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8 Human Diseases

Disease refers to a disorder of structure or function in a human, animal, or plant, especially one that produces specific symptoms or that affects a specific location and is not simply a direct result of physical injury. It is a departure from normal health due to structural or functional disorder of the body.

TYPES OF DISEASES

Diseases can broadly be classified as: Congenital diseases and Acquired diseases.

Congenital Diseases

- These diseases are present since birth.
- They could be due to a genetic abnormality or due to the malfunctioning of any organ or system.
- These are permanent, and generally not curable and may be inherited by the children.
- For example: Albinism, Down's syndrome, Hemophilia etc.

Acquired Diseases

- These diseases develop after birth.
- They can further be classified into:
  - Communicable (or infectious) Diseases, and
  - Noncommunicable (or noninfectious) Diseases.

COMMUNICABLE DISEASES

- A communicable disease is one that is spread from one person to another through a variety of ways that include: contact with blood and bodily fluids; breathing in an airborne virus; or by being bitten by an insect.
- The most common pathogens are bacteria, virus, protozoan, worms, fungi, mites, etc.
- The first symptoms of the disease do not necessarily appear immediately.
- The period between the entry of germs and the appearance of the first symptoms of the disease is known as the incubation period. Examples: Cholera, Malaria, Tuberculosis, Influenza, etc.

Causes of Communicable (Infectious) Diseases

- **Bacteria:** Infections like strep throat, urinary tract infections, and tuberculosis are caused by these single-celled species.
- **Viruses:** Viruses, which are much smaller than bacteria, are responsible for a wide range of illnesses, from common cold to AIDS.
- **Fungi:** Fungi are responsible for a variety of skin diseases, including ringworm and athlete's foot. Fungi can also affect the lungs and nervous system.
- **Parasites:** Malaria is caused by a bacterial infection spread by mosquito bites. Other parasites can be transmitted to humans via the faeces of animals.

Direct Contact

- Coming into contact with an infected person or animal is a simple way to contract most infectious diseases. These diseases are transmitted by direct contact in the following ways:
  - **Person to person:** Infectious diseases are commonly transmitted from one person to another through direct transmission of bacteria, viruses, or other germs. When a person infected with the bacterium or virus touches, kisses, coughs, or sneezes on someone who isn't infected, this may happen.
    - These germs can also spread through sexual contact due to the sharing of body fluids. The individual who spreads the germs may not show any signs of the disease and is merely a carrier.
  - **Animal to person:** Being bitten or scratched by an infected animal, even though it is a pet, will make you sick and, in some cases, even kill you. Animal waste can be dangerous to handle.
  - **Mother to unborn child:** Germs that cause infectious diseases may be passed from a pregnant woman to her unborn child. Germs may pass through the placenta or breast milk in some cases. During birth, germs in the vaginal region may be transferred to the infant.

Indirect Contact

- Disease-causing organisms also can be passed by indirect contact. Many germs can linger on an inanimate object, such as a tabletop, doorknob or faucet handle.

Insect Bites

- Some germs rely on insect carriers, such as mosquitoes, fleas, lice or ticks, to move from host to host. These carriers are known as vectors.
- Mosquitoes can carry the malaria parasite or West Nile virus. Deer ticks may carry the bacterium that causes Lyme disease.

Food Contamination

- Disease-causing germs can also infect us through contaminated food and water. This mechanism of transmission allows germs to be spread to many people through a single source.
- Escherichia coli (E. coli), for example, is a bacterium present in or on certain foods, such as undercooked hamburger or unpasteurized fruit juice.

Diseases Caused by Bacteria

Disease	Name of Bacteria	Transmission	Symptoms
Diphtheria	Corynebacterium diphtheriae	Contact	Affects the throat, difficulty in respiration and suffocation
Pertussis (Whooping Cough)	Haemophilus pertussis	By discharge from the throat of an infected person	Continuous coughing
Tetanus	Clostridium tetani	By bacteria in soil through wounds	High fever, spasms in body, locking of jaws
Cholera	Vibrio cholerae	Flies, food, faeces, carriers	Continuous stool and vomiting
Typhoid	Salmonella typhi	Flies, food	Continuous fever, reddish eruptions on chest & abdomen
Pneumonia	Diplococcus pneumoniae	Contact with air	High fever, inflammation of lungs, fatigue
Tuberculosis	Mycobacterium tuberculosis	Coughing	General weakness, regular fever, coughing, bloodstained sputum
Syphilis	Treponema pallidum	Direct contact, sexually transmitted	Ulcer on penis or on rectum, lips, tongue, nipple, skin rash, fever
Gonorrhoea	Neisseria gonorrhoeae	Sexual contact	Pain in passing urine, discharge of pus, pain
Leprosy	Mycobacterium leprae	Long and close contact	Spots on the body and nerves are affected

