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 ENVIRONMENTAL SCIENCE

(Th-05a)

(As per the syllabus of the SCTE&VT, Bhubaneswar, Odisha)

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**FIRST SEMESTER**

**COMMON FOR ALL BRANCH**

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**TOPIC WISE DISTRIBUTION OF PERIODS AND MARKS**

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| --- | --- | --- | --- |
| **Sl. No** | **Name of the Topic** | **No of Periods as per Syllabus**  | **Expected Marks** |
| 01 | Eco-System | 10 | 10 |
| 02 | Air and Noise Pollution | 12 | 15 |
| 03 | Water and Soil Pollution | 12 | 15 |
| 04 | Renewable sources of Energy  | 14 | 15 |
| 05 | Solid Waste Management ISO 14000 and Environmental Management | 12 | 15 |
|  **Total** | 60 | 70 |

 **UNIT-1**

 **ECO-SYSTEM:**

**LEARNING OBJECTIVES**

* **INTRODUCTION AND STRUCTURE OF ECOSYSTEM**
* **BIOTIC AND ABIOTIC COMPONENTS**
* **FOOD CHAIN AND FOOD WEB**
* **AQUATIC AND TERRESTRIAL ECOSYSTEM**
* **CARBON, NITROGEN , SULPHUR, PHOSPHORUS CYCLE**
* **GLOBAL WARMING, CAUSES, EFFECTS, PROCESS**
* **GREENHOUSE EFFECT, OZONE DEPLETION**

**INTRODUCTION**

An ‘Ecosystem’ is a region with a specific and recognizable landscape form such as forest, grassland, desert, wetland or coastal area. The nature of the ecosystem is based on its geographical features such as hills, mountains, plains, rivers, lakes, coastal areas or islands. It is also controlled by climatic conditions such as the amount of sunlight, the temperature and the rainfall in the region. The geographical, climatic and soil characteristics form its non-living (abiotic) component. These features create conditions that support a community of plants and animals that evolution has produced to live in these specific conditions. The living part of the ecosystem is referred to as its biotic component. Ecosystems are divided into terrestrial or land based ecosystems, and aquatic ecosystems in water. These form the two major habitat conditions for the Earth’s living organisms.

**Definition:** The living community of plants and animals in any area together with the non-living components of the environment such as soil, air and water, constitute the ecosystem.

**STRUCTURE OF ECOSYSTEM**

Components that make up the structural aspects of an ecosystem include:

 1) Inorganic aspects – C, N, CO2, H2O.

 2) Organic compounds – Protein, Carbohydrates, Lipids – link abiotic to biotic aspects.

3) Climatic regimes – Temperature, Moisture, Light & Topography.

 4) Producers – Plants.

5) Macro consumers – Photographs – Large animals.

6) Micro consumers – Saprotrophic, absorbers – fungi.

**PRODUCERS, CONSUMERS AND DECOMPOSERS**

Every living organism is in some way dependent on other organisms. Plants are food for herbivorous animals which are in turn food for carnivorous animals. Thus there are different tropic levels in the ecosystem. Some organisms such as fungi live only on dead material and inorganic matter.

Plants are the ‘producers’ in the ecosystem as they manufacture their food by using energy from the sun. In the forest these form communities of plant life. In the sea these include tiny algal forms to large seaweed. The herbivorous animals are primary consumers as they live on the producers. In a forest, these are the insects, amphibia, reptiles, birds and mammals. The herbivorous animals include for example hare, deer and elephants that live on plant life. They graze on grass or feed on the foliage from trees. In grasslands, there are herbivores such as the blackbuck that feed on grass. In the semi-arid areas, there are species such as the chinkara or Indian gazelle. In the sea, there are small fish that live on algae and other plants. At a higher tropic level, there are carnivorous animals, or animals secondary consumers, which live on herbivorous animals. In our forests, the carnivorous animals are tigers, leopards, jackals, foxes and small wild cats. In the sea, carnivorous fish live on other fish and marine animals. Animals that live in the sea range in size from microscopic forms to giant mammals such as the whale.

Decomposers or detrivorous Decomposers or derivers are a group of organisms consisting of small animals like worms, insects, bacteria and fungi, which break down dead organic material into smaller particles and finally into simpler substances that are used by plants as nutrition. Decomposition thus is a vital function in nature, as without this, all the nutrients would be tied up in dead matter and no new life could be produced Most ecosystems are highly complex and consist of an extremely large number of individuals of a wide variety of species.

In the species-rich tropical ecosystems (such as in our country), only a few species are very common, while most species have relatively few individuals. Some species of plants and animals are extremely rare and may occur only at a few locations. These are said to be **‘endemic’** to these areas. When human activities alter the balance in these ecosystems, the “perturbation” leads to the disappearance of these uncommon species. When this happens to an endemic species that is not widely distributed, it becomes extinct for all time.

**BIOTIC AND ABIOTIC COMPONENTS**

Each ecosystem has two main components:

 (1) Abiotic

(2) Biotic

 **(1) ABIOTIC COMPONENTS:**

The non-living factors or the physical environment prevailing in an ecosystem form the abiotic components. They have a strong influence on the structure, distribution, behaviour and inter-relationship of organisms.

 **Abiotic components are mainly of two types:**

**(a) Climatic Factors:**

Which include rain, temperature, light, wind, humidity etc. Ecosystems

(b) **Edaphic Factors:**

Which include soil, pH, topography minerals etc.?

**The functions of important factors in abiotic components are given below:**

**Soils** are much more complex than simple sediments. They contain a mixture of weathered rock fragments, highly altered soil mineral particles, organic matter, and living organisms. Soils provide nutrients, water, a home, and a structural growing medium for organisms. The vegetation found growing on top of a soil is closely linked to this component of an ecosystem through nutrient cycling.

**The atmosphere** provides organisms found within ecosystems with carbon dioxide for photosynthesis and oxygen for respiration. The processes of evaporation, transpiration and precipitation cycle water between the atmosphere and the Earth’s surface.

**Solar radiation** is used in ecosystems to heat the atmosphere and to evaporate and transpire water into the atmosphere. Sunlight is also necessary for photosynthesis. Photosynthesis provides the energy for plant growth and metabolism, and the organic food for other forms of life.

Most living tissue is composed of a very high percentage of **water**, up to and even exceeding 90%. The protoplasm of a very few cells can survive if their water content drops below 10%, and most are killed if it is less than 30-50%. Water is the medium by which mineral nutrients enter and are translocated in plants. It is also necessary for the maintenance of leaf turgidity and is required for photosynthetic chemical reactions. Plants and animals receive their water from the Earth’s surface and soil. The original source of this water is precipitation from the atmosphere.

**(2) BIOTIC COMPONENTS:**

The living organisms including plants, animals and micro-organisms (Bacteria and Fungi) that are present in an ecosystem form the biotic components.

**On the basis of their role in the ecosystem the biotic components can be classified into three main groups:**

(A) Producers

(B) Consumers

(C) Decomposers or Reducers.

**(A) Producers:**

The green plants have chlorophyll with the help of which they trap solar energy and change it into chemical energy of carbohydrates using simple inorganic compounds namely water and carbon dioxide. This process is known as photosynthesis. As the green plants manufacture their own food they are known as Autotrophs (i.e. auto = self, trophos = feeder) Ecosystems. The chemical energy stored by the producers is utilised partly by the producers for their own growth and survival and the remaining is stored in the plant parts for their future use.

