Answer Key - English

Unit - 2

1) Write short note on

a) NIOT

b) National centre for Antarctica and Ocean research

a) <u>About NIOT</u> **1**

- **Abb:**National Institute of Ocean Technology(NIOT)
- **Established in:** 1993.
- **Status:** An autonomous society under the Ministry of Earth Sciences, Government of India.
- **Administration:** NIOT is managed by a Governing Council and the Director is the head of the Institute.
- **Headquarters:** Chennai, Tamil Nadu.
- **Aim:** develop reliable indigenous technologies to solve various engineering problems associated with harvesting of non-living and living resources in the Indian Exclusive Economic Zone(EEZ) which is about two-thirds of the land area of India.

<u>Mission of NIOT</u> **1**

- To develop world class technologies and their applications for sustainable utilization of ocean resources.
- To provide competitive, value added technical services and solutions to organizations working in the oceans.
- To develop a knowledge base and institutional capabilities in India for management of ocean resources and environment.

<u>Recent Development by NIOT</u> **1**

- NIOT has developed salt water - powered LED Lights for coastal population.
- Named as Roshni which is India's first saline water Lantern that uses seawater for power.
- provides electrical power through ionisation and promotes ease of living to fishing community living along 7500 km long coastline of India.

b) <u>National Centre for Antarctica and Ocean Research</u> **1**

- **Year:** 1998-**Present name:** National Centre for Polar and Ocean Research (NCPOR)

<u>Functions</u> **2**

- To play a leadership role in research in polar and ocean sciences.
- To lead in the geoscientific surveys of India's Exclusive Economic Zones (EEZs) and the continental shelf, deep-sea drilling in the Arabian Sea basin, exploring the ocean for gas hydrates and multi-metal sulfides, and other non-living resources under the International Ocean Discovery Program (IODP).
- Facilitating research being undertaken by other institutions and organizations in Antarctica, the Arctic & the Indian Ocean segment of the Southern Ocean.
- Managing and implementing all scientific and logistical activities of the annual Indian expeditions to the Arctic, Antarctic and Southern Oceans.
- Managing and maintaining the research stations, Maitri, Bharati and Himadri.- Managing the Earth Sciences Ministry's vessels including ORV Sagar Kanya.

2) Write short note on the following organizations which are situated in Tamil Nadu.a)Structural Engineering Research Centre (CSIR-SERC)b)Combat Vehicles Research and Development Establishment (CVRDE)

a) <u>Structural Engineering Research Centre (CSIR-SERC)</u> **1**

- One of the national laboratories under the Council of Scientific & Industrial Research
- **Location:** Chennai

<u>Research Areas</u> **1**

- Structural engineering concepts like:
- Disaster Mitigation
- Structural engineering – shock absorption, etc.
- It undertakes application-oriented research in all aspects of structural engineering – both design and construction, including rehabilitation of structures.

- It also provides design consultancy services, including proof checking, to organisations in the public and private sectors for developing a variety of structural designs.

Emergency Retrieval System(ERS) 1

- CSIR-SERC has developed an Emergency Retrieval System (ERS), which is supposed to help for quick recovery of power transmission in the case of failure of transmission line towers due to calamities such as landslides, earthquakes, cyclones, or any man-made disruptions.
- This will help the country to avoid power failures after the hitting of these calamities and it will also increase the speed of rescue operation where power supported equipment is required

b) Combat Vehicles Research and Development Establishment (CVRDE)

Intro 1

- Combat Vehicles Research & Development Establishment (CVRDE) functions under DRDO-It is committed to the development of the manned and unmanned variants of Armoured Fighting Vehicles (AFVs) and combat aircraft line-replaceable units.

Origin 1

- During 1965, a need was felt to set up an independent DRDO establishment adjacent to Heavy Vehicle Factory (HVF), Ordinance Factory, Avadi for handling R&D tasks relating to armoured fighting vehicles (AFVs).
- Accordingly, an R&D cell from VRDE, Ahmednagar, was set up at Avadi with the name as 'VRDE, Avadi' during the year 1967.
- This detachment grew into a full-fledged R&D Establishment in 1969. Later, this was made as an independent establishment and rechristened as ''Combat Vehicles Research and Development Establishment (CVRDE)'' on 26 March 1975.

Functions 1

- Design and development of
- Vehicles for unmanned missions
- LRUs for Combat Aircraft and Naval systems etc.
- Development of systems viz. hull, turret, mechanical systems, engine, transmission, running gear systems, armament systems, gun control systems, fire control system, electrical and electronic systems (Vetronics) and related technologies.
- CVRDE has capabilities in system integration & field evaluation of various AFVs and its systems.

3) Explain the application of Science& Technology in water management?

Application of S&T in Water Management Data

- As per NITI Ayog 2021,
- 74% of household do not have drinking water on premise
- 84% of rural household do not have piped water resources.

Role of S&T 5

a) GIS maintaining of Ground Water Resources: Helps to provide water availability to remote of rural area.

b) AI for optional usage of Ground water - Present over depletion of water table.

c) Electrostatic precipitations, Ionic filter - At the discharge pipe that precipitates organic & Inorganic pollutants

d) Roof-top water harvesting

e) Modular curing solution - user special kind of plastic particles to sustain moistures of newly build concrete structure.

f) Desalination plants - Technologies used to convert salt water to fresh waste.

Way forward 1

- Govt fromed Jal Shakthi Ministry - to link different rivers using technology will give adequate water.
- Initiatives - "Space science in water conservation" to ensure availability of water to achieve sustain ability a fulfill SDGS.

4) Write in detail about virtualization to the next level for Users Technology?

Metaverse 2

- This new technology 'Metaverse' is taking virtualization to the next level for users.
- Through this, one can be taken to an artificially created world in an instant
- The brain works according to what the human eye sees.
- As such, this technology makes the human eye believe that it is somewhere else.
- So, our brain also believes the same and makes us perceive the artificial world shown in it.
- This technology cannot be explained in words but can only be experienced.

Driving force behind Metaverse

- For the Metaverse to progress, it will need a significant upgrade in processing power, 3D images and virtual reality, internet connection, and more.
- In addition to Facebook, firms such as Nvidia, Microsoft, Unity, Autodesk, and Adobe are also working on the Metaverse platform
- If the 5G network comes in three years, through high-speed internet, Indians will be able to travel across countries and watch sports like cricket from the comfort of their homes.

Metaverse uses **3**

- Metaverse can combine virtual reality and mixed reality into a wide range of daily use cases and domains, including entertainment, manufacturing, health care, collaboration, sports, and training, thanks to its capacity to merge the physical and virtual worlds.
- For example, people who cannot go to a hospital to see a doctor can get the experience of seeing a doctor who is far away immediately.
- Training classes such as yoga and dance can be trained in a more controlled way with 'Metaverse' technology than the current video conferencing technology.
- Blockchain opportunities such as 'NFT' are growing to create and market three-dimensional (3D) virtual objects using this technology.

Positive impact on Environment **1**

- If more people use the Metaverse technology, the demand for travel will also decrease.
- When the traffic decreases, the toxic fumes emitted by the vehicles also decrease and there is a chance to save the natural resources to some extent.

5) Explain Fiber Optical Communication.

Fiber Optical Communication **2**

- Coherent light can be generated with laser or light emitting diodes and may be detected by photo-diodes.
- Optical fibers are used for transmission of light.
- An optical fiber is a thin transparent rod, usually made of glass or plastic, through which light can propagate.
- The light signals travel through the rod from the transmitter to the receiver and can be easily detected at the receiving end of the optical fiber.
- **Principle**: Total internal reflection is used for the transmission of light signals through the optical fiber.

Advantages **2**

- Transmission loss is low.
- Fiber is lighter and less bulky than equivalent copper cable.
- More information can be carried by each fiber than by equivalent copper cables upto 10 gbps and beyond.
- There is no interference in the transmission of light from electrical disturbances or electrical noise.

Applications **2**

- The various applications of fiber in communication area are, voice telephones, video phones, message services, data network etc.
- More suitable for 5G network

Challenges

- Fiber optic cables are more fragile when compared to copper wires.
- It is an expensive technology.

6) Explain GPS and mention its applications.

Global Positioning System **3**

- GPS stands for Global Positionin System.
- It is a global navigation satellite system that offers geolocation and time information to a GPS receiver anywhere on or near the Earth.
- GPS system works with the assistance of a satellite network.
- Each of these satellites broadcasts a precise signal like an ordinary radio signal.
- These signals that convey the location data are received by a low-cost aerial which is then translated by the GPS software.
- The software is able to recognize the satellite, its location, and the time taken by the signals to travel from each satellite.

Applications **3**

- Global positioning system is highly useful many fields such as

1. Fleet vehicle management (for tracking cars, trucks and buses)
2. Wildlife management (for counting of wild animals) and
3. Engineering (for making tunnels, bridges etc).

4. GPS also advances scientific aims such as weather forecasting, earthquake monitoring, and environmental protection.
5. GPS's accurate time facilitates everyday activities such as banking, mobile phone operations and even the control power grids by allowing well synchronized hand-off switching.

7) What is E20? Mention the benefits of E20.

Meaning **2**

- E20 refers to the Government of India's target for 20% ethanol blending in petrol.
- Currently, 8.5% of ethanol is blended with petrol in India
- The deadline for fuel firms to raise the ratio of ethanol in gasoline to 20% will be 2025. From April 1, 2023, the policy of introducing 20% ethanol will take effect.

Benefits of 20% ethanol blending (According to NITI Aayog report) **4**

1. Saving Rs.30,000 crore of foreign exchange per year.
2. Annual savings of $4 billion annually are being expected from petrol with 20 per cent ethanol.
3. This increased blending will expand the use of renewable energy in the world's third-biggest oil importer and consumer
4. help turn the nation's surplus rice and damaged food grains into ethanol
5. Increased energy security.
6. Lowered carbon emissions.
7. Better air quality.
8. Self-reliance.
9. Increased farmers' incomes and greater investment opportunities

8) Bring out the differences between clean energy and green energy with suitable examples.

Green energy **1**

- Green energy is a subset of renewable energy
- It represents generation sources with the smallest environmental footprint such as sunlight, wind, heat, and water. It can also include low-impact hydroelectric sources and specific forms of biomass.
- **Examples:** Solar energy, Wind Energy-Green energy creates no carbon emissions and has the lowest impact on the environment.

Clean Energy **1**

- Zero Emissions, But Not Always Renewable
- While all forms of green and renewable energy are also "clean energy", so is nuclear power as it does not create any carbon emissions or pollutants during generation.
- Many forms of bio-gas – made from organic matter, household waste, and manure – are also regarded as clean energy, although they may not always be completely renewable.
- Despite the finer points, all clean energy sources are a significant improvement over fossil-fuels and create no greenhouse gasses. And in cases such as biofuel and landfill gas capture, clean energy production can even solve multiple problems at the same time.

Differences

Parameters	Green Energy	Clean Energy 4
Renewable	Most significant environmental advantage	Although there are no emissions, renewable energy is not always renewable
Energy Sources	Derived from natural sources such as the sun, wind and water	Defined as the energy that does not pollute the atmosphre
Impact of enviroment	Emits no carbon dioxide and has the least environmental impact	Zero - carbon power tent is larger; it includes not just 100% renewables but also nuclear energy and the carbon - neutralizing impact of technologies such as carbon capture and sequestration (CCS)

9) a) Write short note on "Gobardhan Scheme".

b) State the challenges present in harnessing Wind Energy in India.

a) Gobardhan Scheme

Origin **1**

- Galvanizing Organic Bio-Agro Resources Dhan (GOBAR-DHAN)
- A scheme implemented under the Swachh Bharat Mission Gramin-Phase 2

- **Nodal Ministry:** Department of Drinking Water and Sanitation under the Jal Shakti ministry.
- It was launched in 2018.
- **Aim:** To augment income of farmers by converting biodegradable waste into compressed biogas (CBG).