Diseases Caused by Virus

Disease	Name of Virus	Transmission	Symptoms
Poliomyelitis	Polio virus	Houseflies, food and water	Fever, body pain, backbone and intestine cells are destroyed
Mumps	Mumps Virus (Paramyxovirus)	Contact, virus in saliva spreads	The movement of the jaw becomes very difficult.
Measles	Measles virus (Paramyxovirus)	Contact	Reddish eruptions on body
AIDS	HIV	Blood and sexual contact	Weak immune system
Influenza (flu)	Orthomyxovirus	Contact	Droplet infection created by sneezing, coughing or talking
Dengue	Dengue Virus (DENV) (the virus has five types)	Aedes Mosquito	Reduction in platelet count; Pain in eyes, head, muscles and joints
Chickenpox	Varicella Virus	Contact	Dark red-coloured rash or pox changing into vesicles, which then form crusts and fall
Smallpox	Variola virus	Contact	Light fever, widespread skin rash beginning with flat spots which change into raising bumps then firm fluid filled blisters which then scab.

(Contd...)

3 Basics of Computers

WHAT DOES COMPUTER MEAN?

- A computer is a **programmable device** designed to perform **'arithmetic and logical operations'** automatically and sequentially on the input given by the user and gives the desired output after processing. Computers can also store data for later uses in appropriate storage devices, and retrieve it whenever it is necessary.
- Modern computers are electronic devices used for a variety of purposes ranging from browsing the web, writing documents, editing videos, creating applications, playing video games, etc.
- They are designed to execute applications and provide a variety of solutions by combining integrated hardware and software components.
- Computer components are divided into two major categories namely hardware and software. Hardware is the machine itself and its connected devices such as the monitor, keyboard, mouse etc. Software is the set of programs that make use of hardware for performing various functions.

Characteristics of Computer

The characteristics of computers that have made them so powerful and universally useful are −

- **Speed:** Computers work at an incredible speed. A powerful computer is capable of performing about 3-4 million simple instructions per second.
- **Accuracy:** In addition to being fast, computers are also accurate. Errors that may occur can almost always be attributed to human error (inaccurate data, poorly designed system or faulty instructions/programs written by the programmer).
- **Diligence:** Unlike human beings, computers are highly consistent. They do not suffer from human traits of boredom and tiredness resulting in a lack of concentration. Computers, therefore, are better than human beings in performing voluminous and repetitive jobs.
- **Versatility:** Computers are versatile machines and are capable of performing any task as long as it can be broken down into a series of logical steps. The presence of computers can be seen in almost every sphere – Railway/ Air reservation, Banks, Hotels, Weather forecasting and many more.
- **Storage Capacity:** Today's computers can store large volumes of data. A piece of information once recorded (or stored) in the computer, can never be forgotten and can be retrieved almost instantaneously

Application of Computers

Home

Computers are used at homes for several purposes like online bill payment, watching movies or shows at home, home tutoring, social media access, playing games, internet access, etc. They provide communication through electronic mail. They help to avail work from home facility for corporate employees. Computers help the student community to avail online educational support.

Medical Field

Computers are used in hospitals to maintain a database of patients' history, diagnosis, X-rays, live monitoring of patients, etc. Surgeons nowadays use robotic surgical devices to perform delicate operations, and conduct surgeries remotely. Virtual Reality technologies are also used for training purposes. It also helps to monitor the fetus inside the mother's womb.

Entertainment

Computers help to watch movies online, play games online, act as a virtual entertainer in playing games, listening to music, etc.

Industry

Computers are used to perform several tasks in industries like managing inventory, designing purpose, creating virtual sample products, interior designing, video conferencing, etc., Online marketing has seen a great revolution in its ability to sell various products to inaccessible corners like interior or rural areas. Stock markets have seen phenomenal participation from different levels of people through the use of computers.

Education

Computers are used in the education sector through online classes, online examinations, referring e-books, online tutoring, etc. They help in increased use of audio-visual aids in the education field.

Government

In government sectors, computers are used in data processing, maintaining a database of citizens and supporting a paperless environment. The country's defense organizations have greatly benefitted from computers in their use for missile development, satellites, rocket launches, etc.