 **(B) Consumers:**

The animals lack chlorophyll and are unable to synthesise their own food. Therefore, they depend on the producers for their food. They are known as heterotrophs (i.e. heteros = other, trophos = feeder) The consumers are of four types, namely:

1. **Primary Consumers or First Order Consumers or Herbivores:**

These are the animals which feed on plants or the producers. They are called herbivores. Examples are rabbit, deer, goat, cattle etc.

1. **Secondary Consumers or Second Order Consumers or Primary Carnivores:**

The animals which feed on the herbivores are called the primary carnivores. Examples are cats, foxes, snakes etc.

1. **Tertiary Consumers or Third Order Consumers:**

These are the large carnivores which feed on the secondary consumers. Example are Wolves.

1. **Quaternary Consumers or Fourth Order Consumers or Omnivores:**

These are the largest carnivores which feed on the tertiary consumers and are not eaten up by any other animal. Examples are lions and tigers. Ecosystems (C) Decomposers or Reducers: Bacteria and fungi belong to this category. They breakdown the dead organic materials of producers (plants) and consumers (animals) for their food and release to the environment the simple inorganic and organic substances produced as by-products of their metabolisms. These simple substances are reused by the producers resulting in a cyclic exchange of materials between the biotic community and the abiotic environment of the ecosystem. The decomposers are known as Saprotrophs (i.e., sapros = rotten, trophos = feeder)

**FOOD CHAIN**

All living organisms (plants and animals) must eat some type of food for survival. Plants make their own food through a process called photosynthesis. Using the energy from the sun, water and carbon dioxide from the atmosphere and nutrients, they chemically make their own food. Since they make or produce their own food they are called producers. Organisms which do not create their own food must eat either plants or animals. They are called consumers. Some animals get their energy from eating plants while other animals get energy indirectly from plants by eating other animals that already ate the plants. Animals that eat only plants are called herbivores. Animals that eat both plants and other animals are called omnivores. Animals that eat only other animals are called carnivores. Some animals eat only dead or decaying materials and are called decomposers. In the marine food web, special producers are found. They are tiny microscopic plants called phytoplankton. Since the water is the home for these special tiny plants; it is also the home for tiny microscopic animals called zooplankton. And of course, zooplankton eat phytoplankton. Sometimes zooplankton and phytoplankton are collectively referred to as plankton. Food chains show the relationships between producers, consumers, and decomposers, showing who eats whom with arrows. The arrows show the movement of energy through the food chain. For example, in the food chain shown below, the small fish (silverside) gets its energy by eating the plankton and the large fish (bluefish) gets its energy by eating the small fish. Finally, the bacteria eats the fish after it dies, getting its energy from the large fish. The bacteria also returns nutrients back to the environment for use by the phytoplankton.

PHYTOPLANKTON --- ZOOPLANKTON –-- SILVERSIDE --- BLUEFISH ---BACTERIA - ----NUTRIENTS

Thus the food chain becomes a complete circle. Animals may eat more than one type of food. They may eat many different types of plants or many different animals. This makes everything more complicated and the food chain becomes a food web.

**FOOD WEB**

populations of producer organisms which are eaten by any number of consumer populations. The A food web is made up of interconnected food chains. Most communities include various green crab, for example, is a consumer as well as a decomposer. The crab will eat dead things or living things if it can catch them. A secondary consumer may also eat any number of primary consumers or producers. This non-linear set of interactions which shows the complex flow of energy in nature is more easily visualized in the following diagram. In a food web nutrients are recycled in the end by decomposers. Animals like shrimp and crabs can break the materials down to detritus. Then bacteria reduce the detritus to nutrients. Decomposers work at every level, setting free nutrients that form an essential part of the total food web.

**AQUATIC ECOSYSTEM**

Aquatic ecosystems are commonly categorized on the basis of whether the water is moving (stream, river) or still (pond, lake) and whether the water is fresh (pond), salty (ocean) or brackish (estuary). Aquatic ecosystems deal with biotic community and abiotic components present in water bodies. Depending upon the quality and nature of water, the aquatic ecosystem are categorized into:

* Freshwater Ecosystem
* Marine Ecosystem and
* Estuarine

**TERRESTRIAL ECO SYSTEM**

**Terrestrial Eco-System** includes forest ecosystem, cropland (man-made) ecosystem, grassland ecosystem, desert eco system etc. Where biotic and abiotic components of the respective habitat interact. The producers synthesize carbohydrate type of food in the presence of sun light. The consumers grow, flourish and reproduce by getting the energy from the producers. The decomposers mingle the dead bodies of producers and consumers in the soil and increase the nutrient pool of the eco system .There is continuous food chain, food web, energy flow and nutrient cycle in all eco system. The eco systems are in a state of dynamic equilibrium.

**CARBON, NITROGEN, SULPHUR, PHOSPHORUS CYCLE**

Biogeochemical cycles describe the pathway through which the essential elements move through the biotic and abiotic components of the system and vice versa. For an ecosystem to exist, continuous cycling of elements is very essential. Every biogeochemical cycle possess two components namely the reservoir and exchange pool. The reservoir is normally the abiotic component which is usually large and slow moving. The exchange pool is small but active exchange occurs between the biotic and abiotic component. The elemental cycles parallel to the energy flow, however they differ in the abiotic factor. Energy flow cycle is solar driven and while the elemental cycle is highly conservative and the chemical elements are obtained from the small pool and retained within the system. Biogeochemical cycles are categorized into two types: Gaseous and sedimentary. Atmosphere remains the reservoir for gaseous and earth crust is the reservoir for sedimentary cycle. Carbon, nitrogen and oxygen are included in gaseous biogeochemical cycle and phosphorus and Sulphur are grouped under sedimentary cycle. The sedimentary cycle consists of two phase, one water phase and the other soil/ sediment phase. The elements gets weathered and dissolved in the water phase, moves through the biotic components and returns back to the sediment phase. Unlike sedimentary cycle, the movement is very rapid within the gaseous cycle as it involves the atmosphere as reservoir. Since the cycle involves the geological, biological and chemical component in the cycle it is termed as biogeochemical cycle.

The important biogeochemical cycles are discussed as follows:

**Carbon Cycle:**

Carbon Cycle is one of the important atmospheric cycles. The cycle mainly portrays the circulation of carbon between the atmospheric gas carbon dioxide, assimilation of carbon as organic matter via photosynthesis and its subsequent release back into the atmosphere through respiration. Figure 1 depicts the carbon circulation through the carbon cycle. As we all know carbon is an important constituent of all life molecule. It is present in air as carbon dioxide (0.03%) and as carbonates and bicarbonates (CO3 - , HCO3 -) or molecular CO2 (aq) in surface water and groundwater. It is also present in minerals associated mainly with magnesium and calcium as carbonates. Coal, lignite, petroleum and natural gas are the sources of carbon fixed due to high pressure and temperature deep below the earth’s surface. The organic matter fixed as oil shale is termed as hydro carbonaceous kerogen and it contributes a major portion of the fixed carbon.

**Nitrogen Cycle:**

 Nitrogen is one of the most important and crucial biogeochemical cycle of the environment. It is a key nutrient for the living organisms and is a constituent of the organic molecules such as the amino acids, proteins, chlorophyll and nuclei acids. Before getting into the details of nitrogen cycle, it is essential to know some basic facts about nitrogen. Nitrogen is available in huge amount in the atmosphere. Almost 78% of air is composed of d-nitrogen (N2). Although atmosphere contains 78% of di-nitrogen gas it is not available to the living organisms due to the inertness and non-reactive nature of N2 due to the strong triple bond between the nitrogen atoms. Though di-nitrogen gas is largely available in the atmosphere, it remains inaccessible to the living organisms. Only when di-nitrogen gas is converted into ammonia it becomes accessible. Soil and oceans are the second major reservoir of nitrogen. Contrary, the biosphere constitutes just a minimum quantity of nitrogen (i.e.) almost one million times lesser nitrogen than the atmosphere.