Benefits of the scheme **2**

- Helpful for the country as India is home to the highest cattle population in the world, close to 300 million in number, with a daily output of 3 million tonnes of dung.
- Encourage farmers to consider dung and other waste not just as a waste but as a source of income.
- Provides a stable fuel supply in the market for oil companies and accessible credit in the market through government schemes and banks for entrepreneurs.

b) Challenges :

Policy measures: **3**

1. Initially, the growth in the wind energy sector picked up because of the incentives in generation, accelerated depreciation and taxation. The Government has gradually taken these incentives away.
2. There is a ceiling of tariff imposed on every auction. Winds being region specific, achieving the particular tariff rate becomes difficult.

Technical challenges: (with respect to DISCOMs)

3. Curtailment in power generation
4. delayed payments to energy producers etc.

Research

5. Offshore entails lot of data collection before one actually ventures into it.

Finance

6. High initial investment
7. Lack of private investments
8. Seasonal nature of winds

10) Despite having a huge potential for solar energy in India, the production is not as high as non-renewable energy. Why?

Intro **2**

1. Among the various renewable energy resources, solar energy potential is the highest in the country.
2. In most parts of India, clear sunny weather is experienced 250 to 300 days a year.
3. The annual radiation varies from 1600 to 2200 kWh/m^2, which is comparable with radiation received in the tropical and sub-tropical regions.
4. The equivalent energy potential is about 6,000 million GWh of energy per year.

Challenges in realising the full potential of solar energy **3**

1. Lack of large domestic manufacturing base
2. Import Dependence for PV cells
3. Domestic Content Requirement (DCR) issues due to WTO litigations
4. Finding suitable land for solar projects is challenging.
5. Absence of skilled workforce
6. Absence of proper finance mechanism
7. The lower cost-effectiveness of solar energy makes it a less profitable business.
8. Decline in power sector demand in the last few years
9. Lack of indigenous R&D10.High initial costs are a discouraging factor for its popularity among the general public.

Various Steps Taken **1**

1. International Solar Alliance – an initiative of India and France
2. Policy support measures like special tariffs
3. Solar Park Scheme
4. KUSUM Scheme, etc.

11) Design the off shore Ocean Thermal Energy conservation powered desalination plans.

DOM's impact on India's Economy of Environment Minerals **6**

- Indian ocean has cobalt, zinc, manganese of rare earth minerals
- Needed for electronic industries to make smart phones, lap tops etc.

Energy resources

- Has petroleum of gas hydrates
- Used in oil production

Manganese Nodule & Crest

- Concentration of manganese, iron of cu, nickel of cobalt
- Numerous economic uses

Sustainable Development

- Marine resources - 5 trillion dollar economy by 2022 through blue economy

Climate change

- Cleaner source of energy
- Act as carbon rink

National Security

- Significant role in security of national as many critical military technologies relay have by on rare earth elements.
- Abundant in Ocean.

Disaster Preparedness

- Deep sea exploration can help to predict earthquakes & Tsunamis.

12) Write about the India's Energy conservation and its challenges and actions for improvement.

Energy Self sufficiency 1

- Long - term energy security involves making timely investments to provide energy in line with economic developments and environmental needs.
- Short - term energy security focuses on the ability of the energy system to respond promptly to sudden changes in the supply demand balance.

Importance of energy conservation 1

1. India aims to become a leading global economic power fueling energy needs for infrastructure provision of basic needs, development of human skills, employment generation and development of productive capacities.
2. India's economic fortunes are fied to the ever-fluctuating international oil prices.

Challenges of India's energy Conservation 2

1. Policy Challenge
2. Failure to access Challenge
3. Less Infrastructure Challenge
4. Economic Challenge
5. Foreign affairs Challenge

Action taken to secure energy 2

- Capacity building
- Policy Change
- IESS 2047
- Improve Infrastructure
- Improve renewable energy
- The Energy Conservation (Amendment) Bill, 2022 - initiative aims to save 300 billion units of electricity by 2030 by implementing the building code

13) Define and write the combination of

a) LPG
b) PNG
c) HCNG

a) LPG 2

Abbreviation:

- Liquefied Petroleum Gas

Production:

- By product derived while extracting crude petroleum.

Combination:

- Butane, Propylene, butylene of isobutane

User:

- Fuel in household cooking-Fuel in some auto mobile

b) PNG 2

Abbreviation:

- Piped Natural Gas

Combination:

- One carbon of CH_4 hydrogen atom per molecules (95% methane of rest HC)

Uses:

- Fuel in heating appliances
- Cooking gas

c) HCNG 2

Abbreviation:

- Hydrogen Enriched Compressed Natural Gas

Combination:

- Blending of H_2 and CNG

User:

- Fuel in buses
- Delhi first city to roll out HCNG buses (2020)
- Steps towards combating air pollution

14) Give an account on "Unconventional form of Natural Gas"

1. Coal Bed Methane 1.5

- Coal bed methane (CBM) refers to a reserve of natural gas stored in coal seams. It is an unconventional form of natural gas
- Because of the lack of hydrogen sulphide, it is called 'sweet gas'.
- CBM is methane adsorbed into the solid matrix of the coal.
- CBM is formed during the process of coalification, the transformation of plant material into coal.
- It occurs in underground coal mines where it presents a serious safety risk.

2. Shale Gas 1.5

- Unlike conventional hydrocarbons that can be extracted from the permeable rocks easily, shale gas is trapped under low permeable rocks.

3. Coalbed Composition **1.5**

- Mainly composed of Methane (CH_4) with minor amounts of nitrogen, carbon dioxide and heavier hydrocarbons like ethane

4. Extraction Process **1.5**

- Extraction requires creation of fractures in oil and gas rich shale to release hydrocarbons through a process called hydraulic fracking/ fracturing
- The recoverable reserves are identified in Cambay, Krishna – Godavari, Cauvery, Damodar Valley, Upper Assam, Assam-Arakan Basin, Pranahita –Godavari, Rajasthan and Vindhya Basins.

15) Give the Comparison between gene and chromosome behaviour?

Intro **1.5**

1. Around twentieth century cytologists established that, generally the total number of chromosomes is constant in all cells of a species.
2. A diploid eukaryotic cell has two haploid sets of chromosomes, one set from each parent. All somatic cells of an organism carry theMendelian factors Chromosomes behavior

Comparison **4.5**

Alleles of a factor occur in pair	Chromosomes occur in pairs
Similar or dissimilar alleles of a factor separate during the gamete formation	The homologous chromosomes separate during meiosis
Mendelian factors can assort independently	The paired chromosomes can separate in dependently during meiosis but the linked genes in the same chromosome normally do not assort independently.

16) Explain the laws of Mendel?

Mendelian inheritance – Mendel's Laws of Heredity **1**

- Mendel proposed two rules based on his observations on monohybrid cross, today these rules are called laws of inheritance. The first law is The Law of Dominance and the second law is The Law of Segregation.
- These scientific laws play an important role in the history of evolution.

The Law of Dominance **2.5**

- The characters are controlled by discrete units called factors which occur in pairs. In a dissimilar pair of factors one member of the pair is dominant and the other is recessive.
- This law gives an explanation to the monohybrid cross (a) the expression of only one of the parental characters in F1 generation and (b) the expression of both in the F2 generation. It also explains the proportion of 3:1 obtained at the F2

The Law of Segregation (Law of Purity of gametes): **2.5**

- "When a pair of contrasting factors are brought together in a F1 hybrid. The two factors of the allelic pair remain together without mixing and when gametes are formed, the two separate out, so that only one enters each gamete."
- Alleles do not show any blending; both characters are seen as such in the F2 generation although one of the characters is not seen in the F1 generation.
- During the formation of gametes, the factors or alleles of a pair separate and segregate from each other such that each gamete receives only one of the two factors.
- A homozygous parent produces similar gametes and a heterozygous parent produces two kinds of gametes each having one allele with equal proportion. Gametes are never hybrid.

17) Define Stem cell. Explain about its application in Medical field.

Stem cell **1**

- Stem cells are undifferentiated biological cells that can differentiate into specialized cells and can divide to produce more stem cells.

Properties **1**

1. Capable of dividing and renewing themselves for long periods.
2. They are unspecialized
3. Can give rise to specialized cell types.

Types **1**

1. Embryonic stem cells

2. Adult stem cells

Applications 3

1. Embryonic stem cells:

- Exist only during earliest stage of development
- Supply new cells for an embryo are it grows of develops into a baby.

2. Adult stem cells:

- Supply new cells as an organism grows of replace cells that get damaged.
- Multi potent - they can only change into some cells
- **Eg:** blood cells, skin cells etc.

3. In stem cell transplants

- stem cells replace cells damaged by chemotherapy or disease or serve as a way for the donor's immune system to fight some types of cancer and blood-related diseases, such as leukemia, lymphoma, neuroblastoma and multiple myeloma.
- These transplants use adult stem cells or umbilical cord blood.

18) Define GM crops? what are its legal position in India. Give its advantages and how they significant in view of food security.

GM Crops 1

- **Abbreviation:** Genetically Modified Crops / Transgenic crops.
- **Definition:** GM crops are crops whose genes are artificially modified, usually by inserting genetic material from another organism.

Characteristics 1

- Increased yield
- Tolerance to a herbicide
- Resistance to disease (or) drought-Improve its nutritional value.
- **Eg:**Bt cotton, Bt Brinjal

Legal Position in India 1

- Genetic Engineering Appraisal Committee - apex body that allows for commercial release of GM crops.
- 2002 - BT Cotton commercial release
- Unapproved GM variant - can attract a jail of 5 yrs and fine Rs. 1 lakh under Environment Protection Act, 1986.

Advantages of significance in view of food security 3

- Human health of Nutrition
- Remove malnourishment- high protein GM food.
- Eg: Golden Rice - Vitamin A deficiency
- Low levels of myco toxins - BT corn
- India introduced Bt cotton seeds in 2002. It has greatly reduced the use of toxic pesticides. Bt cotton produces a common soil bacterium, Bacillus Thuringiensis (Bt). It is a natural pest repelling bacteria that is toxic to many worms and pests that can harm the crop but is not hazardous to humans.

Environment:

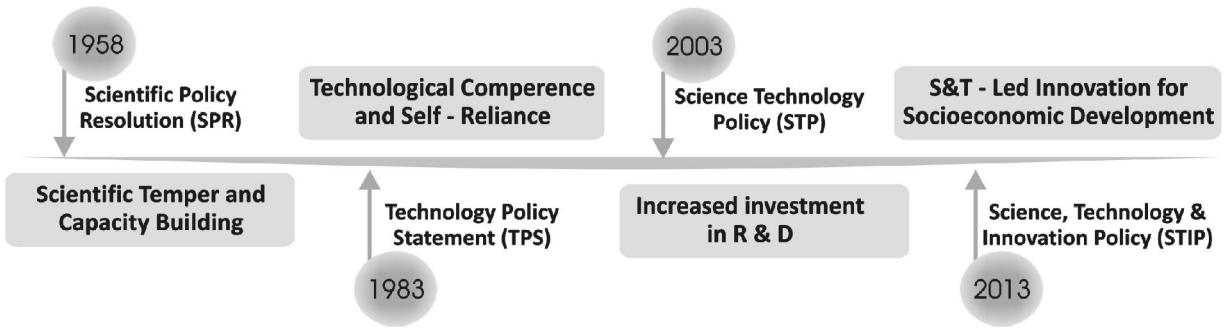
- Sustainable agriculture - lowering chemical fertilizers, pesticides, weedicide-Adaptation to climate change.

Unit - 2

1) Discuss about the salient features and impact of India's Science & Technology policies?

Introduction 1

- Right after independence, India realized the value of science in promoting the welfare of people. Let us discuss about the policies released so far.