Banking

In the banking sector, computers are used to store details of customers and conduct transactions, such as withdrawal and deposit of money through ATMs. Banks have reduced manual errors and expenses to a great extent through extensive use of computers.

Business

Nowadays, computers are totally integrated into business. The main objective of business is transaction processing, which involves transactions with suppliers, employees or customers. Computers can make these transactions easy and accurate. People can analyze investments, sales, expenses, markets and other aspects of business using computers.

Training

Many organizations use computer-based training to train their employees, to save money and improve performance. Video conferencing through computers allows saving of time and travelling costs by being able to connect people in various locations.

Arts

Computers are extensively used in dance, photography, arts and culture. The fluid movement of dance can be shown live via animation. Photos can be digitized using computers.

Science and Engineering

Computers with high performance are used to stimulate dynamic processes in Science and Engineering. Supercomputers have numerous applications in the area of Research and Development (R&D). Topographic images can be created through computers. Scientists use computers to plot and analyze data to have a better understanding of earthquakes and other natural phenomena.

Disadvantages of Computer

The disadvantages of computers in today's arena are-

- **No Intelligence Quotient (IQ)** – A computer is a machine that has no intelligence to perform any task. Each instruction has to be given to the computer. A computer is unable to take any decision on its own.
- **Dependency** – It functions as per a user's instruction, so it is fully dependent on a human being.
- **No Feeling** – Computers have no feelings or emotions. It cannot make judgement based on feeling, taste, experience, and knowledge, unlike a human being.

Generations of Computers

Computer generations are based on the major use of vacuum tubes, transistors, and the microprocessor. As of 2020, there are five generations of the computer.

First generation (1940-1956)

The first generation of computers used vacuum tubes as a major piece of technology. Vacuum tubes were widely used in computers from 1940 through 1956. Vacuum tubes were larger components and resulted in first-generation computers being quite large in size, taking up a lot of space in a room. Some of the first-generation computers took up an entire room.

The ENIAC is a great example of a first-generation computer. It consisted of nearly 20,000 vacuum tubes, 10,000 capacitors, and 70,000 resistors. It weighed over 30 tons and took up a lot of space, requiring a large room to house it. Other examples of first-generation computers include the EDSAC, IBM 701, and Manchester Mark 1.

Second generation

The second generation of computers saw the use of transistors instead of vacuum tubes. Transistors were widely used in computers from 1956 to 1963. Transistors were smaller than vacuum tubes and allowed computers to be smaller in size, faster in speed, and cheaper to build.

The first computer to use transistors was the TX-0 and was introduced in 1956. Other computers that used transistors include the IBM 7070, Philco Transac S-1000, and RCA 501

Third generation (1964-1971)

The third generation of computers introduced the use of IC (integrated circuits) in computers. Using IC's in computers helped reduce the size of computers even more than second-generation computers, and also made them faster.

Nearly all computers since the mid to late 1960s have utilized IC's. While the third generation is considered by many people to have spanned from 1964 to 1971, IC's are still used in computers today. Over 45 years later, today's computers have deep roots going back to the third generation.

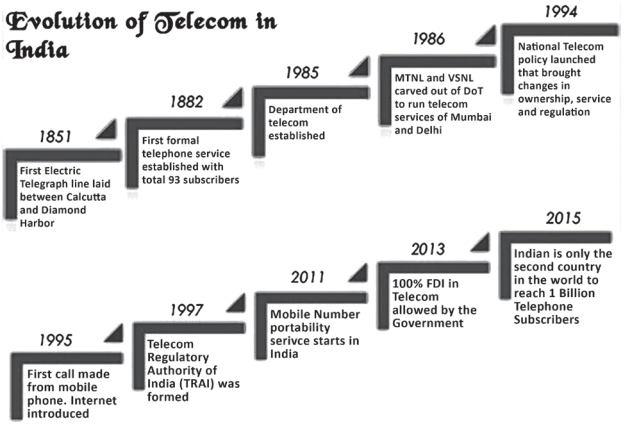
Fourth generation (1972-2010)

The fourth generation of computers took advantage of the invention of the microprocessor, more commonly known as a CPU. Microprocessors, with integrated circuits, helped make it possible for computers to fit easily on a desk and for the introduction of the laptop.

4 Telecommunication

Telecommunications are the means of electronic transmission of information over distances through a vast range of information-transmitting technologies such as telephones, telegraph, radio, microwave communication arrangements, fiber optics, satellites and the Internet. The information may be in the form of voice telephone calls, data, text, images, or video.