**Sulphur Cycle**

Sulphur is a yellow, odourless, non-metallic element found in the earth’s crust. It is an important constituent of protein and vitamin playing a vital role in protein and enzyme functioning in plants and animals. Sulphur is present naturally in the earth’s crust, water bodies and atmosphere. Sulphur primarily occurs in the earth’s crust in the form of gypsum (CaSO4) and pyrite (FeS2, PbS, and HgS). Oceans are the largest reservoir of sulphur. Around 2.6 g/L of sulphates are present in the oceans in addition to dissolved hydrogen sulphide gas, and elemental sulphur. Atmosphere is another source of sulphur (Sulphur dioxide, ammonium sulphate and sulphate particles, Hydrogen sulphide gas).

**Phosphorus Cycle**

 Phosphorus is an element on the Earth and is present in water, soil and sediments. Phosphorous is not present in the atmosphere and hence lacks an atmosphere component in the cycle making the cycle endogenic. The availability of phosphorus in soil is very limited and this is the reason for application of phosphate fertilizers to enhance plant growth. Animals and humans obtain phosphorus through the food chain from plants and plant eating animals. Phosphorus is an essential nutrient for animals and plants. It is a constituent of protoplasm and DNA with a major role in cell development and energy storage (ATP).

**CONCLUSION:**

The cycling of the elements among the biological, geological and chemical component of the environment is the biogeochemical cycle. It is very essential for proper functioning and survival of the ecosystem. Though each cycle is different from the other, its functioning is of utmost important for maintaining the structure and function of an ecosystem. Anthropogenic activities bring a lot of lot of alterations in the biogeochemical cycles which further adds on oil to the burning global issues.

**GLOBAL WARMING, CAUSES, EFFECTS, PROCESS**

Global warming is a phenomenon of climate change characterized by a general increase in average temperatures of the Earth, which modifies the weather balances and ecosystems for a long time. It is directly linked to the increase of greenhouse gases in our atmosphere, worsening the greenhouse effect.

**CAUSES**

* Fossil Fuel
* Deforestation
* Chlorofluorocarbon
* Intensive farming
* Waste disposal
* Mining
* Over consumption

The massive use of fossil fuels is obviously the first source of global warming, as burning coal, oil and gas produces carbon dioxide - the most important greenhouse gas in the atmosphere - as well as nitrous oxide. The exploitation of forests has a major role in climate change. Trees help regulate the climate by absorbing CO2 from the atmosphere. When they are cut down, this positive effect is lost and the carbon stored in the trees is released into the atmosphere. With the excessive use of air conditioners and refrigerators, humans have been adding CFCs into the environment which affects the atmospheric ozone layer. The ozone layer protects the earth surface from the harmful ultraviolet rays emitted by the sun. The CFCs have led to ozone layer depletion making way for the ultraviolet rays, thereby increasing the temperature of the earth. Another cause of global warming is intensive farming, not only with the ever-increasing livestock, but also with plant protection products and fertilizers. In fact, cattle and sheep produce large amounts of methane when digesting their food, while fertilizers produce nitrous oxide emissions. Waste management methods like landfills and incineration emit greenhouse and toxic gases - including methane - that are released into the atmosphere, soil and waterways, contributing to the increase of the greenhouse effect. Over consumption also plays a major role in climate change. In fact, it is responsible for the overexploitation of natural resources and emissions from international freight transport, which both contribute to global warming.

**EFFECT**

Following are the major effects of global warming:

**Rise in Temperature**

Global warming has led to an incredible increase in earth’s temperature. Since 1880, the

Earth’s temperature has increased by ~1 degrees. This has resulted in an increase in the melting of glaciers, which have led to an increase in the sea level. This could have devastating effects on coastal regions.

**Threats to the Ecosystem**

Global warming has affected the coral reefs that can lead to the loss of plant and animal lives. Increase in global temperatures has made the fragility of coral reefs even worse.

**Climate Change**

Global warming has led to a change in climatic conditions. There are droughts at some places and floods at some. This climatic imbalance is the result of global warming.

**Spread of Diseases**

Global warming leads to a change in the patterns of heat and humidity. This has led to the movement of mosquitoes that carry and spread diseases.

**High Mortality Rates**

Due to an increase in floods, tsunamis and other natural calamities, the average death toll usually increases. Also, such events can bring about the spread of diseases that can hamper human life.

**Loss of Natural Habitat**

A global shift in the climate leads to the loss of habitats of several plants and animals. In this case, the animals need to migrate from their natural habitat and many of them even become extinct. This is yet another major impact of global warming on biodiversity.

**GREENHOUSE EFFECT**

The greenhouse effect is the rise in temperature that the Earth experiences because certain gases in the atmosphere (water vapour, carbon dioxide, nitrous oxide, ozone, methane, for example) trap energy that comes from the sun. These gases are usually called greenhouse gases since they behave much like the glass panes in a greenhouse. The glass panels of the greenhouse let in the light but keep heat from escaping and this is similar to the effect these gasses have on earth.

Sunlight enters the Earth's atmosphere, passing through the greenhouse gases. As it reaches the Earth's surface, land, water, and biosphere absorb the sunlight's energy. Once absorbed, this energy is sent back into the atmosphere. Some of the energy passes back into space, but much of it remains trapped in the atmosphere by the greenhouse gases. This is the completely natural process and without these gases all the heat would escape back into space and Earth's average temperature would be about 30 degrees Celsius (54 degrees Fahrenheit) colder.

The greenhouse effect is very important process, because without the greenhouse effect, the Earth would not be warm enough for humans to live. But if the greenhouse effect becomes stronger, it could make the Earth warmer than usual. Even a little extra warming may cause problems for humans, plants, and animals.

**OZONE DEPLETION**

**Ozone depletion** consists of two related events observed since the late 1970s: a steady lowering of about four percent in the total amount of ozone in [Earth's](https://en.wikipedia.org/wiki/Earth) atmosphere, and a much larger springtime decrease in [stratospheric](https://en.wikipedia.org/wiki/Stratospheric) ozone (the [ozone layer](https://en.wikipedia.org/wiki/Ozone_layer)) around Earth's polar regions.[[1]](https://en.wikipedia.org/wiki/Ozone_depletion#cite_note-WMO-20Q-1) The latter phenomenon is referred to as the [ozone hole](https://en.wikipedia.org/wiki/Ozone_depletion#Ozone_hole_and_its_causes). There are also springtime polar [tropospheric ozone depletion events](https://en.wikipedia.org/wiki/Tropospheric_ozone_depletion_events) in addition to these stratospheric events.

The main causes of ozone depletion and the ozone hole are manufactured chemicals, especially manufactured [halocarbon](https://en.wikipedia.org/wiki/Halocarbon) [refrigerants](https://en.wikipedia.org/wiki/Refrigerant), [solvents](https://en.wikipedia.org/wiki/Solvent), [propellants](https://en.wikipedia.org/wiki/Propellant), and foam-[blowing agents](https://en.wikipedia.org/wiki/Blowing_agent) ([chlorofluorocarbons](https://en.wikipedia.org/wiki/Chlorofluorocarbon) (CFCs), HCFCs, [halons](https://en.wikipedia.org/wiki/Haloalkanes)), referred to as *ozone-depleting substances* (ODS). These compounds are transported into the [stratosphere](https://en.wikipedia.org/wiki/Stratosphere) by [turbulent mixing](https://en.wikipedia.org/wiki/Turbulence) after being emitted from the surface, mixing much faster than the molecules can settle. Once in the stratosphere, they release [atoms](https://en.wikipedia.org/wiki/Atoms) from the [halogen](https://en.wikipedia.org/wiki/Halogen) group through [photo dissociation](https://en.wikipedia.org/wiki/Photodissociation), which [catalyze](https://en.wikipedia.org/wiki/Catalyze) the breakdown of ozone (O3) into oxygen (O2) Both types of ozone depletion were observed to increase as emissions of halocarbons increased.