Scientific Policy Resolution (1958)Motivation 2

- Nurturing scientific enterprise/ scientific temper.
- S&T seen as an instrument of socio-economic transformation and nation building.

Salient Features:

- Cultivation of scientific enterprise in pure and applied science research and capacity building.
- Opportunities for scientific activity, discovery and dissemination of new knowledge.

Impact:

- Emergence of several scientific organizations and national laboratories.
- Strong foundation in R&D and higher education

Technology Policy Statement 1983 Motivation **2**

- Technology seen to influence lives and bolster societal expectations.
- Focus on meeting people's aspirations through technological development.

Salient Features:

- Maximize utilization of local (human and material) resources.
- Strengthen technological self-reliance in new sectors: information, electronics, and biotechnology

Impact:

- Establishment of Technology Development Fund (TDB)
- Establishment of Technology, Information Forecasting and Assessment Council (TIFAC)

Science & Technology Policy 2003 Motivation: **2**

- Recognition that S&T enterprise in intertwined and inextricable.
- Unprecedented impact of growth in information technology and democratization of internet on socioeconomic growth and development.

Salient Features:

- Call to invest heavily into R & D.
- Goal to increase investments in R & D to 2% GDP.
- Modernize S&T infrastructure in academic institutions.
- Incentivize return of scientists and engineers trained abroad to contribute to the Indian R & D ecosystem.

Impact:

- Significant rise in R & D investment (0.7% GDP at the end of 10 yr period).
- Rise in India's publication making.
- Steady increase in institutional and human capacity (IISERs – 2006 onwards, New IITs 2008 onwards).

Science, Technology And Innovation Policy 2013 **2**

- **Motivation:** 2010 – 20 announced as decade of innovation.
- Intent to synergize Science, Technology and Innovation (STI) to transition to a knowledge -based economy.
- Aim to position India among top 5 global scientific powers.

Salient Features **2**

- Innovation is the "key" to building Science and Technology (S&T) lead innovation ecosystem.
- Attracting private sector into R & D.
- Linking STI to socio-economic priorities.

Impact **1**

- A step in the right direction towards building a robust national innovation ecosystem.
- India's leadership and participation in global mega science initiatives.

2) Explain about CAIR and give its significance in Science & Technology?

Centre for Artificial Intelligence and Robotics [CAIR] Formation **1**

- The Centre for Artificial Intelligence and Robotics (CAIR) was formed as a nodal agency in October 1986 to carry out research and development in artificial intelligence and robotics in defence services.
- The centre is functioning under Defence Research and Development Organisation (DRDO).

Contributions of CAIR **1**

- CAIR has contributed to various defence projects in image processing, intelligent systems, human-machine interface design, automation and robotics.
- CAIR is also developing user-friendly systems with artificial intelligence applications for real-life problems.

Centre for Artificial Intelligence and Robotics **2**

- The centre's vision is to develop cutting edge technologies in AI, Robotics and allied areas, focusing on Defence applications.
- The centre's mission is to explore emerging areas of AI and Robotics, develop advanced software technologies for use in Defence

systems and provide technical consultancy, field support and training support to our users.

Composition of CAIR 2

- The centre has a multi-disciplinary team of scientists and engineers drawn from varied domains of engineering and sciences who are involved in various activities relating to R&D, design and development, production support, quality assurance, training and consultancy services.

Major thrust areas 2

1. Intelligent Systems
2. Machine Learning
3. Robotics
4. Software Engineering

- The centre has established a strong collaboration with various agencies such as the Indian Space Research Organisation (ISRO), Indian Institute of Technology (IITs), National Law School of India University (NLSIU), Central Power Research Institute (CPRI), Indian Institute of Science (IISc), National Aerospace Laboratories (NAL), Electronics Corporation of India Limited (ECIL), Bangalore.

Significance of the Centre for Artificial Intelligence and Robotics (CAIR) 4

- The primary aim of CAIR is to develop state-of-the-art technologies in artificial intelligence, robotics, and intelligent systems that are relevant to defence applications.
- Over the years, CAIR has acquired expertise in various areas of robotics and artificial intelligence. These include:

1. Knowledge-based systems
2. Highly reliable real-time embedded systems
3. Robotics for hazardous and space applications
4. Learning techniques for industrial automation
5. Machine vision and image processing
6. Speech understanding and synthesis

- Its main task is to develop technology for defence purposes. The centre has developed several important products such as missiles, radars and tanks till now.
- Still, nowadays, it is focusing on developing AI and robotic technology because these technologies will be very useful for defence purposes in future.
- DRDO has periodically reviewed the centre's activities, and it has been restructured from time to time to suit the current requirements of Defence Services.
- The centre has been regularly engaged in keeping with its charter in application-oriented projects and basic research in areas relevant to defence applications.

3) Write a note on ICAR?

Indian Council for Agricultural Research

About 2

- ICAR is an autonomous organisation under the Department of Agricultural Research and Education (DARE), Ministry of Agriculture and Farmers Welfare, Government of India.
- It was established on 16 July 1929.-ICAR was Formerly known as Imperial Council of Agricultural Research.
- Headquartered at New Delhi, ICAR has 101 institutes and 71 agricultural universities spread across the country.

Functions 2

- Indian Council of Agriculture Research is the apex body for coordinating, guiding and managing research and education in agriculture including horticulture, fisheries and animal sciences in the entire country.
- Union Minister of Agriculture is the ex-officio President of the ICAR Society. Shri Narendra Singh Tomar is the President of ICAR.
- 'ICAR Vision 2050', provides the strategic framework for innovation-led inclusive and sustainable agricultural growth in the country.

Role Played By ICAR for Agriculture 2

- **Green Revolution -** The ICAR has played a pioneering role in ushering Green Revolution.
- It has played a major role in promoting excellence in higher education in agriculture.

Increase in Production of foodgrains

- The research and technology development by ICAR has increased the production of foodgrains by 5.6 times, horticultural crops by 10.5 times, fish by 16.8 times, milk by 10.4 times and eggs by 52.9 times.
- **Vaccine for avian flu** - In July 2006,a vaccine against bird flu was developed. The vaccine was developed at the high-safety veterinary disease laboratory in Bhopal, the only facility in the country where the H5N1 variant of bird flu was tested.
- ICAR was tasked with developing a vaccine following the avian flu outbreak in February.

The ICAR was provided for ICAR Rs 8 crores for the purpose

Mandate of Indian Council For Agriculture Research **2**

- Plan, Undertake, Coordinate and Promote Research and Technology Development for Sustainable Agriculture.
- Aid, Impart and Coordinate Agricultural Education to enable Quality Human Resource Development.
- Frontline Extension for technology application, adoption, knowledge management and capacity development for agri-based rural development.
- Policy, Cooperation and consultancy in Agricultural Research, Education & Extension.

Initiatives by ICAR **4**

1. **Farmers Innovation Fund –** ICAR is all set to start a system to scientifically validate, scale-up and propagate the innovations of progressive farmers. A centre for innovation will be established in New Delhi where the innovations will be scientifically validated and farmers will be allowed to pursue research work.The system intends to link farmers and farming with science and encourage farmers to continue their innovations.
2. **Nano fertilisers and Nano pesticides** – ICAR is developing nano fertilizers and nano pesticides to promote organic farming and to reduce the use of pesticides and fertilizers.
3. **Technology in Agriculture** – the council emphasises that agriculture is a science and application of principles of science helps in boosting agriculture.
4. **Creation of network**- a link between 105 startups and farmers to encourage the use of technology in the farm sector.
5. **Farmers' Science Congress** – It was inaugurated in 2020 for the first time in the 107 years of history of the Indian Science Congress highlighting the importance of farmer's innovations and their scientific validity. The Theme of Indian Science Congress in 2020 was "Science & Technology: Rural Development".
6. **Organic Farming** – ICAR has validated 51 integrated farming systems to help increase farm income and has developed 45 different organic farming models suitable for different agro-climatic regions.
7. **Attracting and Retaining Youth in Agriculture (Arya)** – A programme named Arya is also being implemented to improve rural bio-economy and attract youth to agriculture.

4) Discuss India's achievements in the field of space science & Technology. How the application of the technology has helped India in its socio-economic development?

Introduction **0.5**

- India has became a significant global player in space S & T development. India's ISRO in 1972 direct & regulate India's space programme.
- I**SRO:** 1972-**Motto** - Harness space technology for national development.

India's achievement in space S &T :

1. Mars orbit Mission **1**

- Achieved at low cost of 460 Cr.
- The Mars Orbiter Mission (MOM) was India's first interplanetary mission.
- India became the fourth space agency in the world to reach Mars orbit, after Roscosmos, NASA, and the European Space Agency.
- It also made India the first nation in the world to reach the Martian orbit in its maiden attempt.
- The spacecraft, Mangalyaan, was launched on Nov 5, 2013 and reached Mars' orbit on September 24, 2014.

2, Launch of 104 Satellite in logo **1**

- PSLV C - 37 : Economical space of soft power diplomach
- PSLV also created history by deploying 104 satellite in a single launch. This remarkable exploit was a new moment of pride for scientific, space community and the country.

3. Launch of Chandrayan **1**

- By GSLV -Set to explore south pole of moon-Chandrayaan-1 was India's first moon mission.
- It was the first unmanned lunar probe under the Chandrayaanprogramme and was launched in October 2008 by ISRO.
- The spacecraft consisted of a lunar orbiter and an impactor.

4. GSLV **1**

- Another brilliant innovation by ISRO is the Geosynchronous Satellite Launch Vehicle (GSLV).

- GSLV too is a space launch vehicle designed to launch satellites and other space objects into Geosynchronous Transfer Orbits.
- GSLV-D5 was the first successful flight of the GSLV using the indigenous cryogenic engine. The D5 was launched on January 5, 2014.

5. Reusable launch vehicle **1**

- Reduce space junk & make human space programme possible.
- Towards developing essential technologies for a fully reusable launch vehicle to enable low cost access to space, ISRO successfully flight tested India's first winged body Reusable Launch Vehicle
- Technology Demonstrator (RLV-TD) demonstrating Autonomous navigation, guidance and control & reentry mission management On 23rd May 2016

IRNSS (NAVIC) **0.5**

- Replace GPS used for military & marine navigation

India's first Crygenic Engine **1**

- The successful flight testing of indigenous cryogenic stage onboard GSLV-D5 Flight.
- Geosynchronous Satellite Launch Vehicle (GSLV) is capable of placing 2 Tonne class communication satellite into Geosynchronous Transfer Orbit (GTO) and
- India is one among six countries in the world to demonstrate such launch capability to GTO with the use of complex cryogenic technology.

Remote Sensing **1**

- RESOURCE SAT
- The Indian Remote Sensing Satellites (IRS) System, with currently 11 satellites in orbit, is one of the largest constellations of remote sensing satellites in operation in the world today.
- It provides inputs for management of natural resources and various developmental projects across the country using space based imagery

Recent achievements **1**

Amazonia - 1

- Earth observation satellite (PSLV51)
- 1st dedicated mission for New space India - commercial of ISRO
- Provide remote sensing date of region to Brazil.
- UNITY sat: - Radio relay sciences

SOSAT:

- Nano satellite
- Study the radiation level
- Demonstrate long range communication technologies

Socio- economic Benefits **3**

Low cost Vs high benefits :

- Navigation, communication, weather forecasting, disaster management etc.
- Can forecasted at low cost

Other Reasons:

- Building up of scientific and technological temperament in the students leading to a better country.
- All the projects are made in India - 'Make in India' vision is hence fulfilled
- Advanced Communication tech which connects the entire nation
- Remote sensing operation helps product the onset of monsoons, cyclone etc - helps seven millions of lives
- Disaster management.
- Weather prediction
- Metrological support
- EDUSAT - education is reaching the untouched villages.
- BHUVAN - Mapping services provides disaster support.
- The concept of "Gramsat" satellites have emerged to provide the basic requirements of villages.