Telecommunications and broadcasting are administered worldwide by an agency of the United Nations called the International Telecommunication Union (ITU). Most countries have their own agencies for enforcing telecommunications regulations.



EVOLUTION OF THE TELECOM SECTOR IN INDIA

- The Indian telecom sector is more than 165 years old. Telecommunications was first introduced in India in 1851 when the first operational land lines were laid by the government near Kolkata (then Calcutta), although telephone services were formally introduced in India much later in 1881.
- Further, in 1883, telephone services were merged with the postal system. In 1947, after India attained independence, all foreign telecommunication companies were nationalised to form the Posts, Telephone and Telegraph (PTT), a body that was governed by the Ministry of Communication.
- The Indian telecom sector was entirely under government ownership until 1984 when the private sector was allowed in telecommunication equipment manufacturing only. The government concretised its earlier efforts towards developing R&D in the sector by setting up an autonomous body – Centre for Development of Telematics (C-DOT) in 1984 to develop state-of-the-art telecommunication technology to meet the growing needs of the Indian telecommunication network.
- The actual evolution of the industry started after the Government separated the Department of Post and Telegraph in 1985 by setting up the Department of Posts and the Department of Telecommunications (DoT).

Issues and Challenges of Telecom Sector

- **High Right-of-Way (ROW) cost:** Sometimes, state governments charge a huge amount for permitting the laying of fiber, etc.
- **Lack of fixed-line penetration:** India has very little penetration of fixed-line in its network whereas most of the developed countries have a very high penetration of fixed lines (telephone lines that traveled through a metal wire or optical fiber as part of a nationwide telephone network). Also, only around 25% of Towers in India are connected with fibre networks, whereas in developed nations, it is in excess of 70%. The 5G Network requires towers to be connected with very high-speed systems. Those high speeds are not possible on the present radio systems.
- **Declining Average Revenue Per User (ARPU):** ARPU's decline now is sharp and steady, which, combined with falling profits and in some cases, serious losses, is prompting the Indian telecom industry to look at consolidation as the only way to boost revenues.
- **Limited Spectrum Availability:** Available spectrum is less than 40% as compared to European nations and 50% as compared to China.
- **Low Broadband Penetration:** Low broadband penetration in the country is a matter of concern.
- Over the Top (OTT) applications such as WhatsApp, OLA and so on do not need permission or a pact with a telecommunications company. This hampers the revenue of telecommunication service providers.

- **Huge fluctuations in the duties on Telecom Equipment** which contribute to connecting the whole system from the central server to the consumer.
- **The timeframe of policy execution:** The government has withdrawn a lot of things to benefit the telecom sector but by the time it gets executed to the market, it becomes too late.
- **Lack of Telecom Infrastructure in Semi-rural and Rural areas:** Service providers have to incur a huge initial fixed cost to enter semi-rural and rural areas.
- **Pressure on Margins Due to Stiff Competition:** With competition heating up post-entry of Reliance Jio, other telecom players are feeling the heat of a substantial drop in tariff rates both for voice and data (more significant for data subscribers).

Steps Taken by the Government

- A new National Digital Communications Policy – 2018 (NDCP-2018) was unveiled in Oct 2018, to replace National Telecom Policy-2012, to cater to the modern needs of the digital communications sector of India. The policy aims to attract USD 100 billion worth of investments and generate 4 million jobs in the sector by 2022.
- The Telecom Commission was re-designated as the "Digital Communications Commission".
- In 2017, the Department of Telecom (DoT) came up with a gazette notification, advising the state governments to give quicker ROW permission and charge very little amount to service providers. Though, only some states responded.
- The government has provided benefits to the telecom sector by withdrawing some duties.
- The government has fast-tracked reforms in the telecom sector and continues to be proactive in providing room for growth for telecom companies.
- The Department of Information Technology intends to set up over 1 million internet-enabled common service centres across India as per the National e-Governance Plan.
- Foreign Direct Investment(FDI) cap in the telecom sector has been increased to 100% from 74%. Out of 100%, 49% will be done through automatic route and the rest will be done through the Foreign Investment Promotion Board (FIPB) approval route. FDI of up to 100% is permitted for infrastructure providers offering dark fibre, electronic mail and voice mail.
- The Government of India has introduced the Digital India programme under which all the sectors such as healthcare, retail, etc. will be connected through the internet.