Ozone depletion and the ozone hole have generated worldwide concern over increased cancer risks and other negative effects. The ozone layer prevents harmful wavelengths of [ultraviolet](https://en.wikipedia.org/wiki/Ultraviolet) (UVB) light from passing through the [Earth's atmosphere](https://en.wikipedia.org/wiki/Earth%27s_atmosphere). These wavelengths cause [skin cancer](https://en.wikipedia.org/wiki/Skin_cancer), [sunburn](https://en.wikipedia.org/wiki/Sunburn), permanent blindness, and [cataracts](https://en.wikipedia.org/wiki/Cataracts),[[5]](https://en.wikipedia.org/wiki/Ozone_depletion#cite_note-5) which were projected to increase dramatically as a result of thinning ozone, as well as harming plants and animals. These concerns led to the adoption of the [Montreal Protocol](https://en.wikipedia.org/wiki/Montreal_Protocol) in 1987, which bans the production of CFCs, halons, and other ozone-depleting chemicals. Currently, scientists plan to develop new refrigerants to replace older ones.

**QUESTION AND ANSWER DISCUSSION**

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**.SHORT QUESTION**

1. What is Eco-System?

Ans.- An ecosystem is a geographic area where plants, animals and other organisms, as well as weather and landscapes, work together to form a bubble of life.

1. What is biotic component?

Ans- Biotic components are all the living things in an ecosystem. They are the animals, the plants and the microorganisms. Biotic components also include the waste from living things and dead organisms

1. What is abiotic component?

Ans-- Abiotic components can include water, light, radiation, temperature, humidity, atmosphere, acidity, salinity, precipitation, altitude, minerals, tides, rain, dissolved oxygen nutrients, and soil.

**LONG QUESTION**

1. What is the structure of eco-system?

2. What is global warming?

3. What is greenhouse effect?

**UNIT-2**

**AIR AND NOISE POLLUTION**

**DEFINITION OF POLLUTION AND POLLUTANTS**

**DEFINITION**

**Pollution** may be defined as an undesirable change in the physical, chemical or biological characteristics of air, water and land that may be harmful to human life and other animals, living conditions, industrial processes and cultural assets. Pollution can be natural or manmade. The agents that pollute are called pollutants.

**POLLUTANTS**

**Pollutants** are by-products of man’s action. The important pollutants are summarised below:

• Deposited matter—Soot, smoke, tar or dust and domestic wastes.

• Gases—CO, nitrogen oxides, sulphur oxides, halogens (chlorine, bromine and iodine).

• Metals—Lead, zinc, iron and chromium.

• Industrial pollutants—Benzene, ether, acetic acid etc., and cyanide compounds.

 • Agriculture pollutants—Pesticides, herbicides, fungicides and fertilizers.

• Photochemical pollutants—Ozone, oxides of nitrogen, aldehydes, ethylene, photochemical smog and proxy acetyl nitrate.

 • Radiation pollutants—Radioactive substances and radioactive fall-outs of the nuclear test.

**CLASSIFICATION OF POLLUTANTS**

On the basis of natural disposal, pollutants are of two types:

 **(i) Non-degradable Pollutants**

These are the pollutants, which degrade at a very slow pace by the natural biological processes. These are inorganic compounds such as salts (chlorides), metallic oxides waste producing materials and materials like, aluminium cans, mercuric salts and even DDT. These continue to accumulate in the environment.

**(ii) Biodegradable Pollutants**

These include domestic sewage that easily decomposes under natural processes and can be rapidly decomposed by natural/ artificial methods. These cause serious problems when accumulated in large amounts as the pace of deposition exceeds the pace of decomposition of disposal.

**NATURAL AND MANMADE SOURCES OF AIR POLLUTION (REFRIGERANTS, I.C, BOILER).**

**SOURCES OF AIR POLLUTION**

1. Natural Sources
2. Human-Made Sources

**1. Natural Sources:** Naturally occurring particulate matter (PM) includes dust from the earth’s surface (crustal material), sea salt in coastal areas and biological material, in the form of pollen, spores or plant and animal debris. Volcanic eruptions can introduce very important quantities of gases and particles into the atmosphere. For example, the Etna volcano emits 3,000 tons of sulphur dioxide (SO2) on an average day and up to 10,000 tons during periods of great activity. Other natural sources of air pollution include: thunderbolts, which produce significant quantities of oxides of nitrogen (NOx); algae on the surface of the oceans, which give out hydrogen sulphide (H2S); wind erosion, which introduces particles into the atmosphere; and humid zones, such as swamps, peat-bogs or little deep lakes, which produce methane (CH4).

**2. Human-Made Sources:** In urban areas, most air pollution comes from human-made sources. Such sources can be classified as either mobile (cars, trucks, air planes, marine engines, etc.) or point source (factories, electric power plants, etc.). To date, road traffic constitutes the major source of air pollution in the large cities of industrialised countries. Combustion of carbon constituted fuels (coal, fuel oil, wood, natural gas) is never complete, and it produces carbon monoxide (CO) and hydrocarbons. Human activities have increased the amount of VOCs due to petroleum, chemical industries and transportation, and NOx from combustion in power stations and automobiles. Consequently, O3 is more concentrated and more smog occurs in densely populated and industrial regions. In urban environments, particles arise mainly as a result of combustion from mobile and stationary sources. Coal and sulphur from fuel oils oxidise into SO2. These are fuels that are used to move, warm up and get the necessary energy to the many industrial processes.

**AIR POLLUTANTS:**

Air pollution is the greatest environmental threat to public health globally and accounts for an estimated 7 million premature deaths every year. Air pollution and climate change are closely linked as all major pollutants have an impact on the climate and most share common sources with greenhouse gases. Improving our air quality will bring health, development, and environmental benefits.

It is a substance or effect dwelling temporarily or permanently in the air, which adversely alters the environment by interfering with the health, the comfort, or the food chain, or by interfering with the property values of people. A pollutant can be solid (large or sub-molecular), liquid or gas.

**TYPES**

Air pollutants can be classified into two types.

1. Primary Pollutant
2. Secondary Pollutant

**The Primary Pollutants** are “directly” emitted from the processes such as fossil fuel consumption, volcanic eruption and factories. The major primary pollutants are Oxides of Sulphur, Oxides of Nitrogen, Oxides of Carbon, Particulate Matter, Methane, Ammonia, Chlorofluorocarbons, Toxic metals etc.

**The Secondary Pollutants** are not emitted directly. The secondary pollutants form when the primary pollutants react with themselves or other components of the atmosphere. Most important secondary level Air Pollutants are Ground Level Ozone, Smog and POPs (Persistent Organic Pollutants).

**PARTICULATE POLLUTANTS**

Particulate pollution is pollution of an environment that consists of particles suspended in some medium. There are three primary forms: atmospheric particulate matter, marine debris, and space debris. Some particles are released directly from a specific source, while others form in chemical reactions in the atmosphere. Particulate pollution can be derived from either natural sources or anthropogenic processes.