Conclusion:

- Despite all achievements ISRO accounts for only 2 % of global space market. If more private participation & funding is its revolutionize India's standard.

5) Examine the features of crypto currency and its technology used? Discuss in detail about how crypto currency can revolutionize India's financial sector?

Crypto currency

- Crypto currencies are a digital form of money that runs on a totally new monetary system.
- Supported by a decentralized peer-to-peer network called the blockchain.
- Block chain technology ensures that all transactions in crypto currencies are recorded in a public financial transaction database
- **Example** Bitcoins, Ethereum.

How crypto currency can revolutionize India's financial sector Anonymous: 6

- Cryptocurrencies make it possible to lend, sell, buy, or borrow without an identity, credit score, or even a bank.

Highly secure:

- All records of its creation and when it's sent or received are stored in a sort of big digital book that anyone can access, keeping it honest.
- It can't (easily) be stolen or seized and can be used anywhere in the world.

Cheaper to transfer:

- Some coins are used to transfer value (measured in a currency like dollars) cheaper and faster than using credit or conventional means.

Illegal and highly volatile:

- However crypto is NOT just used for illegal purposes.
- Due chiefly to its price fluctuation and other reasons it has fallen out of favor on the black market.

No physical form:

- Cryptocurrency does not exist in physical form and is typically not issued by a central authority.
- However, it can be and many governments are working to create a crypto coin version of its respective fiat currency.

Decentralized:

- Use decentralized control as opposed to a central bank digital currency.
- When created with decentralized control, it works through a blockchain, that serves as a public financial transaction database.

Use of Blockchain Technology 2

- Blockchain Technology as revolutionized the Indian finance sector in the following ways.
- Digital payments have an informal structure, International monetary transaction are disrupted.
- Blockchain Technology reduces operational cost and falsification of payments to the bank.
- Regulates interaction between client it makes banking easier
- Blockchain Technology for commercial banking financial transactions facilities, transport receipts through blockchain technology and all tax related receipts are provided as a centralized document for everyone to use.

Steps taken to avoid illegal transactions 2

- Every banking and financial institutions is advised to create a large data base of customer identification cards such as Pancard, Driving License etc.,
- It is a measure taken against illegal irregularities in banking transaction.
- This technology allows insurance companies to collect customer information and process reimbursements.
- This technology helps to established and executes contracts without the intervention of any middlemen.
- Crypto Currency is a alternative to investing. A global currency is the solution to the volatility and financial chaos of 2012 - 13.

Conclusion 2

- Cryptocurrency and blockchain reduces delays, conflicts, and confusion in many aspects of financial services. Thus, there is a need for the Fintech industry to jointly work with the RBI and the government on a constructive policy framework for cryptocurrencies in India.

6) Describe about Objective, scope and target of TN solar energy policy 2019. &Evaluate its outcome.

Orgin 2

Released

- 2018 unveiled 2019.
- Former CM J.Jayalalitha

Ministry

- Ministry of New Delhi and Renewable energy.

Aim 1

- Generating 9000 MW of solar energy for the state by 2023.

Objectives: 3

- Define clear and transparent policy governance.
- Establish an eco-system that translates the solar energy vision in to policy.
- Regulatory mechanism to ensure solar energy portfolio obligation.
- Open access to public electricity grid-for grid-concocted distributed generation of solar power.
- Encourage and incentivize electricity consumers to set up solar energy system.

- Establish single window system -for technical support, funding. Project Clearance-co operation b/w govt departments.
- Encourage public-private partnerships of Joint venture- mobilize investment in solar.
- Facilitate 'Ease Doing business' in the solar energy system.
- Create investment-friendly environment.
- Create win-win situation for all stakeholder.

Scope **6**

A. Applicable to projects, programs of instable.
B. Relates to solar PV of solar thermal energy.
C. Both Utility of consumer category.

Utility category system:

- Saleof solar energy to distributor.

Consumer category system:

- Self consumption and expert of surplus energy to grit.

Target:

- TN-installed solar energy generation capacity - 9000MW by 2023.
- 40% - consumer category.

Evaluation of outcomes:

- Target of roof top - 3600MW.
- Till 2022, only 14% is installed due to regulatory of administrative hurdles.
- Further, the net used - in tariff does not even 50% of actual cost of solar roof top.

Green India report

- 3015MW per 89 km can be easily generated in Chennai through roof top.
- 45% - contributes residential sector.
- Only need a consumer- friendly policy with a perfect compensation mechanism.

7) With growing energy needs should India keep on extending its nuclear power programme? Critically discuss

Nuclear Power: **2**

- It is the controlled use of nuclear energy. Nuclear energy can be released by nuclear reactor in a machine called a nuclear reactor.

India's energy need:

- As per NITI Ayog estimation
- Primary energy supply - 3 to 4 times
- Hence, electricity needs by 5 to 6 times.
- Need to keep Extending nuclear energy programme

Rise in Energy Demand **1**

- India's energy demands increasing
- As per IEA's Global Energy of Co2 status report,
- India's Demand - 4% increases
- Equivalent to 35 million tonne of oil
- 11% of global demand growth.

Decrease in Energy supply **1**

- Decreases by changes in weather patterns.
- Eg: Electricity production from hydropower decreases
- Water reservoirs decrease due to lower precipitation of increased evaporation.

Development **1**

- Due to industrialization - India's energy needs grown
- Nuclear energy - advocated to be a facilitator.

Foreign Policy Nexus **1**

- Substantial role - formation of bilateral relations among nation.
- Eg: Indo - US - bilateral agreement - state.

Energy Availability **1**

- India - 4th largest consumer in the world, but remains energy - poor.
- As per 2018, around 11% of population - no electricity.

Climate change **1**

- To reduce carbon emission 33 - 35% by 2030 as per UNFCCC - emission free - nuclear energy needed.
- Can increases clean energy electricity capacity to 40%

Issues Associated **3**

1. Lack of public funding:

- No generous subsidy like renewable is receiving
- Absence of public funding - tough to complete against natural gas of renewable

Factors pulling Nuclear out of competition:

- Sky rocketing construction cost
- Fukushima safety upgrades
- Reliance on government subsidies.

2. Grassroots resistance:

- Reluctance towards new plants - resulted in considerable delay in commission in Kudankulam plant.
- Forced shifting of westing house's plant Andhra Pradesh.

3. Acquisition of Land:

- Land acquisition major problem
- Delays to land acquisition related challenges.

Way forward 1

1. Utilizing Available resources:

- Natural deposits of Uranium 70,000 tones of Thorium 3,600,000 tone in country
- Utilize to produce power.

2. Addressing Safety Concerns:

- Priority basis
- Nuclear safety regulatory authority setting up earliest.

3. Technological Support:

- Reprocessing of environment capacity - boosting required.
- Need advanced technology for enhancing its enrichment capacity.

8) List the various applications of Cryogenic Technology.

Cryogenic application in food industry 2

1. Cryogenic tunnel freezer

- A tunnel freezer is a long closed structure through which products are passed for fast and effective cooling. This method is ideal for the rapid cooling or freezing of large amounts of food products.
- How the tunnel works depends on the purpose for which it is used. Products are often sprayed with liquid nitrogen at -196 °C to cure the product surface.

2. Cooling trays

- Primarily for freezing the outside of a product, cooling trays are ideal. For example, ice cream is often dipped into a dipping tray to form a thin layer of chocolate or fruit around it. In this way, the quality of the body of the ice cream remains optimal.

Cryogenic application in medical industry 2

1. Filling stations

- In many medical institutions, small amounts of liquid nitrogen are used to, for example, treat skin lesions or to store samples.
- At a filling station, employees can fill open or closed dewars, which can then be taken to the ward or workstation. In this way, there is always enough liquid nitrogen available, and is it also possible to keep track of how much nitrogen is being used by each individual department.

2. Cryogenic Dewars

- Cryogenic dewars are used to preserve biological materials in optimal condition. At medical institutions, cryogenic dewars are often located in a biobank.
- A nitrogen dewar is used to preserve materials such as blood cells, stem cells, and embryos through cryopreservation.

3. Cryosauna

- Popular spa treatment exposes the body to extremely low temperatures for about 2-3 minutes, allegedly improving overall well-being. Mainly in sports, rehabilitation, and wellness services, this treatment is popular.
- Acryosauna is cooled with vapor from liquid nitrogen or by air-cooled through liquid nitrogen

Cryogenic Application in Pharmaceutical industry

1. Freeze Dryer 2

- Freeze drying is a frequently used method to remove water from sensitive materials without adversely affecting the material.
- Some pharmaceutical products that are often freeze-dried are antibiotics, vaccines, serums, and biotechnology products.
- Liquid nitrogen is often used for its effective cooling in freeze dryers.

2. Cryogenic Palletizer

- Cryogenic gases are also used for the granulation of probiotics and starter cultures.
- To keep the product's quality optimal, liquid nitrogen is used to achieve such a low temperature that any potential deterioration processes are stopped

Cryogenic Application in automotive industry

The cooling box 2

- Like with the food industry, the cooling box also plays a vital role in the automotive industry. For what is known as shrink fits, a cooling box filled with liquid nitrogen is essential.
- To facilitate a shrink fit, an automotive part is cooled and shrunk at an extremely low nitrogen temperature, allowing it to be inserted into, for example, an engine block with a light force.
- Once the part reaches the ambient temperature again, it expands automatically and is then firmly anchored.

Cryogenic Application in electronics industry

1. Inert production area 2

- Electronic components are highly fragile. They are so small that oxidation, humidity, and high

temperatures during the production process can easily cause damage.

- By manufacturing in an inert working facility, these problems are reduced or even completely prevented.

2. Microchip Tester

- Cryogenic gases also play a valuable role after the production of electronic devices.
- In an environment cooled with liquid nitrogen, tests are carried out, for example, to determine whether the microchips in a device can withstand the low temperatures during everyday use.

Cryogenic Application in Metal Industry **2**

Extrusion matrix for aluminium

- During aluminum extrusion, immense heat is generated, which must be discharged effectively for a successful end product. In most cases, liquid nitrogen is used for this purpose.

9) What is DNA fingerprinting technique and explain its applications?

DNA fingerprinting technique **3**

Origin

- The DNA fingerprinting technique was first developed by Alec Jeffreys in 1985 (Recipient of the Royal Society's Copley Medal in 2014).
- Each of us have the same chemical structure of DNA. But there are millions of differences in the DNA sequence of base pairs.
- They are :

1. Adenine (A)
2. Cytocin (C)
3. Guanine (G)
4. Thyamin (D).

- This makes the uniqueness among us so that each of us except identical twins is different from each other genetically.

Characteristics **3**

- The DNA of a person and finger prints are unique. There are 23 pairs of human chromosomes with 1.5 million pairs of genes. It is a well known fact that genes are segments of DNA which differ in the sequence of their nucleotides.
- Not all segments of DNA code for proteins, some DNA segments have a regulatory function, while others are intervening sequences (introns) and still others are repeated DNA sequences.
- In DNA fingerprinting, short repetitive nucleotide sequences are specific for a person. These nucleotide sequences are called as variable number tandem repeats (VNTR).The VNTRs of two persons generally show variations and are useful as genetic markers.

Functions involved in DNA finger printing **2**

1. Repetitive DNA

- Few representative chromosomes have been shown to contain different copy number of VNTR DNA finger printing involves identifying differences in some specific regions in DNA sequence called repetitive DNA, because in these sequences, a small stretch of DNA is repeated many times.

2. **Satellite DNA**

- These repetitive DNA are separated from bulk genomic DNA as different peaks during density gradient centrifugation. The bulk DNA forms a major peak and the other small peaks are referred to as satellite DNA.
- Depending on base composition (A : T rich or G : C rich), length of segment and number of repetitive units, the satellite DNA is classified into many sub categories such as micro-satellites, mini-satellites, etc., These sequences do not code for any proteins, but they form a large portion of human genome.
- These sequences show high degree of polymorphism and form the basis of DNA fingerprinting .