Suggestions

- NDCP-2018 advocates:-
  - Establishment of a National Digital Grid by creating a National Fibre Authority;
  - Establishing Common Service Ducts and utility corridors in all new city and highway road projects;
  - Creating a collaborative institutional mechanism between Centre, States and Local Bodies for Common Rights of Way, standardization of costs and timelines;
  - Removal of barriers to approvals; and
  - Facilitating the development of Open Access Next Generation Networks.
- Explore the option of revenue sharing agreement between Internet players and telecommunication companies.
- Outsourcing non-core functions such as network maintenance, IT operations and customer service.
- Divestment of tower assets into separate companies will enable curb costs and focus on core operations.
- Introduce new and efficient technologies such as M2M (technology that enables networked devices to exchange information and perform actions without the manual assistance of humans) and cloud computing.
- Benefits of industry status in line with other infrastructure sectors in the country to be implemented.
- Penetration of rural markets (72% of the population staying in rural areas) will be the key growth driver.
- The government should increase the network area through optical fibre instead of copper which is expensive. This is necessary to ensure last-mile connectivity.
- The government needs to prepare a ground for easy right-of-way permissions and lower the cost of right-of-ways.
- It is time to go for a generational shift to ensure that the current tariff is financially viable for service providers.
- Telecom Operators should leverage on the talent pool in the country which is bringing in a lot of new innovations in AI, blockchain technology etc.
- New Infrastructure on a shareable basis just like the way telecom service providers share the cost of towers is the need of the hour.
- The government should spend more on R&D and create an environment that makes India capable of manufacturing and exporting hardware components like mobile handsets, CCTV Cameras, touch screen monitors etc.

Conclusion

- The telecom sector in India has to deal with various challenges like maintaining a sufficient spectrum, adoption of new technologies faster to be able to use the new features and techniques to serve the customers with better and feature-rich service.

5 Space Science & Technology

Outer Space refers to the void that exists between celestial bodies. There is no boundary where outer space is said to begin, but according to space treaties the Kármán line located at an altitude of 100 km above sea level is conventionally used as the start of outer space. Asteroids, Comets, Kuiper Belt Objects and all other kinds of celestial bodies of rock, metal and ice are in constant motion as they orbit the Sun.

Space research is scientific study carried out in outer space. Space research involves dual use technology with application in both civilian and defence sectors. Indian space research also involves dual use technology and other countries that possess this technology include Russia, USA, European Union, Israel, Japan and China.

WHAT IS AN ORBIT?

An orbit is a regular and repeating curved trajectory of an object in space. An object in an orbit is called a Satellite. The object in orbit can be an artificial satellite or a natural satellite. The earth, like any other planets in space, rotates around the sun, in its own orbital path at a constant speed. For the planets, the orbits are almost circular.

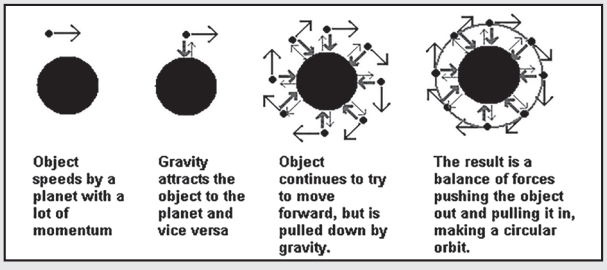
Types of Orbits

On the Basis of Altitude

- **Low Earth Orbit (LEO)**
  - A low Earth orbit is normally at an altitude of less than 2000 km and could be as low as 160 km above the Earth. Satellites in this circular orbit travel at a speed of around 7.8 km per second. At this speed, a satellite takes approximately 90 minutes to circle the Earth. Objects that are placed in the Low Earth Orbit are subject to atmospheric drag. Atmospheric Drag is a process of reduction of the altitude of a satellite's orbit due to frequent collision of gas molecules and it is a cause of orbital decay." So, Higher the orbital altitude, lower will be the atmospheric density and drag. However, beyond 1000 km above the earth's surface, objects will be subject to Earth's "Van Allen Radiation Zone" – it is a very sensitive zone, filled with energetic charged particles from solar winds and cosmic rays, that are captured by the earth's magnetic field leading to varying levels of radiation. So, to avoid catastrophes, missions to LEO aims for altitude between 160 km to 1000 km above the earth's surface.

How an Orbit is Formed?

Orbit is a result of perfect balance between the momentum of an object and the force of gravity. "When an object is in motion, it will be in motion unless some external force is applied to it – Newton's First Law". When an object is released into space, it follows a straight trajectory, but due to the earth's gravity the object is pulled towards it and the trajectory becomes curved shaped and then follows an orbital motion.