The particles that pollute the air by being suspended can be defined as particulate pollutants. These particles are results of some anthropogenic processes like vehicles, industries, construction sites/activities, etc. or natural sources like pollen, volcanic eruptions, natural gaseous precursors, etc. A wide variety of airborne material. Particulate matter (PM)) pollution consists of materials (including dust, smoke, and soot), that are directly emitted into the air or result from the transformation of gaseous pollutants. Particles come from natural sources (e.g., volcanic eruptions) and human activities such as burning fossil fuels, incinerating wastes, and smelting metals. Coal grinding, fugitive road dust and dust from rock quarries are examples of physical processes that release particulate matter to the atmosphere. These particles are usually large (>100 mm diameter), do not have a long residence time in the atmosphere, and are not taken into the body during respiration. PM formed through chemical reactions are typically much smaller.

**EFFECTS AND CONTROL**

**EFFECTS OF AIR POLLUTION**

**Effect on Plants**

1. SO2 causes chlorosis and also results in the death of cells and tissues.
2. Fluorides and PAN damage leafy vegetables such as lettuce and spinach.
3. Oxides of nitrogen and fluorides reduce crop yield.
4. Smog bleaches and blaze foliage of important leafy plants.
5. Hydrocarbons cause premature yellowing, fall of leave and flower buds, discoloration and curling of sepals and petals.
6. Smoke and dust cover the leaf surface and reduce photosynthetic capacity of plants.

 (vii) Ozone damages cereals, fruits, and cotton crop.

 **Effect on Man**

The effect of pollutants on animals and man are as follows- (i) Ozone causes dryness of mucous membranes, changes eye vision, causes headache, pulmonary congestion and oedema. (ii) Ozone has been reported to produce chromosomal aberrations. (iii) SO2 causes drying of mouth, scratchy throat, smarting eyes and disorders of respiratory tract. (iv) SO3, CO and NO2 diffuse into blood stream and reduce oxygen transport. CO damages cardiovascular system. Hydrocarbons and other pollutants act, as carcinogens and lead to different cancers. (v) Cotton dust leads to respiratory disorders e.g. bronchitis and asthma. (vi) Smoking of tobacco causes cancerous growth in lungs.

**Change in Climate**

CO2 content of air is increasing due to deforestation and combustion of fuel. This increase is affecting the composition and balance of gases in the atmosphere. Increase in CO2 concentration may increase the atmospheric temperature, producing greenhouse effect A rise of global temperature by more than 2-3 degrees may melt glaciers and polar ice. This would lead to a rise in ocean level and consequent flooding and submergence of coastal areas. Rainfall pattern may also change, affecting agricultural output in various regions of’ the world. Aerosols deplete the ozone layer in the stratosphere. Thinning of ozone layer would permit more of the harmful ultraviolet rays to reach the earth. This may cause, sunburn, blindness and inactivation of proteins, RNA, DNA and plant pigments. Aesthetic Loss Dust and smoke spoils the beauty of nature. Especially the mountain environments, which serve as a great attraction for tourists. Foul odours emitted by industries, automobiles, dirty drains and garbage heaps in cities are a great nuisance. Control of Air Pollution Following measures have been suggested to control air pollution-

1. Some gases, which are more soluble in a particular liquid than air, for example, ammonia in water, can be separated by dissolving in it
2. Particles larger than 50 mm are separated in gravity settling tanks. Using cyclone collectors or electrostatic precipitators separates fine particles.
3. The height of chimneys should .be increased to the highest possible level to reduce pollution at the ground level.
4. SO2 pollution can be controlled by extracting sulphur from the fuel before use. (v) Pollution control laws should be enforced strictly.
5. Trees should be planted on the roadside, riverbanks, parks and’ open places as they keep the environment fresh. (vii) Population growth, which is the main cause of pollution should be checked. (viii) Nuclear explosions should be restricted.

**Equipment used to Control Air Pollution**

 Air pollution can be reduced by adopting the following approaches.

1. Ensuring sufficient supply of oxygen to the combustion chamber and adequate temperature so that the combustion is complete thereby eliminating much of the smoke consisting of partly burnt ashes and dust.

2. To use mechanical devices such as **scrubbers, cyclones, bag houses and electro- static precipitators** in manufacturing processes. The equipment used to remove particulates from the exhaust gases of electric power and industrial plants are shown below. All methods retain hazardous materials that must be disposed safely. Wet scrubber can additionally reduce sulphur dioxide emissions.

3. The air pollutants collected must be carefully disposed. The factory fumes are dealt with chemical treatment.

**GASEOUS POLLUTION CONTROL:**

**ABSORBER**

Absorbers used for air pollution control use aqueous scrubbing liquids to remove gases and vapours. Absorber design has benefited substantially from the extensive development of these types of systems for process applications (non-pollution control) and is, therefore, a relatively mature technical field. The use of absorbers has increased since 1990 because of increased concerns about gaseous contaminants, which are classified as air toxic or volatile organic compounds (VOCs). In addition to stand-alone systems, absorbers are frequently used downstream of thermal and catalytic incinerators that generate acid gases because of the combustion of sulphur-containing and/or halogenated compounds.

**CATALYTIC CONVERTER**

Catalytic converter Catalytic converters (CAT) are designed to turn harmful constituents of exhaust emitted by internal combustion engines into harmless gases by means of a chemical reaction. A catalytic converter is therefore an important part of modern emission purification systems for SI and diesel engines. Function Catalytic converters (CAT) are designed to turn harmful constituents of exhaust emitted by internal combustion engines into harmless gases by means of a chemical reaction.

**Structure of Catalytic Converters**

A catalytic converter consists of a stainless-steel casing that houses a metallic (metalith) or ceramic (monolith) substrate. This substrate has a very large number of fine channels running through it along its length. The aim here is to create the greatest possible surface area to optimise the catalytic effect. The surface of the substrate is coated with a highly porous layer (washcoat) to which precious metals (platinum, palladium and/or rhodium) are added in suspension. It is these precious metals that are the actual catalysts initiating the chemical reactions required to purity the exhaust gases.

**EFFECTS OF AIR POLLUTION DUE TO REFRIGERANTS**

Globally, the production of cold housing is seen as a major energy challenge of this new century. The economic development of developing countries, submitted their majority in hot climates, will lead to a growing demand chilling requirements. Yet currently, the production of cold solutions is mainly based on **refrigeration systems** major consumers of electrical energy. It is then necessary to prepare socio-economically acceptable solutions tailored to meet those needs without compromising future international commitments on the protection of the environment, particularly for reducing greenhouse gas emissions and better protection of the ozone layer by use of refrigerants neutral. For some years now, because of their impact on the environment, the use of halogenated refrigerants has been progressively subject to quotas. In this context, the use of “natural” refrigerants becomes a possible solution.

There is the urgent need for substitution. Substitution is a basic rule in the prevention of chemical hazards. In the case of refrigerants, it can be a complex operation: many products are not harmful to human health, but are for the environment. Care should be taken to choosing a refrigerant with, overall, the fewest possible hazards (health, fire, environment), which again, may have to be compatible with existing refrigeration. It is essential to preserve the environment by reducing greenhouse gas emissions by replacing the cooling pollutants (HCFCs). This is essentially the refrigeration at low temperatures, below (-20°C), using solar thermal energy, to improve the quality of life for many people especially in arid and semi-arid areas of our country.