1. Uses of DNA FingerPrinting

- DNA isolated from blood, hair, skin cells, or other genetic evidences left at the scene of a crime can be compared through VNTR patterns, with the DNA of a criminal suspect to determine guilt or innocence.
- VNTR patterns are also useful in establishing the identity of a homicide victim, either from DNA found as evidence or from the body itself.

Application of DNA finger printing **4**

- **Forensic analysis:** It can be used in the identification of a person involved in criminal activities, for settling paternity or maternity disputes, and in determining relationships for immigration purposes.
- **Pedigree analysis:** inheritance pattern of genes through generations and for detecting inherited diseases.

- **Conservation of wild life:** protection of endangered species. By maintaining DNA records for identification of tissues of the dead endangered organisms.
- **Anthropological studies:** It is useful in determining the origin and migration of human populations and genetic diversities.

10) Explain about Chromosomal Theory of Inheritance?

Discovery of Chromosomal theory of Characters **2**

- G. J. Mendel (1865) studied the inheritance of well-defined characters of pea plant but for several reasons it was unrecognized till 1900.
- Three scientists (de Vries, Correns and Tschermak) independently rediscovered Mendel's results on the inheritance of characters.
- Various cytologists also observed cell division due to advancements in microscopy. This led to the discovery of structures inside nucleus.

Chromosomes& Genes **4**

- In eukaryotic cells, worm-shaped structures formed during cell division are called chromosomes (colored bodies, visualized by staining).
- An organism which possesses two complete basic sets of chromosomes are known as diploid. A chromosome consists of long, continuous coiled piece of DNA in which genes are arranged in linear order.
- Each gene has a definite position (locus) on a chromosome. These genes are hereditary units. Chromosomal theory of inheritance states that Mendelian factors (genes) have specific locus (position) on chromosomes and they carry information from one generation to the next generation.

Historical development of chromosome theory **6**

- **Wilhelm Roux (1883)** postulated that the chromosomes of a cell are responsible for transferring heredity.
- **Montgomery (1901)** was first to suggest occurrence of distinct pairs of chromosomes and he also concluded that maternal chromosomes pair with paternal chromosomes only during meiosis.
- **T. Boveri (1902)** supported the idea that the chromosomes contain genetic determiners, and he was largely responsible for developing the chromosomal theory of inheritance.
- **W.S. Sutton (1902)**, a young American student independently recognized a parallelism (similarity) between the behaviour of chromosomes and Mendelian factors during gamete formation.
- **Sutton and Boveri (1903)** independently proposed the chromosome theory of inheritance.
- Sutton united the knowledge of chromosomal segregation with Mendelian principles and called it chromosomal theory of inheritance.

Salient features of the Chromosomal theory of inheritance

- Somatic cells of organisms are derived from the zygote by repeated cell division (mitosis). These consist of two identical sets of chromosomes.
- One set is received from female parent (maternal) and the other from male parent (paternal). These two chromosomes constitute the homologous pair.
- Chromosomes retain their structural uniqueness and individuality throughout the life cycle of an organism.
- Each chromosome carries specific determiners or Mendelian factors which are now termed as genes.
- The behavior of chromosomes during the gamete formation (meiosis) provides evidence to the fact that genes or factors are located on chromosomes.

11) Explain about Sex Determination in human?

Sex Determination **2**

- The formation of zygote into male or female sex during development is called sex determination. Sex is determined by the chromosomes of an individual.

Sex Determination in Human **2**

Homogametic human

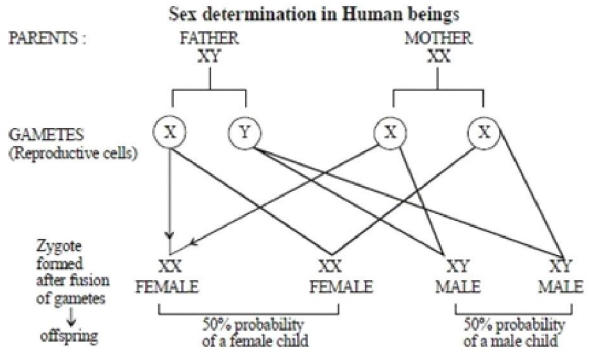
- Recall that human beings have 23 pairs of chromosomes out of which 22 pairs are autosomes and one pair (23rd pair) is the sex chromosome. The female gametes or the eggs formed are similar in their chromosome type (22+XX). Therefore, human females are homogametic.

Heterogametic Human **2**

- The male gametes or sperms produced are of two types. They are produced in equal

proportions. The sperm bearing (22+X) chromosomes and the sperm bearing (22+Y) chromosomes. The human males are called heterogametic.

Sex Determining Factor **6**



- It is a chance of probability as to which category of sperm fuses with the egg. If the egg (X) is fused by the X-bearing sperm an XX individual (female) is produced. If the egg (X) is fused by the Y-bearing sperm an XY individual (male) is produced. The sperm, produced by the father, determines the sex of the child. The mother is not responsible in determining the sex of the child.
- Now let's see how the chromosomes take part in this formation. Fertilization of the egg (22+X) with a sperm (22+X) will produce a female child (44+XX).while fertilization of the egg (22+X) with a sperm (22+Y) will give rise to a male child (44+XY).

12) What are the important places of Oil Exploration in India?

Major Oilfields found in India **1**

- On-shore Oil Production. One-shore oil fields are located in the Brahmaputra valley of north-east India, Gujarat coast in western India and Cauvery on-shore basin in Tamil Nadu. Besides Andhra Pradesh has both on-shore and off-shore oil reserves.

Oilfields in North-East India: **3**

- The major oilfields in north-east India are those of the Brahmaputra valley in Assam and its neighbouring areas including Arunachal Pradesh, Nagaland, Meghalaya, Tripura, Manipur and Mizoram.

Assam:

- Assam is the oldest oil producing state in India. The main oil bearing strata extend for a distance of 320 km in upper Assam along the Brahmaputra valley. Following are some of the important oilfields of Assam:

The Digboi field:

- Located in the north-east of Tipam hills in Dibrugarh district of Upper Assam, Digboi is the oldest oil field of India.
- The oil bearing strata cover an area of about 13 sq km where oil is available at 400 to 2,000 metre depth.
- Over 800 oil wells have been drilled so far. Before the opening of the oil fields of west India, Digboi used to account for three-fourths of the total oil production of India.
- The most important centres are Digboi, Bappapang, Hassapang and Paintola. Most oil is sent to oil refinery at Digboi.

The Naharkatiya field:

- It is located at a distance of 32 km southwest of Digboi at the left bank of BurhiDibing river. Here oil was discovered in 1953 and production started in 1954.
- Oil is available at depths varying from 4,000 to 5,000 metres. Out of the 60 successful wells drilled so far, 56 are producing oil while the remaining 4 are producing natural gas.
- The annual production is 2.5 million tonnes of oil and one million cubic metre natural gas. Oil from this area is sent to oil refineries at Noonamati in Assam (443 km) and Barauni in Bihar (724 km) through pipeline.

The Moran-Hugrijan field:

- It is located about 40 km south-west of Naharkatiya. Oil at Moran- Hugrijan field was discovered in 1953 and production started in 1956.
- Drilling has proved an oil bearing Barail horizon at a depth of 3,355 metre.
- Other fields have been discovered at Rudrasagar, Sibsagar, Lakwa, Galeki, Badarpur, Barholla and Anguri.
- Arunachal Pradesh has oil reserves at Manabhum, Kharsang and Charali. In Tripura, promising oilfields have been discovered at Mamunbhanga, Baramura-Deotamura Subhang, Manu, Ampi Bazar, Amarpur-Dambura areas. Nagaland also has some oil bearing rock strata.

On-Shore Oil Fields of Western India: **4**

Gujarat:

- Explorations by Oil and Natural Gas Commission (ONGC) have yielded valuable

findings of oil bearing rock strata over an area of about 15,360 sq km around the Gulf of Khambhat.

- The main oil belt extends from Surat to Amreli. Kachchh, Vadodara, Bharuch, Surat, Ahmedabad, Kheda, Mehsana, etc. are the main producing districts.

Ankleshwar:

- The first major oil-find came in 1958 with the discovery of Ankleshwar field located about 80 km south of Vadodara and nearly 160 km south of Khambhat.
- Ankleshwar anticline is about 20 km long and 4 km wide. Oil is available at depths varying from 1,000 to 1,200 metres.
- It is estimated that 25 lakh tonnes per year of oil can be obtained from this field.
- Oil from this field is sent to refineries at Trombay and Koyali.

Khambhat or Lunej field:

- The oil and Natural Gas Commission drilled test wells in 1958 at Lunej near Ahmadabad and confirmed the occurrence of a commercially exploitable oil field.
- The annual production is 15 lakh tonnes of oil and 8-10 lakh cubic metres of gas.
- The total reserves are estimated at 3 crore tonnes.

Ahmedabad and Kalol field:

- It lies about 25 km north-west of Ahmedabad.
- This field and a part of Khambhat basin contain 'pools' of heavy crude trapped in chunks of coal.

Rajasthan:

- One of the largest onland oil discoveries was made in Banner district of Rajasthan in 2004.
- The oil block covers an area of approximately 5,000 sq km.
- State-of-the-art technology with innovative geological modeling was used in discovering this oil field.
- Initial estimates of the oil in place of this discovery range from 63 to 153 million tonnes.
- Two important discoveries, viz., Sarswati and Rajeshwari, with a total 35 million tonnes of inplace oil reserves were made earlier in 2002.

Western Coast Off-Shore Oilfields:

Mumbai High:

- The greatest success achieved by the ONGC with respect to offshore surveys for oil was that of Mumbai High in 1974.
- It is located on the continental shelf off the coast of Maharashtra about 176 km north-west of Mumbai.
- Here the rock strata of Miocene age covers an area of 2,500 sq km with estimated reserves of about 330 million tonnes of oil and 37,000 million cubic metres of natural gas.
- Production on commercial scale began in 1976.
- Oil is taken from a depth of over 1,400 metre with the help of a specially designed platform known as Sagar Samrat.
- The discovery of Mumbai High has revolutionised the oil production in India. The share of Mumbai High in the total oil production of India has shot up considerably.

Bassein:

- Located to the south of Mumbai High.
- Huge reserves have been found at a depth of 1,900 metre. Production has started and is expected to pick up fast.

Aliabet:

- It is located at Aliabet Island in the Gulf of Khambhat about 45 km off Bhavnagar.

East Coast:

- The basin and delta regions of the Godawari, the Krishna and the Cauvery rivers hold great potential for oil and gas production.
- The Rawa field in Krishna- Godawari off-shore basin is expected to produce 1 to 3 million tonnes of crude oil annually.
- In 2002-03, Tamil Nadu produced 3.95 lakh tonnes of oil which was slightly more than the one per cent of the total oil production of India.