Note: The trajectory of an orbit can be circular or elliptical

  - LEO is the circular orbit in which Remote Sensing Satellites (RSS) are launched. Remote Sensing Satellites follow a circular orbit moving from North Pole to the South Pole, therefore this orbit is also known as Polar Orbit. In a 24 hour period, polar orbiting satellites will view most of the Earth twice: once in daylight and another in darkness. Moreover, within LEO, high bandwidth communication can be experienced with low time lag.
- **Medium Earth Orbit (MEO)**
  - MEO generally lies at an altitude range between 2000 km to 35786 km above the surface of earth.
  - Two medium Earth orbits are notable: the semi-synchronous orbit and the Molniya orbit.
  - The semi-synchronous orbit is a near-circular orbit at about 20,200 kilometers above the earth's surface. A satellite at this height takes 12 hours to complete an orbit. In 24-hours, the satellite crosses over the same two spots on the equator every day.
  - The Molniya orbit is used for observing high latitudes.
  - The most common use of satellites in this region is for navigation, such as GPS, Glonass and Galileo constellations. Communications satellites that cover the North and South Pole are also put in MEO. On the contrary, due to comparatively high altitude more ground coverage can be achieved.

- Nevertheless, MEO has disadvantages too. With the increase in altitude as compared to LEO, propagation delay begin to creep into the transmission of signals. Thus the power required to transmit the signal will increase.

- **Geosynchronous Earth Orbit (GEO)**
  - Geosynchronous Earth orbit lies at the highest altitude of approximately 36000 km above the earth's equator.
  - The orbital period is equal to the earth's rotational period around its axis, which allows satellites to match Earth's rotation. This position is a valuable spot for monitoring weather, communications and surveillance.
  - A Satellite in the Geosynchronous orbit can see or track one spot of the planet all the time. Satellites in this orbit can be used for military and commercial purposes such as telephone, internet and television. It also ensures a stable connectivity as it can spot a single area over months or years.

On the Basis of Application

- **Geostationary Orbit (GSO):** The geostationary orbit is a special case of geosynchronous orbit in which a satellite moves in a circular geosynchronous orbit in the equatorial plane in the direction of the earth's rotation. The satellite in this orbit has the same orbital period as the rotation of the earth around its axis, making it appear stationary relative to a fixed spot on the earth. This allows for them to provide constant coverage of an area. This orbit is good for providing television broadcasting, weather monitoring and communication services.
- **Sun Synchronous Orbit:** It is a special type of polar orbit. Here the orbital plane of the satellite has been always at the same constant angle relative to the sun-earth line during all seasons. A Sun-synchronous orbit crosses over the equator at approximately the same local time each day (and night). This orbit keeps the angle of sunlight on the surface of the earth as consistent as possible, though the angle will change from season to season. The path that a satellite has to travel to stay in a Sun-synchronous orbit is very narrow. If a satellite is at a height of 100 kilometers, it must have an orbital inclination of 96 degrees to maintain a Sun-synchronous orbit. Any deviation in height or inclination will take the satellite out of a Sun-synchronous orbit.
- **Highly Elliptical Orbit:** Satellites in Highly Elliptical Orbit have orbits that are close to the earth at one point of their orbit, but are much farther away from the earth at other times. Often highly-elliptical orbits are used to serve areas to the far north or south of the earth, which cannot be reached using geostationary satellites.
- **Transfer Orbit:** In orbital mechanics a transfer orbit is an intermediate elliptical orbit that is used to move a satellite or other object from one circular, or largely circular, orbit to another.
- **Polar Transfer Orbit (PTO):** It is an orbit at an altitude of about 100 km below the Polar or Low Earth Orbit. Remote Sensing satellites are launched into this orbit first and then using their own propulsion system the satellites lifts themselves to the desired orbit.
- **Geostationary Transfer Orbit (GTO):** This orbit is located at a height of about 200 km below the geostationary orbit. GSS are first launched in GTO and then lifts itself using its own propulsion system to the desired orbit. The geostationary transfer orbit (GTO) is a high eccentric orbit which traverses low Earth orbit (LEO) and geostationary orbit (GSO).

Space Probes

- **Sounding Rockets:** Sounding rockets are one or two stage solid propellant rockets used for probing the upper atmospheric regions and for space research. They also serve as easily affordable platforms to test or prove prototypes of new components or subsystems intended for use in launch vehicles and satellites. They carry instruments into the upper atmosphere and into space near the Earth. These instruments may measure the temperature and pressure of the atmosphere as well as radiation from space.
- **Lunar Spacecraft:** They explore the moon to prepare the way for astronauts to land there.
- **Interplanetary Probes:** They explore the space between the planets. However, they do not reach a specific body in space. These may fly past the target planet, go into orbit around it and land on it.