The speed of change of technology and patterns of living are quite rapid and produce unexpected results. For the entire world in recent times, the threat to human health and ecosystems due to these changes is alarming. This is why any delay in tackling the problems may likely lead mankind to the Biblical Armageddon. Refrigerant losses can be significantly minimized by overall good housekeeping and care in handling ODS containing units by users and maintenance technicians. In particular, education of the public through symposia, seminars, workshops etc. on the dangers of CFCs to human health is important for general appreciation of the magnitude of this problem. Most importantly, use of newly identified refrigerants as alternatives to CFCs in retrofitting applications must be encouraged. Finally, a gradual shift of refrigeration systems design and manufacture to new energy sources (solar, wind, etc.) powered options using non-polluting working substances would be rewarding on the long run.

**ICI BOILER**

**ICI boilers** emit pollutants such as hazardous air pollutants (HAPs), particle pollution, and volatile organic compounds (VOC). These pollutants can contribute to health problems that may affect employees, residents, and the community. While Federal, state, local, and Tribal regulations limit the amount of emissions from ICI boilers, dangerous releases of HAPs can occur if an ICI boiler does not operate in compliance with regulations.

Emissions from ICI boilers are a function of the type and quantity of primary fuel burned in the boiler unit, the type of boiler, and emissions controls.

Boilers emit a variety of pollutants, including those associated with combustion processes and HAPs, such as:

* + Nitrogen oxides (NOx).
	+ Sulfur dioxide (SO2).
	+ Particle pollution.
	+ Carbon monoxide (CO).
	+ Formaldehyde.
	+ Poly nuclear aromatic hydrocarbons (PAHs).
	+ Lead
	+ Hydrogen Chloride (HCl).
	+ Cadmium.
	+ Mercury.
	+ Dioxin/furans.
* Nitrogen Oxides
	+ Nitrogen oxides can react in the air to form acid rain, ground-level ozone (smog), and other toxic chemicals.
	+ Nitrogen oxides are one of the chief ingredients of ground-level ozone, which has been linked to a number of respiratory effects. EPA has developed a Web site on ground-level ozone as well as [nitrogen oxides](https://www.epa.gov/airquality/nitrogenoxides/index.html).
* Sulfur Dioxides
	+ Sulfur dioxides can react with other chemicals to form particle pollution, which can lodge deep in the lungs and cause respiratory problems and possibly death.
	+ Sulfur dioxides can cause temporary breathing difficulties for people who have asthma and are active outdoors.

**NOISE POLLUTION**

Noise contamination is an undesirable or hostile sounds that irrationally interfere into our day by day exercises. It has numerous sources, the majority of which are related with urban improvement like street, air, rail transport, modern noise , neighbourhood and recreational commotion. Various components add to issues of high noise levels, including expanding population and expanding commotion levels in a vehicle.

**Major causes / sources of noise pollution are:**

* Industrial Sources
* Transport Vehicles
* Household
* Public Address System
* Agricultural Machines
* Defence Equipment

**Measurement of Pollution Level**

The most common measurement in environmental noise is the dB(A) level. It can be measured with a simple Sound Level Meter having an A-weighting filter to simulate the subjective response of the human ear. The dB(A) level is used to report ambient noise and noise intrusions, it is also used in computing LAeq•T and LAN• T• Ambient noise should be measured with the Sound Level Meter switched to its "F" (Fast) time weighting. The range of ambient noise fluctuations should also be reported, e.g. 54 to 58 dB(A). When measuring noise intrusions, the maximum level should be reported, to assist in this some Sound Level Meters have a Max-Hold mode in which electronic circuitry captures and holds on display the highest measured dB(A) level. In automotive noise enforcement, the Max-Hold feature is an advantage because it does not require an experienced operator and the data is more credible in court testimony. Graphic Level Recorders are available for recording the noise history of transient events and of long-term environmental conditions.

**Effects of Noise Pollution on Human Health**

The impact of noise on human health is a matter of great concern. Noise pollution can affect us in several ways, some of which are listed below:

1. **Hearing Problems:** Exposure to noise can damage one of the most vital organs of the body, the ear. Hearing impairment due to noise pollution can either be temporary or permanent. When the sound level crosses the 70 db mark, it becomes noise for the ear. Noise levels above 80 decibels produce damaging effects to the ear. When ear is exposed to extreme loud noise (above 100 decibels) for a considerable period of time, it can cause irreparable damage and lead to permanent hearing loss.

**2. Poor Cognitive Function:** With regular exposure to loud noise, the ability to read, learn and understand decreases significantly over time. Problem solving capabilities and the ability to recall may also decline due to frequent bombardment of noise. Noise pollution can also increase the margin of error as well as hamper your productivity at office. Research has proved that children studying in noisy environment tend to show relatively low cognitive function. For instance, the cognitive status of children sent to schools that are in the close proximity of highways is less in comparison to those learning in quieter surroundings.

 **3. Cardiovascular Issues:** A noisy environment can be a source of heart related problems. Studies have shown that high intensity sound cause a dramatic rise in blood pressure as noise levels constrict the arteries, disrupting the blood flow. The heart rate (the number of heart beats per minute) also increases. This was evident in one study wherein the heart rate of children staying in noisy surroundings was measured. It was found to be more than the heart rate of children living in less noisy environment. These sudden abnormal changes in the blood increase the likelihood of cardiovascular diseases in the long run.

 **4. Sleep Disturbances:** Difficulty in sleeping due to exposure to high decibel noise can deter your overall well-being. It is a known fact that noise can interrupt a good night's sleep, and when this occurs, the person feels extremely annoyed and uncomfortable. People deprived of uninterrupted sleep show a sharp dip in their energy levels which often results into extreme fatigue. This can considerably decrease a person's ability to work efficiently.

**5. Trouble Communicating:** A noisy environment that produces more than 50-60 decibels simply does not allow 2 people to communicate properly. Interpreting the speech of a second person becomes quite difficult and may lead to misunderstandings.

**6. Mental Health Problems:** Exposure to loud sound can lead to elevated stress levels as well as stimulate violent behaviour. A constant noise in the vicinity can also trigger headaches, make people tense and anxious and disturb emotional balance.

**Noise Pollution (Regulation and Control Rules), 2000**

**3. Ambient air quality standards in respect of noise for different areas/zones.**

(1) The ambient air quality standards in respect of noise for different areas/zones shall be such as specified in the Schedule annexed to these rules.

 (2) The State Government (shall categorize) 5 the areas into industrial, commercial, residential or silence areas/zones for the purpose of implementation of noise standards for different areas.

(3) The State Government shall take measures for abatement of noise including noise emanating from vehicular movements, (blowing of horns, bursting of sound emitting fire crackers, use of loud speakers or public address system and sound producing instruments) 9 and ensure that the existing noise levels do not exceed the ambient air quality standards specified under these rules.

 (4) All development authorities, local bodies and other concerned authorities while planning developmental activity or carrying out functions relating to town and country planning shall take into consideration all aspects of noise pollution as a parameter of quality of life to avoid noise menace and to achieve the objective of maintaining the ambient air quality standards in respect of noise.

(5) An area comprising not less than 100 metres around hospitals, educational institutions and courts may be declared (by the State Government)14 as silence area/zone for the purpose of these rules. {Provided that, an area shall not fall under silence area or zone category, unless notified by the State Government in accordance with sub-rule (2).}14 4. Responsibility as to enforcement of noise pollution control measures.

(1) The noise levels in any area/zone shall not exceed the ambient air quality standards in respect of noise as specified in the Schedule.

(2) The authority shall be responsible for the enforcement of noise pollution control measures and the due compliance of the ambient air quality standards in respect of noise.

[(3) The respective State Pollution Control Boards or Pollution Control Committees in consultation with the Central Pollution Control Board shall collect, compile and publish technical and statistical data relating to noise pollution and measures devised for its effective prevention, control and abatement.]8 5. Restrictions on the use of loud speakers/public address system (and sound producing instruments) . 10

(1) A loud speaker or a public address system shall not be used except after obtaining written permission from the authority.