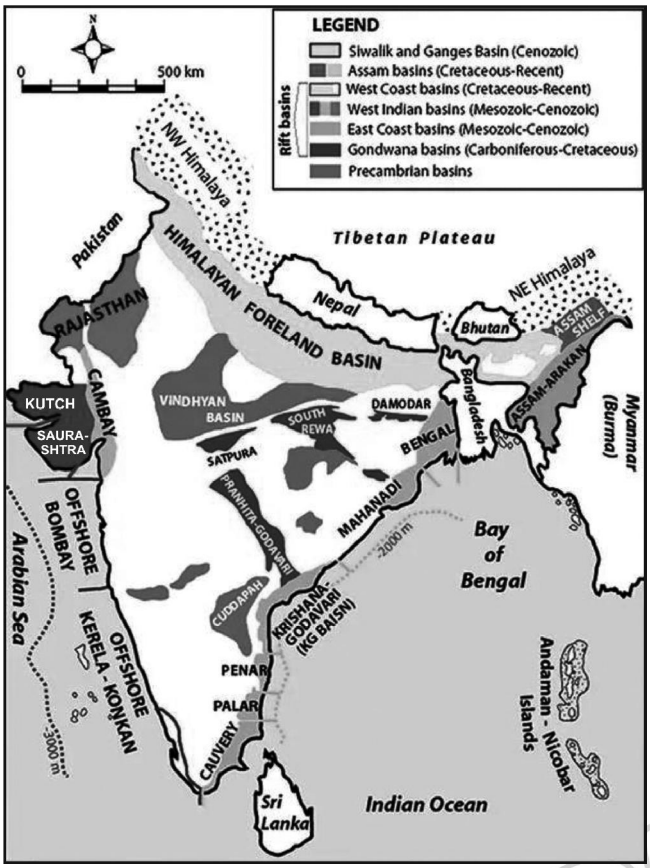
Tamilnadu **1**

- The Narimanam and Kovilappal oilfields in the Cauvery on-shore basin are expected to produce about 4 lakh tonnes of crude oil annually.
- A5 lakhtonne refinery is being set up at Panaigudi near Chennai to refine crude oil from this area.

Andhra Pradesh **1**

- Produces less than one per cent of the total crude oil of India.
- Oilfields have recently been discovered in the Krishna-Godavari basin.
- The oilfield near Amolpur is expected to yield 3,600 barrels of crude oil per day.

- Some of the outstanding areas which hold possibilities of oil are: **2**



Unit - 3

1) Write an essay about New science and technology Innovation policy 2020?

- Innovation Policy 2020 in January 2021. The draft policy aimed to address the issues in the past four science and technology policies.

Core principles: **1**

- Decentralised, evidence-informed, bottom-up, experts-driven, and inclusive

Aim: **1**

- Profound changes through short, medium and long-term mission mode projects by building a nurtured ecosystem that promotes research and innovation
- To identify and address strengths and weaknesses of the Indian Science Technology and Innovation (STI) ecosystem to catalyse socio-economic development of the country

Overall objectives: **2**

- To position India among the top three scientific superpowers in the decade to come.
- To attract, nurture, strengthen, and retain critical human capital through a people-centric STI ecosystem.
- To double the number of full-time equivalent (FTE) researchers, gross domestic expenditure on R&D (GERD) and private-sector contribution to GERD every five years.
- To build individual and institutional excellence in STI with the aim of reaching the highest levels of global recognition and awards in the coming decade.

Important Provisions:

- Related to Equity and Inclusion

Gender Equality: **6**

- It proposes that at least 30% representation be ensured for women in all decision-making bodies, as well as "spousal benefits" be provided to partners of scientists belonging to the Lesbian, Gay, Bisexual, Transgender, Queer (LGBTQ+) community.
- The LGBTQ+ community should be included in all conversations related to gender equity, and provisions be made to safeguard their rights and promote their representation and retention in the science and technology sector.

Child and Elderly Care:

- Child-care benefits are proposed to be made gender-neutral, and flexible work timings and adequate parental leave are to be offered to cater to maternity, childbirth and child care.
- All publicly-funded research institutions and universities will be asked to provide day-care centres for children of employees, and also have a provision for elderly care.

For Disabled:

- For the benefit of people with disabilities, the policy asks all publicly-funded scientific institutions to make "structural and cultural changes" to support their inclusion.

Other Related Provisions:

- For age-related cut-offs in matters relating to selection, promotion, awards or grants, the "academic age" and not the biological age would be considered.
- Removal of bars on married couples being employed in the same department or laboratory.
- As of now, married couples are not posted in the same department, leading to cases of loss

of employment or forced transfers when colleagues decide to get married.

- **Open Science Policy (One Nation, One Subscription):** To make scientific knowledge and data available to all, the government has proposed:
- To buy bulk subscriptions of all important scientific journals across the world, and provide everyone in India free access to them.
- **Science, Technology and Innovation Observatory:** It will be set up whichwill serve as the central repository of all kinds of data generated from scientific research in the country.

Research and Education: **2**

- It proposes to establish

1. Education Research Centres (ERCs) and
2. Collaborative Research Centres (CRCs) to provide research inputs to policymakers and bring together stakeholders.

- **Research and Innovation Excellence Frameworks (RIEF**) will be developed to enhance the quality of research along with the promotion of engagements with the relevant stakeholders.
- A **dedicated portal** to provide access to the outputs of such publicly-funded research will be created through the Indian Science and Technology Archive of Research (INDSTA).
- To **set up Infrastructure** to boost local Research and Development capabilities and reduce large scale import in selected sectors of domestic importance such as electronic hardware for home appliances, railways, intelligent transport, clean tech, defence, etc.

For Strengthening India's Strategic Position **1**

- To achieve technological self-reliance and position India among the top three scientific superpowers in the decade to come.
- To double the number of Full-Time Equivalent (FTE) researchers, Gross Domestic Expenditure on R&D (GERD) and private sector contribution to the GERD every 5 years.
- Establishment of a Strategic Technology Board that will bridge all strategic government departments, and monitor and recommend technologies to be bought or indigenously made.

Advantages: **1**

- The provision for supporting indigenous knowledge systems in India
- The draft STIP provide steps to improve artificial intelligence
- The policy will encourage the participation of Indian scientific diaspora
- The policy will set up a special fund for research known as the strategic technology development fund.

Way Forward **1**

Operationalise Clusters:

- Acknowledge the cluster-based approach and incorporate it.
- An example of an electronics hardware cluster is in Silicon Valley.

Increasing Funding For Research:

- At 0.6% of GDP, India's gross domestic expenditure on R&D (GERD) is relatively low compared to other major economies with a GERD-to-GDP ratio of 1.5% to 3%.
- One way to increase R&D spend in the country is to make it attractive for companies to invest.

Enabling Research in Disruptive technology:

- Technologies that are collectively called Industrial revolution 4.0 are undoubtedly the future of science and technology landscape.
- India must take advantage of these disruptive and impactful technologies.
- More research on these associated technologies may positively impact many industries such as defence, education, health etc.

2) Give a detailed note about India's Space Programmes?

Chandrayaan - 1 **5**

- Our country launched a satellite Chandrayaan-1 (meaning Moon vehicle) on 22nd October 2008 to study about the Moon.
- It was launched from Sathish Dhawan Space Center in Sriharikota, Andhra Pradesh with the help of PSLV (Polar Satellite Launch Vehicle) rocket.
- It was put into the lunar orbit on 8th November 2008.
- The spacecraft was orbiting around the Moon at a height of 100 km from the lunar surface. It collected the chemical, the mineralogical and the geological information about the Moon.
- This mission was a major boost for the Indian space programs and helped to develop its own technology to explore the Moon. Chandrayaan-1 was operated for 312 days and achieved 95% of its objectives.

- The scientists lost their communication with the space craft on 28th August 2009. On the successful completion of all the major objectives, the mission was concluded.

Objectives of Chandrayaan-1

- The following are the objectives of Chandrayaan – 1 mission.
- To find the possibility of water on the Moon.
- To find the elements of matter on the Moon.
- To search for the existence of Helium-3.
- To make a 3-dimensional atlas of the Moon.
- To study about the evolution of the solar system.

Achievements of Chandrayaan-1

- The following are the achievements of Chandrayaan-1 mission.
- The discovery of presence of water molecules in the lunar soil.
- Chandrayaan-1 confirmed that the Moon was completely molten once.
- Chandrayaan-1 has recorded images of the landing site of the US space-craft Apollo-15 and Apollo-11.
- It has provided high-resolution spectral data on the mineralogy of the Moon.
- The existence of aluminium, magnesium and silicon were picked up by the X-ray camera.
- More than 40,000 images have been transmitted by the Chandrayaan-1 camera in 75 days.
- The acquired images of peaks and craters show that the Moon mostly consists of craters.
- Chandrayaan-1 beamed back its first images of the Earth in its entirety.
- Chandrayaan-1 has discovered large caves on the lunar surface that can act as human shelter on the Moon.

Mangalyaan (Mars vehicle) **5**

- After the successful launch of Chandrayaan-1, ISRO planned an unmanned mission to Mars (Mars Orbiter Mission) and launched a space probe (space vehicle) on 5th November 2013 to orbit Mars orbit.
- This probe was launched by the PSLV Rocket from Sriharikota, Andrapradesh. Mars Orbiter Mission is India's first interplanetary mission.
- By launching Mangalyaan, ISRO became the fourth space agency to reach Mars.
- Mangalyaan probe traveled for about a month in Earth's orbit, and then it was moved to the orbit of Mars by a series of projections.
- It was successfully placed in the Mars-orbit on 24th September 2014.

Objectives of Mangalyaan

- The following are the objectives of Mangalyaan mission.
- To develop the technology required for interplanetary mission.
- To explore the surface of Mars.
- To study the constituents of the atmosphere of Mars.
- To provide information about the future possibility of life and past existence of life on the planet.

Chandrayaan - 2 **5**

- ISRO has currently launched a follow on mission to Chandrayaan-1 named as Chandrayaan-2, on 22nd July 2019. Chandrayaan-2 mission is highly complex mission compared to previous missions of ISRO.
- It brought together an Orbiter, Lander and Rover. It aims to explore South Pole of the Moon because the surface area of the South Pole remines in shadow much larger than that of North Pole.

Orbiter

- It revolves around the moon and it is capable of communicating with Indian Deep Space Network (IDSN) at Bylalu as well as Vikram Lander.

Lander

- It is named as Vikram in the memory of Dr.Vikram A. Sarabhai, the father of Indian space program.

Rover

- It is a six wheeled robotic vehicle named as 'Pragyan' (Sanskrit word) that means wisdom.
- Chandrayaan-2 was successfully inserted into the lunar orbit on 20th August 2019. In the final tage of the mission, just 2.1 km above the lunar surface, Lander 'Vikram' lost its communication with the ground station on 7th September 2019. But the Orbiter continues its work successfully

3) Covid - 19 pandemic has caused unprecedented devastation worldwide. However, technological advancements are being availed readily to win over the crisis. Give an account of how technology was sought to aid the management of the Pandemic.

Introduction 1

- Covid - 19 pandemic is a far greater source economic and political phenomenon than a biomedical one. Due to its ability to spread rapidly and its ill-effects on live of the worst humanitarian crises in recent human history.
- Caused unprecedented devastation worldwide

Economic impact 2

- Data,As per 1 MF - Global economy shrink by - 4.4 %
- As per ILO - 1.6 billion informal economy workers affected - 60 % declined earnings.
- As per ILO - 80 % of informal sector lost employment.
- Lockdown and restrictions affected the supply chains. Demand - supply gaps emerged.
- Stockpiling of essential Commodities - increase in demand.
- There were crash in demand of non-essential goods.
- GST Collection & Tax Collection decreased - due to decline in business activities.

Political impact: 2

- Suspensions of legislative activities.
- Isolation (or) deaths of multiple politicians
- Rescheduling of elections due to fears of spreading the virus.
- Impact of federalism - eg. tussle between centre& state in India.

Social impact: 2

- As per WHO, Death COVID - 19 5.2 million
- Increased Poverty
- Increased bond insecurity
- Closed education institutions
- Over burdened healthcare system
- Domestic violence as shadow pandemic
- Disproportionate impact on women

Environment impact : 2

- Biomedical Waste Crisis - rise of PPE ways
- Health risk to sanitation workers & garbage collectors.
- 1/2 million sanitation workers fasted positive for COVID - 19

Technology to aid management of the Pandemic : COVID - 19 tools (ACT) Accelerator 6

- Production & equitable access to COVID - 19 tests, treatments & vaccines.