Natural Satellite vs. Artificial Satellite

- Natural satellite is a celestial body smaller than a planet, which revolves around a planet. They are also called natural moon.
- Artificial satellite is a man-made device that orbits around the earth or a planet and helps in meteorology, communication, remote sensing, navigation, spying and other applications.

SATELLITE LAUNCHING

A satellite is launched into space and into their orbit by hitching a ride on a rocket or on the Space Shuttle, where they are placed inside the cargo bay. The rocket that is used to launch a satellite is called a "launch vehicle", which is made up of several different segments, or stages, with each stage playing a different role.

The first stage of the launch vehicle contains the fuel that is needed to lift the satellite and launch vehicle off the ground and into the sky. After all the fuel has been used up, the first stage is no longer needed and breaks off and falls to the ground in an uninhabited area.

10 Energy

Energy is one of the most important of all the world's resources. We need energy for light, to cook food, power industrial machinery and fuel transport. Fortunately, the natural environment provides us with a wide range of energy resources. A distinction is made between primary energy and secondary. Primary energy is fuels that provide energy without undergoing any conversion process, for example coal, natural gas and fuel wood. Secondary energy includes electricity and petrol, which are made from the processing of primary fuels. In today's world, electricity is undoubtedly the leading source of energy.

However, the demand for energy across the world is constantly rising. This increased demand is caused in part by the increase in population, industrialization and economic development. The amount of energy a country uses is widely used to indicate or measure the level of development. As a country develops, energy-consuming activities, such as manufacturing, provision of services and transport increase in scale and importance. This rising demand for energy results in a country generating more of its own energy from its different sources or relying on other countries with imports of fuels.

During the early phase of the industrial revolution, the demand for energy was primarily met by conventional sources of energy like coal. But with the growing awareness about the disadvantages of conventional resources, uncertainty about supply and the rapid global warming, there was a need of environment friendly sources and this was met with the tapping of non-conventional means like solar, hydro, wind energy, etc.

The Sun is the ultimate source of energy on earth. However, the energy resources can be classified on the basis of source and accessibility as:

- Non-renewable Sources of Energy
- Renewable Sources of Energy

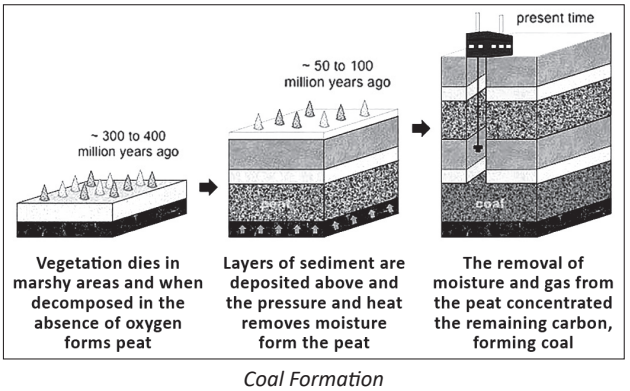
CONVENTIONAL/NON-RENEWABLE SOURCES OF ENERGY

Conventional sources of energy are the natural energy resources which are regularly used for many years and are accepted as fuel to produce heat, light, food and electricity.

Conventional sources of energy are generally non-renewable sources of energy as the accumulation or creation of conventional sources of energy takes years, once they are exploited or consumed.

Coal

- Coal is a combustible sedimentary rock formed from ancient vegetation which has been captured for long between other rock strata and transformed by the combined effects of microbial action, pressure and heat over a considerable time period. This process is commonly called 'coalification'.
- It is composed mostly of carbon (50–98%), hydrogen (3–13%) and oxygen, and smaller amounts of nitrogen, sulphur and other elements. It also contains water and particles of other inorganic matter. When burned, coal releases energy as heat, which has a variety of uses.
- The quality of coal is determined on the basis of the ratio of combustible organic matter to inorganic impurities found in it. These inorganic impurities are non-combustible and after the combustion of coal, leave an inert residue/ash. Indian coal is considered to be of low quality because of its high ash content. The low quality coal ejects higher volume of particulate matter in the atmosphere on combustion.