[(2) A loud speaker or a public address system or any sound producing instrument or a musical instrument or a sound amplifier shall not be used at night time except in closed premises for communication within, like auditoria, conference rooms, community halls or during a public emergency.]11

[(3) Notwithstanding anything contained in sub-rule (2), the State Government may subject to such terms and conditions as are necessary to reduce noise pollution, permit use of loud speakers or public address systems and the like during night hours (between 10.00 p.m. to 12.00 midnight) on or during any cultural, religious or festive occasion of a limited duration not exceeding fifteen days in all during a calendar year and the concerned State Government or District Authority in respect of its jurisdiction as authorized by the concerned State Government shall generally specify in advance, the number and particulars of the days on which such exemption should be operative.

**Explanation.**- *For the purposes of this sub-rule, the express*ions-

(i) “festive occasion” shall include any National function or State function as notified by the Central Government or State Government; and “National function or State function” shall include”- (A) Republic Day; (B) Independence Day; (C) State Day; or (D) such other day as notified by the Central Government or the State Government.]

(ii) “National function or State function” shall include”- (A) Republic Day; (B) Independence Day; (C) State Day; or (D) such other day as notified by the Central Government or the State Government.]

**SHORT QUESTION WITH ANSWER**

1. How do you define pollution?

Ans- Pollution is the introduction of harmful materials into the environment. Landfills collect garbage and other land pollution in a central locatio

1. what are the sources of natural pollutant?

Ans- Naturally occurring pollutants include ash, soot, sulphur dioxide, salt spray, volcanic, combustion gases, etc. These pollutants are released during volcanic eruptions, forest fires, and grass fires.

1. what is catalytic converter?

Ans -A catalytic converter is an essential part of a vehicle's exhaust system. It helps lower the number of toxic pollutants emitted into the air by converting hazardous combustion gases into less harmful substances, like water vapor and carbon dioxide

**LONG QUESTION**

1. What are the causes and effects of Air pollution?
2. What are the sources and effects of Noise pollution?
3. Write a note on Regulation and control Rules 2000?

 **Unit-3**

**Water and Soil pollution Sources of water Pollution-**

**Water pollution can come from many sources, including:**

Point sources: These have a single identifiable cause, such as a wastewater treatment plant, storm drain, or oil spill.

Non-point sources: These are more diffuse, such as agricultural runoff.

Industrial activities: These include mining, paper and pulp mills, and the use of chemicals to disinfect water.

Agricultural activities: These include the use of fertilizers and pesticides, and manure runoff.

Urban runoff: This includes storm water and salt runoff during winter.

Fossil fuel power plants: These are a source of diffuse pollution.

Radioactive waste: This can persist in the environment for thousands of years and can be released from nuclear energy facilities.

Petroleum pollution: This can come from oil spills or from oil from roads and parking lots that ends up in water bodies.

Natural causes: These include mercury filtering from the Earth's crust

**Types of water pollution**

Surface water pollution.

Water is the most precious resource in the world, integral to the survival of all life on Earth. Given that over 70% of the planet’s surface is covered by the stuff, it should perhaps logically follow that there is plenty to go around. However, various water pollution types render it unsafe for drinking, washing, bathing or swimming. Although not all forms of water contamination are manmade, very many are. Here’s a rundown of some of the chief offenders.

**Groundwater pollution**

Did you know that a significant proportion of the Earth’s water is stored in underground reservoirs? It’s for this reason that wells are dug to access the resource. When contaminants (such as fertilisers, pesticides, heavy metals and wastewater) are allowed to pollute the soil, they can penetrate far deeper and render groundwater supplies un portable and unusable. What’s more, the remote and widespread nature of this kind of contamination makes it virtually impossible to address.

**Chemical pollution**

Chemicals are used in a wide variety of anthropogenic activities, from protecting agricultural crops from pests and disease to manufacturing consumer goods to transporting and consuming energy sources such as oil and petrol. Inevitably, some of these chemicals find their way into the natural environment, either through agricultural run-off after heavy rainfall, accidental spillage or improper disposal of waste products. This can have a dramatic impact on water sanitation.

**Microbiological pollution**

Microbiological pollution refers to that which is caused by microorganisms within the water. This type of contamination largely occurs naturally and, on many occasions, the bacteria, protozoa and viruses are harmless or even beneficial to the ecosystems they inhabit. However, this is not always the case and some microbiological pollution can disrupt the delicate balance found in such environments, killing off plant and animal life and causing disease among humans which consume or use the water.

**Nutrient pollution**

Fertilisers, pesticides and other products used during agricultural processes often contain significant amounts of nutrients, such as phosphorous and ammonia. These are specifically used to protect crops from pests or disease, or else bolster their growth and maximise yields. When run-off sends these chemicals into water sources, they can cause an imbalance of nutrients, promoting the growth of some organisms (such as algae) to the detriment of others.

Suspended matter pollution

Although water is often dubbed the universal solvent, some particles of pollution are simply too large to mix with water molecules. This means that they either form a layer of floating silt atop the water’s surface, or else sink to its floor in the form of a thick mud. Either way, they can inhibit the growth of marine life beneath the waves and compromise the quality of the water in their vicinity, posing a risk to humans as well as animals.

For those interested in learning more about the topic of water pollution, the upcoming Water, Wastewater and Environmental Monitoring (WWEM) exhibition promises to be a great source of information. Scheduled to take place in Telford in the UK on the 12th and 13th October 2022, the exhibition will cover the subject from all angles

**CHARACTERISTICS OF WATER POLLUTANTS**

**Water pollutants can have a variety of characteristics, including:**

Appearance: Contaminated water may be cloudy, cooled, or have an oil film on it. Freshwater can also change colour from brown to yellow to black as it's exposed to the environment.

Smell: Contaminated water may have an odour, often of sulphur or chlorine.

Taste: Contaminated water may have a distinct taste, often metallic or bitter.

Temperature: Thermal pollution can cause water to become too hot, which can disrupt the water environment.

Chemical composition: Chloride ions are a major pollutant in drinking water.

Source: Water pollution can be caused by a variety of sources, including agriculture, domestic sewage, toxic waste, and oil spills.

Impact: Water pollution can have devastating impact on surroundings

Water molecules form hydrogen bonds and are extremely polar. The five main properties of water are its high polarity, high specific heat, high heat of vaporization, low density as a solid, and attraction to other polar molecules

**Turbidity**

Turbidity is a measure of how cloudy or muddy water is, and is an optical characteristic of water. It's a measure of the amount of particles, like sediment, plankton, or organic by-products, in a body of water

turbidity is the measurement of water clarity (i.e., transparency). Suspended particles – such as silt, algae, plankton, and sewage – can cause water to appear cloudy or murky. These particles scatter and absorb light rays rather than allowing light to be transmitted straight through the water.

**pH**

A simple definition is that it measures how acidic or basic a solution is. pH stands for potential of Hydrogen. It represents the ratio of Hydronium ions (H3O) to Hydroxide ions (OH). It is a measure of acidity and alkalinity of a solution.

A more scientific definition is that it indicates the concentration of hydrogen ions in a liquid. While a low pH indicates a higher concentration of hydrogen, a high pH indicates a lower hydrogen concentration.

Pure water has a pH of 7, which is considered neutral. The pH scale measures how acidic or basic water is, ranging from 0 to 14. A pH less than 7 indicates acidity, while a pH greater than 7 indicates a base.