'Aarogya setu'

- Mobile app utilizing Bluetooth-Track COVID - 19 patients.

PM Innovate Challenge

- Startups, individuals & companies to provide innovative tech soln.

CO-VIN

- Digitalized tech platform for COVID vaccine distribution system

Tata CRISPR

- (Clustered Regularly Interspaced short Palindromic Repeats)
- World's 1st diagnostic test for COVID - 19
- AI enabled MyGov Corona HelpTest

RT - PCR Test

- identifies the presence of virus based on its genetic fingerprint

PRANA - VAYU

- Indigenously Ventilators

Rapid Antibody Detection Test

- Define the extent to which a disease has spread

COVID 19 BWM

- Biomedical waste tracking mobile application.

4) What do you know about Nano technology? "Nanotechnology is an interdisciplinary field covering many streams of engineering and science". substantiate it.

- Nanotechnology or nanotech in short is the technology that involves the manipulation of matter on atomic, molecular, and supramolecular scales. This includes particles of a scale of 1 to 100 nanometer. **2**

Electronics industry 1

- **Nano-RAM:** It is a non-volatile RAM (Random Access Memory) based on carbon nanotubes deposited on a chip-like substrate. Its small size permits very high-density memories.
- **Nano optomechanical SRAM (Static RAM):** This shows faster read/write time as compared to a MEMS memory. Also, the processes take place without interference which further reduces time when compared to a traditional electrical enabled SRAM.

Healthcare and Medical field **2**

1. **Nanotech** detectors for heart attack
2. **Nanochips** to check plaque in arteries
3. **Nanocarriers** for eye surgery, chemotherapy, etc.
4. **Diabetic pads** for regulating blood sugar levels
5. **Nanoparticles** for drug delivery to the brain – for therapeutic treatment of neurological disorders
6. **Nanosponges** – are polymer nanoparticles coated with a red blood cell membrane, can be used for absorbing toxins and removing them from the bloodstream
7. **NanoFlares** – used for detection of cancer cells in the bloodstream
8. **Nanopores** – use in making DNA sequencing more efficient.

Energy sector **1**

- **Solar paints or photovoltaic paints –** can replace solar panels. Applying solar paints to any surface will enable it to capture energy from the sun and transform it into electricity. This can be used in houses and cars.
- **Wind power generations** – nanogenerators – these are flexible thin sheets which when bent can generate potential power.
- **Nanobatteries** – these are used to help rechargeable lithium-ion batteries last longer.

Agriculture and Food **1**

- Nano fertilizers
- Hybrid polymers are used in packaging and to reduce spoilage
- Sensors for food-borne pathogens
- Nanoemulsions – to reduce bacteria on produce
- Nanoparticles based on titanium dioxide – used as antimicrobial agents

Chemical defence **1**

- In the arena of chemical weapons terrorism, NT offers solutions against the usage of chemical agents like VX, HD, GD, and GB. Some nanoparticle oxides like CaO, Al2O3, and MgO interact with such chemicals much faster than microparticles and are ideally suited for fast decomposition of such chemicals.
- A sensing device for detection of nerve-gas agents in the atmosphere has been developed based on NT applications.

Conventional Weapons/Ammunition **1**

- NT-based stronger and lighter materials would allow the building of conventional barrel-type weapons with reduced mass.
- It is conceivable that small arms and light weapons could use barrels, locks etc. made of nanofibre composites.
- Even in respect of ballistic and air-breathing missiles, the reduced mass could translate into a marked increase in speed, range, or payload as well as a reduction in carrier size.

Maritime applications **1**

- Micro and nanoscale electronic packages are likely to maintain reliability under extremely harsh conditions resulting from concurrently acting vibrations, high-current density, high-power and high-temperature loads.
- Products such as functionally graded nanocomposites are exciting examples of the potential for NT to bring innovations from the bench to the fleet, while also providing an opportunity for reducing costs.
- Experts are of the view that nanoparticles can be used to mark ships, fishing boats, navigable channels, and delimiting safe heavens.
- The crystals are soluble in paints, fuel, lubricants, speciality chemicals, glues, etc. but cannot be easily counterfeited, removed, or altered by anyone except the authorised agency which designed them.

Aerospace and other defence applications **1**

- Less vulnerable corrosive material is helpful in satellite manufacturing as well.
- Also, such structural materials and the miniaturization as such achieved by NT is likely to play a vital role in designing the next generation of unmanned aerial vehicles/ unmannedcombat aerial vehicles.

Space applications of Nanotech

Ignitors' life **1**

- The life of satellites, to a large extent, is determined by the amount of fuel they can carry on board.
- Onboard ignitors wear out quickly and cease to perform effectively.
- Nanomaterials, such as nanocrsytalline tungsten-titanium diboride-copper composite, are potential candidates for enhancing ignitors' life and performance characteristics.

Light weight solar panels/cells 1

- Apart from onboard fuel, satellites in outer space use solar power as a power source for various activities.
- Satellite designers are continuously working on finding the means to reduce the weight of such solar cells.
- Space scientists are trying to adopt nanomaterials as alternative materials to their conventional counterparts.

Applications of aerogels in space craft 1

- Lighter nanoporous materials like aerogels are found to have wider applicability in spacecraft manufacturing.
- Even some special lightweight suits, jackets etc. could be made using aerogels.
- Aerogels are a low-density solid-state material derived from gel in which the liquid component of the gel has been replaced with gas. The result is an extremely low-density solid with several remarkable properties, most notably its effectiveness as an insulator.
- They are porous and extremely lightweight, yet they can withstand 100 times their weight.

Space weather forecasting 1

- Knowledge of space weather in the near Earth and solar space environment is critical for space research.
- Nanostructured sensors are expected to play a fundamental role in obtaining information on the ionosphere and other regions of space.

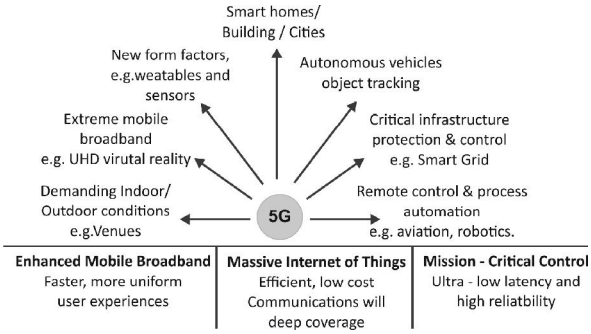
5) Discuss about the advantage and challenges regarding 5G Technology in India.

5G technology : 2

- New kind of network that is designed to connect virtually everyone and everything together including machines, objects, and devices.

Characteristics: 4

- The millimetre-wave spectrum (30-300 GHz)deliver higher multi-Gbps peak data speeds,
- 20 Gbps (gigabits per second) speed-u l t r a low latency
- more reliability
- massive network capacity
- increased availability
- uniform user experience to more users



Benefits of 5G for communication sector: 3

- expected to create a cumulative economic impact of $1 trillion in India by 2035,
- As per telecom gear maker Ericsson, 5G-enabled digitalization revenue potential in India will be above $27 billion by 2026.
- As per global telecom industry GSMA that India will have about 70 million 5G connections by 2025.
- expected to form the backbone of emerging technologies such as the Internet of Things (IoT) and machine to machine communications.
- supporting applications and services, including, driverless vehicles, tele-surgery, real time data analytics.

Primary applications

- sensor-embedded network that will allow real time relay of information on manufacturing, consumer durables, agriculture.
- enable vehicle-to-vehicle and vehicle-to-infrastructure communication, -egdriverless cars

Challenges of Economies: 4

- **Frequency allocation:** Indian operators have far less spectrum in comparison to international operators. The high investment cost which makes telecom companies unsure about Return on Investment.
- **Network investment:** In India, the telecom sector is facing capital augmentation issues which need to be resolved. Non-availability of funds for investment: Many of the Indian operators are also weighed down by debt.
- **Reluctancy of Telecom operators** to participate in the auction citing the reserve price of Rs.490 crore per MHz as high and the amount of spectrum on offer being insufficient.

- **Regulatory restrictions:** Faster rounds of new technology introduction when prior technology investments have not been recouped add further complexity.
- **Technical Challenges**: Designing IT architecture that can be deployed globally, while still allowing for localized technology to cater for different regions is a challenge.
- **Lack of Government incentives:** Government has little incentive to forgo revenues, given the increasing pressure on its revenues, especially after the covid-19 induced slowdown.
- **Discouraging Taxes:** Current flat rate of 6% of adjusted gross revenue for licence fees and 3% for spectrum usage charges has dissuaded telecom providers from investing in new technologies.
- **Poor auction design** is ensuring that valuable spectrum is idle. This includes precious 5G spectrum in 700 MHz and 3.5 GHz, and the much sought-after E and B bands.

Way Forward: **2**

- Need to align Digital India with 5G technology.
- Incentivize design and manufacture of 5G technologies, products and solutions in India.
- Idle spectrum must be freed up, at least till it generates significant revenues.
- Allocate funds and incentivise local technology and telecom firms to develop their internal capacities which would in turn help 5G technology succeed in the country.
- Promote 5G start-ups that enable this design and manufacturing capabilities.
- Promote generation of IPR backing the above designs.-Reward efficient use of spectrum
- Upgrade of narrow-band networks
- Development of markets.-Manufacture of 5G chipsets, this may require massive investments.
- Appropriate test-beds and technology platforms to enable and help Indian technical ecosystem to have an edge in 5G.
- Accelerated deployment of next generation ubiquitous ultra-high broadband infrastructure with 100% coverage of 10 Gbps across urban India and 1 Gbps across Rural India.
- Coverage, reliability, and scalability must be optimized and seamless mobile networks will require a unified management policy to ensure consistent standards.

6) What is remote sensing? Describe the components of remote sensing?

Introduction **1**

- Geoinformatics is the integration of remote sensing, Global Navigation Satellite System and Geographic Information System dealing with spatial information.
- A basic understanding of these components is crucial for carrying out various types of surveys, navigation, hydrology, disaster management, etc.

Remote sensing **2**

- Remote sensing is an integrated discipline encompassing some branches of arts, science and technology of collecting information about the terrestrial objects using camera and sensor system.

Elements of Remote Sensing **6**

Energy Source

- The primary requirement for remote sensing is to have an energy service, which provides electromagnetic energy to the target of interest.
- The sun being a major source of energy, radiation and illumination having a sharp power allows capturing reflected light with conventional cameras and films.

Radiation and the Atmosphere

- The energy is required to illuminate the target. This energy is in the form of Electromagnetic radiation. Electromagnetic radiation is a dynamic form of energy that propagates as wave motion at a velocity in space.

Interaction with the target

- The interaction of Electromagnetic radiation with the target is important to remote sensing for two main reasons.
- First, information carried Electromagnetic radiation reflected by the earth's surface is modified while traversing through the atmosphere.
- Second, the interaction of Electromagnetic radiation with the atmosphere can be used to obtain useful information about the atmosphere itself.

- The total energy is subjected to modification by the several physical process, scattering, absorption and refraction. Scattering is the re-direction of Electromagnetic radiation by particles suspended in the atmosphere or by large molecules of atmospheric gases.

Recording of energy by the sensor

- After the energy has been scattered by or emitted from the target, we require a sensor (remote not in contact with the target) to collect and record the electromagnetic radiation.
- A sensor is highly sensitive to all the wave lengths yielding spatially detailed data on absolute brightness.

Transmission, Reception and Processing

- The energy recorded by the sensor has to be transmitted in electronic form, to a receiving and processing station where the data processed into an image.
- The Image processing methods may be grouped into three functional categories such as Image Restoration, Image Enhancement and Information Extraction.

Interpretation and Analysis

- Image interpretation is defined as the act of examining images
- identify objects and judge their significance.
- An interpreter studies remotely sensed data and attempts through logical process to detect, identify, measure and evaluate the significance of environment and cultural object pattern and spatial relationship.