Coal Formation

Coal Bed Methane (CBM)

- CBM is an unconventional form of natural gas found in coal deposits or coal seams. It contains a few percentage of Carbon dioxide and very little amount of propane and butane.
- It is also called sweet gas because it lacks Hydrogen sulphide.
- CBM is formed during the process of coalification, the transformation of plant material into coal.
- CBM can be recovered from underground coal before, during, or after mining operations.
- It can also be extracted from "unmineable" coal seams that are relatively deep, thin or of poor or inconsistent quality.

CBM Policy in India

Salient features of the CBM Policy adopted by the Government of India in July 1997 are:

- No participating interest from the Government of India.
- Allotment of CBM Blocks through open international competitive bidding.
- Exploration and Development of CBM under confessional type of agreement through Model Contract.
- Seven years tax holiday from the date of commencement of commercial production.
- Nominal commercial bonus of USD 0.3 million on declaration of commercial assessment.
- Freedom to sell gas at market driven prices in the domestic market. 35% income tax for Indian companies and 48% for foreign companies.
- Provision of 100% cost recovery.
- Exemption on customs duty on imported equipment.

- Vertical and horizontal wells are used to develop CBM resources.

CBM in India: With India having the fourth largest proven reserves of coal globally, according to the Directorate General of Hydrocarbons, the country holds significant prospects for exploration and production of CBM, which is also seen as a clean energy source.

Currently, Great Eastern Energy Corporation and Essar Oil are the only two CBM-gas producing blocks in the country, both from separate reserves in Raniganj, West Bengal. Reliance Industries has reportedly begun test production from its two blocks in Madhya Pradesh.

Clean Coal Technology

- **Gasification:** Under the integrated coal gasification combined cycle (IGCC), steam and hot pressurized air or oxygen is combined with coal in a reaction to force carbon molecules apart. The resulting 'Synthesis gas' (syngas) is a mixture of carbon monoxide and hydrogen. The syngas is burned in a gas turbine to generate electricity. IGCC power plants have higher fuel efficiency and are environmentally superior due to reduced emissions.
- **Using Fly Ash for Beneficial Purpose:** The light weight particles of fly ash are captured and stored in the exhaust of the electrostatic precipitators of coal power plants. The very fine fly ash cement like properties and is used as an additive in cement. In India, the government has mandated the production of fly ash bricks and advises their use in construction as a means to combat the growing problem of fly ash waste.
- **Ultra Mega Super Critical Power Projects (UMPPs):** Development of Ultra Mega Power Projects (UMPPs) is one step in the direction of achieving energy security for India. In UMPPs water is directly heated from liquid to superheated steam stage through the use of superheater coils. The UMPPs have a higher energy efficiency of 45% as compared to 35% in subcritical power plants. Each UMPP will generate power of about 4000MW.
- **Ultra-Supercritical Technology:** Ultra-supercritical technology uses steam with very high temperatures, up to 620°C, and pressure, up to 300 bar, resulting in a much higher efficiency than conventional coal fired plants. A unit burns much less coal, thereby generating less emission per megawatt of power output.

Petroleum

Crude petroleum consists of hydrocarbons of liquid and gaseous states varying in chemical composition, colour and specific gravity. Crude petroleum occurs in sedimentary rocks of the tertiary period. Most of the petroleum in India occurs in anticlines and fault traps between non-porous and porous rocks of tertiary age. Oil extracted is crude oil and contains many impurities. It cannot be used directly and therefore needs to be refined.

It is often referred to as liquid gold because of its scarcity and diversified uses. Petroleum or mineral oil is the next major energy source in India after coal.

New Exploration Technologies in Petroleum

The technologies used in petroleum exploration are:

- **Hydraulic Fracturing or Fracking:** In this technique, chemical-laced water is injected to break up subterranean rock formations to extract oil and natural gas.
- **Thermal Intervention:** It involves injection of steam into wells to extract heavy oils or oil sands. The problem is, it takes a lot of energy to generate that steam, so some oil companies are turning to solar energy instead of natural gas or other fossil fuels.

Natural Gas

Natural gas is a fossil energy source that formed deep beneath the earth's surface. Natural gas contains many different compounds. The largest component of natural gas is methane, a compound with one carbon atom and four hydrogen atoms (CH_4). Natural gas also contains smaller amounts of natural gas liquids (NGL; which are also hydrocarbon gas liquids), and non-hydrocarbon gases, such as carbon dioxide and water vapor.

Advantages of Natural gas

- Environment friendly fuel because of low carbon dioxide emissions as compared to coal or oil and far fewer pollutants than other hydrocarbon fuels.
- It burns completely and is therefore a more efficient fuel
- No adulteration and pilferage is possible in case of Natural Gas.

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