Regional Remote Sensing Services Centres (RRSSCs) 2

- Recognizing the need and importance of natural resources management in the country, Government of India has set-up the National Natural Resources Management System (NNRMS).

Objective and Functions

- Provide facilities for digital image analysis and Geographic Information System (GIS) to the users.
- Guide / assist users in application of digital image analysis techniques and GIS
- Develop and demonstrate techniques in the new area of applications.
- Train scienctists of user agencies in Remote Sensing Application, digital techniques GIS and theme based applications.

Applications of remote sensing 3

Agriculture

- The satellites have ability to image individual fields, regions and countries on a frequent revisit cycle. Customers can receive field-based information including crop identification, crop area determination and crop condition monitoring (health and viability).

Forest Management

- The forest - fire, sudden deforestation, encroachment of forest - land are recent challenges to the ecologist. It can be easily identified and curbed with the help of remote sensing satellite pictures.

Geology

- Various fields Remote sensing techniques used in geology are -Lithological mapping
- Structural mapping

Oceanography

- Satellite remote sensing plays an important role in coastal zone management.
- It allows us to locate and regularly monitor various aspects such as bathymetry (the measurement of the depth of water in water bodies), chlorophyll content, suspended sediment concentration, etc.

Cartography

- Remote sensing aids in extensive surveys that are made from high altitudes to show the urban development, rural development, mountain areas, deserts, etcwhich help the cartographers.
- High-resolution satellite cameras located at altitudes of several hundred kilometres can record details as small as a few metres on the surface of the Earth.

Meteorology

- The radar system is basically used to collect the weather data. It collects meteorological data from unmanned land/ ocean based Data collection platforms and serves as a communication satellite for rapid exchange of meteorological data among centres and for rapid dissemination of weather forecasts warnings etc, to user agencies.

Topography

- Topography specifically involves the recording of relief or terrain, the threedimensional quality of the surface, and the identification of specific landforms.

Urban Planning

- These information systems also offer interpretation of physical (spatial) data with other socio-economic data, and thereby providing an important linkage in the total planning process and making it more effective and meaningful.
- Digitization of planning base maps has facilitated updating of base maps wherever changes have taken place in terms of land development etc. Superimposition of any two digital maps which are on two different scales is feasible.

Kalam Sat **1**

- India once again broke a global space record by launching the world's lightest satellite weighing a mere 64 grams, called Kalamsat. It was designed and developed not by professional space scientists and engineers, but by 18-year-old Tamil Nadu student RifathSharook and his team.
- Sharook's project, the first to be manufactured via 3D printing, got selected through a competition, 'Cubes in Space', sponsored jointly by NASA and 'I Doodle Learning'.
- The project aims to take the performance of new technology to space.

7) Tamil Nadu leading State in Renewable Energy - Elucidate. **2**

- Tamil Nadu has most diversified power generation sector of any other state in India, Tamil Nadu is the pioneer state in renewable energy among Indian states with contributing 25.44 percent of the total capacity renewable energy sector.
- Globally, India leads the renewable energy sector with a target of 175 GW capacity by 2022.
- India ranks third in the world in execution of projects and Investments in Renewable
- India ranks fifth globally in overall installed renewable energy capacities.
- Our country is committed to aligning and implementing its action.
- By 2030, India aims to have 60 percent of its installed capacity through clean, renewable energy.
- About 32730 MW of the total installed renewable energy capacity Tamil Nadu provides 8326.86 MW pure renewable energy.
- This the total capacity installed in the renewable energy sector Tamil Nadu contribution is 25.44 percent.

Background : **1**

- Tamil Nadu has the most diversified power generation sector of any state in India.
- **Total installed capacity of Tamil Nadu**- 31894 MW.

1. Almost 50 percent of this (15,799 MW) - renewable energy.
2. 2% -coal based power generation
3. 5% -nuclear power plants
4. 3% - fuel power generation and
5. 14% -long – and medium – term power purchase agreements and self-utilization project.

- Tamil Nadu is a state blessed with abundant sun shine thought out the year.
- The Government of Tamil Nadu has been a pioneer in adopting new strategies and technological measures to implement various methods significantly harvest its resources without any encroachment on nature.

Implementing Agency **11**

- Recognizing the importance and scope of renewable energy, the Government of Tamil Nadu created separate organization called Tamil Nâdu energy development Agency (TEDA) in 1985 to promote the use of new and renewable energy source and implement many good projects.
- The Company is solar wind biomass and biogas self use. It also promote research and development activities on renewable energy source such as power generation

Solar Energy potential:

- **Tamil Nadu Installed solar capacity** - 3.6 GW as of November 2020
- Tamil Nadu has high solar radiation potential (5.66 KW/ sq.m and average 12.66.52 w/sq.m) and about 300 days of sunny days in a year for solar applications.
- In total Renewable energy solar energy contributes 1,555MW.

World's largest solar park

- The world's largest solar park with 205 meter solar planets covering an area of 2,500 acres

(10sq km, 3.9 sq mi) is located at Kamudi, Ramanathapuram district.

- The Tamil Nadu energy Development Department will also run on solar power pups are promoted among the farmers
- Rural Development and Local governments are playing a major Role in promoting the use of renewable energy. By installing solar photovoltaic systems in green house and benefiting consumers with solar jet metering facilities.

Wind Power:

- Tamil Nadu tops the all other states, The wind power generation capacity in India.
- Tamil Nadu contributes 23 percent in country is total production.
- In 2017, National wind energy located at Chennai, According to an estimate published by the institute (NIWE), India is sea breeze is 302 GW at 100 m above ground level determined.
- About 35GW of this capacity is located on the coasts of Tamil Nadu
- The overall wind capacity in Tami Nadu is 120 meters above ground level 68,750 MW height as per National wind corporation (NIWE) Reports.
- In 2019 – 2020 about 11.717 million units of wind power, Tamil Nadu has used these generated, electricity till January 2020.

TN Wind Power Installed capacity

- With 8507 MW of wind power installed capacity Tamil Nadu ranks first in the country.
- It is estimated that India has a total potential of 695 GW of wind power generation of this Tamil Nadu alone can contribute 68GW of power capacity.
- Wind speed in Tamil Nadu is 8.6 m/ sec at 100m heights calculated to be up to 9 m/s at 120 m hub heights.

Places that favour setting up of wind farm

- Palakkad, Cumbum, Sengottai and passes of Aralvaimozhi are the windy areas in Tamil Nadu that are suitable for wind farm.
- The third largest off shore wind farm in the world is Muppandal 1500 MW
- The farm is created by Tamil Nâdu energy Development organization.

The wind power development program

- started in 1984 In India. Tamil Nadu has been a pioneer in many aspects in the use of wind energy.
- The country's first wind turbine connected to a power peck was setup in Mullaikadu near Thoothukudi in January 1986.
- The country's first wind power observatory was established in 1986. At sultan pet of Coimbatore district Near Palakkad pass.
- In the year 1990, the country's first wind farm was established by private sector.
- Tamil Nadu is the first state to use GPS in wind form.

Energy:

- Co-operation plants, sugar mill waste based cogeneration plants, biomass gasification based power project and municipal solid waste and vegetable based power plants are being promoted by the government.

Schemes to promote renewable energy:

- Prime minister's Greenhouse scheme, solar rooftop capital, incentive scheme, solar Roof top capital, incentive scheme, wind solar integration and small hydro/ micro hydro projects and notable projects.

Rooftop solar PV- power plants:

- The Tamil Nadu energy development Agency facilitates the installation of grid – connected rooftop solar and off – grid solar power plants in homes and government building
- Tamil Nadu energy development Agency is also setting up solar power plants at many places on behalf of government departments.

Chief Minister's Green House scheme:

- It focuses on the welfare of families living mainly below the poverty line rural areas. Under this scheme providing CFL/LED based solar cell (SPV) home lighting systems
- CFL/LED based home lighting systems are providing to newly constructed houses under weavers housing scheme. Chief Minister's solar Roof top capital incentive scheme.

Sustainable future activities:

- Solar energy policy solar energy policy 2019 targets 9,000 mw of Installed solar capacity by 2023.
- Promotion of distributed and utility-scale photovoltaic generation, 500 MW Ultra mega solar photovoltaic power park at Kadladi project AND 250 mw floating solar cell projects, 5MW of rooftop system capacity are key operational initiatives of the policy.
- Wind projects with a capacity of 689.01 MW are operational with central power distribution utility (CTU) connectivity by power Grid Corporation of India limited.
- Another 1,000 MW of capacity to be commissioned in a short period of time.

Electrical Vehicle Policy **1**

- Electric vehicle are being introduced to reduce air pollution.
- The Tamil Nadu government is encouraging various public/ private companies to set up.
- More battery charging stations for these electric vehicles to run efficiency.

8) What is Human Genome Project (HGP) List out its Goals and features, and uses? 5

- **Human Genome Project:** The international human genome project was launched in the year 1990. It was a mega project and took 13 years to complete.
- **Genome :**The human genome is about 25 times larger than the genome of any organism sequenced to date and is the first vertebrate genome to be completed on 2003.
- **Project :**Human genome is said to have approximately 3 × 109 bp. HGP was closely associated with the rapid development of a new area in biology called bioinformatics.
- It is on international model of genome to control the human growth limit.

Goals and methodologies of Human Genome Project **3**

- The main goals of Human Genome Project are as follows Identify all the genes (approximately 30000) in human DNA.
- Determine the sequence of the three billion chemical base pairs that makeup the human DNA.
- To store this information in databases.
- Improve tools for data analysis.
- Transfer related technologies to other sectors, such as industries.
- Address the ethical, legal and social issues (ELSI) that may arise from the project.

Salient features of Human Genome Project **3**

- The human genome contains 3 billion nucleotide bases.
- An average gene consists of 3000 bases, the largest known human gene being dystrophin with 2.4 million bases.
- Genes are distributed over 24 chromosomes.

1. **Chromosome 19** - highest gene density.
2. **Chromosome 13 and Y chromosome** -lowest gene densities.

- The chromosomal organization of human genes shows diversity.
- There may be 35000-40000 genes in the genome and almost 99.9 nucleotide bases are exactly the same in all people.
- Functions for over 50 percent of the discovered genes are unknown.
- Less than 2 percent of the genome codes for proteins.
- Repeated sequences make up very large portion of the human genome. Repetitive sequences have no direct coding functions but

they shed light on chromosome structure, dynamics and evolution (genetic diversity).

- Chromosome 1 has 2968 genes whereas chromosome 'Y' has 231 genes.
- Scientists have identified about 1.4 million locations where single base DNA differences (SNPs – Single nucleotidepolymorphism – pronounce as 'snips') occur in humans. Identification of 'SNIPS' is helpful in finding chromosomal locations for disease associated sequences and tracing human history.

Applications **3**

- In the year 2010, 1800 genes which leads to diseases have identified through this project.
- The mapping of human chromosomes is possible to examine a person's DNA and to identify genetic abnormalities.
- This is extremely useful in diagnosing diseases and to provide genetic counseling to those planning to have children.
- This kind of information would also create possibilities for new gene therapies. Besides providing clues to understand human biology, learning about non-human organisms, DNA sequences can lead to an understanding of their natural capabilities that can be applied towards solving challenges in healthcare, agriculture, energy production and environmental remediation.
- A new era of molecular medicine, characterized by looking into the most fundamental causes of disease than treating the symptoms will be an important advantage.

Future challenges **1**

- Once genetic sequence becomes easier to determine, some people may attempt to use this information for profit or for political power.
- Insurance companies may refuse to insure people at 'genetic risk' and this would save the companies the expense of future medical bills incurred by 'less than perfect' people.
- Another fear is that attempts are being made to "breed out" certain genes of people from the human population in order to create a 'perfect race'.