Water has a neutral pH of 7, which indicates that it is neither acidic nor basic. The scale ranges from 0 (very acidic) to 14 (very basic). It is normal for water to have a range of between 6.5 and 8.5 on the scale.1 M

**TOTAL SUSPENDED SOLIDS**

Total suspended solids (TSS) are the dry weight of solid particles that are suspended in water and can be trapped by a filter. TSS can include sand, sediment, algae, bacteria, and other inorganic materials.

Definition

The dry weight of solid particles that are suspended in water and can be trapped by a filter

What it includes

Sand, sediment, algae, bacteria, and other inorganic materials

How it affects water

Decreases water clarity, and can interfere with aquatic life

How it's measured

An analytical test is used to determine the amount of TSS in a water sample

**TOTAL SOLIDS**

Total solids (TS) in water is the sum of dissolved solids, suspended solids, and settle able solids.

**BOD AND COD,Definition,calculation**

Biochemical oxygen demand (BOD) and chemical oxygen demand (COD) are both ways to measure the amount of oxygen consumed in water samples to determine the concentration of organic matter

**BOD**

Measures the amount of dissolved oxygen consumed by microorganisms as they break down organic matter in water. BOD is typically tested over a 5-day period.

**COD**

Measures the amount of oxygen consumed when a water sample is chemically oxidized. COD tests are faster than BOD tests and can be used on wastewater that is too toxic for BOD.

BOD is treated biologically

BOD is commonly treated by adding bacteria.

COD is higher than BOD

COD will always be higher than BOD because it measures the chemical breakdown of both organic and inorganic compounds.

COD can reduce DO

Low concentrations of COD can reduce dissolved oxygen (DO) in lakes and rivers, which can harm aquatic life.

BOD and COD are regulated

Many regulations and standards include limits on BOD or COD levels, depending on the intended use of the water.

BOD and COD are removed by treatment

Technologies for removing BOD and COD include aerobic treatment, which brings wastewater into contact with oxygen, and anaerobic treatment, which takes place without oxygen.

BOD is calculated using the formula BOD = (DO1 - DO2) \* Dilution Factor / Volume of Sample. The BOD value is reported in mg/L and indicates the amount of oxygen consumed by microorganisms in a water sample.

COD can be estimated using the formula COD = (C/FW)·(RMO)·32. This formula is based on the stoichiometric reaction of oxidizable compounds with oxygen.

The ratio of COD to BOD for a particular wastewater remains constant over time. For example, food processing wastewater typically has a COD:BOD ratio of around 2:1, while textile wastewater can have a ratio of around 5:1.

**Waste water Treatment**

Wastewater treatment is a process that removes contaminants from wastewater, making it safe to return to the environment or reuse. The process usually involves collecting wastewater at a treatment plant and treating it in various ways.

**Primary Method-**

The primary treatment process for wastewater removes floating objects, reduces pollution, and settles material by gravity. This process is the first of three phases of wastewater treatment, and it's designed to reduce the amount of Biochemical Oxygen Demand (BOD) and Total Suspended Solids (TSS) in the water.

**The primary treatment process includes the following steps:**

Screening: Large objects like sticks and rags are removed by machines called bar screens.

Grit chamber: Cinders, sand, and small stones settle to the bottom of the chamber.

Clarifiers: Wastewater sits in clarifiers to allow impurities to settle to the bottom or float to the top.

Skimming: Grease and oil are removed from the wastewater.

The solids and floatables are pumped to the anaerobic digestion process, while the remaining water flows to secondary treatment.

**SEDIMENTATION-**

Sedimentation is a water treatment process that uses gravity to remove suspended solids from water. It's a physical treatment that's used in both freshwater and wastewater treatment. Sedimentation is the process of allowing particles in suspension in water to settle out of the suspension under the effect of gravity. The particles that settle out from the suspension become sediment, and in water treatment is known as sludge.

The process of settling down of heavier insoluble particles at the bottom of a liquid is called sedimentation. The heavier insoluble particles that settle down at the bottom of the liquid are called sediments

Sedimentation is a common way of treating water. It is a process that removes solids that float and settle in the water. The process relies on the use of sedimentation tanks that remove larger solids

**FROTH FLOATATION**

Froth flotation is a process that separates hydrophobic materials from hydrophilic materials using air bubbles. It's used in a variety of industries, including mineral processing, paper recycling, and wastewater treatment**.**

Froth flotation is a process for selectively separating hydrophobic materials from hydrophilic. This is used in mineral processing, paper recycling and waste-water treatment industries. Historically this was first used in the mining industry, where it was one of the great enabling technologies of the 20th century.

The flotation process encompasses a series of steps: grinding the ore to a size giving reasonable liberation of valuable and gangue materials; making conditions favourable for the adherence of the desired minerals or valuable to air bubbles, which is usually done by chemical means; creating a rising current of air ...

SECONDARY METHODS

Secondary water treatment is a biological process that reduces organic matter in wastewater before it's released into the environment. This process uses bacteria and other microorganisms to consume organic matter and convert ammonia into nitrate. Secondary treatment is also called biological treatment.

**Some secondary water treatment techniques:**

Trickling filter: Sewage passes through a bed of stones that's three to six feet deep.

Activated sludge process: Wastewater flows through a series of chambers in large rectangular tanks called aeration basins, where it's mixed with millions of microorganisms. Air bubbles are added to the water, making it look like it's boiling.

Anaerobic filters: Organic pollutants break down in slime, and the gas produced is collected. This method works best with diluted wastewater.

Secondary treatment produces a higher quality effluent than a septic tank.

Secondary treatment involves the removal of biodegradable organic matter (BOD) and suspended solids (TSS) through the processes of aeration and filtration. Secondary treatment is typically characterized as producing a treated wastewater effluent with a BOD of 25 mg/L or less and TSS of 30 mg/L or less**.**

Secondary Wastewater treatment is the second stage of wastewater treatment. In primary treatment, suspended solids, colloidal particles, oil, and grease are removed. In secondary treatment, biological treatment is done on the wastewater to remove the organic matter present. This treatment is performed by indigenous and aquatic micro-organisms like bacteria and protozoa which consume biodegradable soluble contaminants like sugar, fat, detergent, and food waste. These processes are sensitive to temperature and with an increase in temperature, the rate of biological reactions increases.

Secondary Wastewater treatment is divided into two different treatment processes:-

1. Aerobic Treatment: Aerobic wastewater treatment is a biological treatment that uses oxygen to break down organic matter and remove other pollutants like nitrogen and phosphorus. Aerobic treatment technologies are:

Activated Sludge Process (ASP) / Extended Aeration System (EAS)

Sequential Batch Reactor (SBR)

Moving Bed Bio Film Reactor (MBBR)

Membrane Bioreactor (MBR)

Activated Sludge Treatment

2. Anaerobic Treatment: Anaerobic treatment is a process where wastewater or material is broken down by micro-organisms without the aid of dissolved oxygen. However, anaerobic bacteria can and will use oxygen that is found in the oxides introduced into the system or they can obtain it from organic material within the wastewater. Anaerobic treatment technology is Up-flow Anaerobic Sludge Blanket Reactor (UASB)

**TRICKLING FILTER**

A trickling filter is a wastewater treatment system that uses a fixed bed of media to remove organic matter from wastewater**:**

**How it works**

Pre-settled wastewater is sprayed over the filter media, where microorganisms grow and break down the organic matter.

What it's made of

The filter media can be made of rocks, gravel, slag, polyurethane foam, sphagnum peat moss, ceramic, or plastic.

**How it's designed**

Trickling filters are designed to allow air to penetrate, which promotes aerobic microbial growth in the upper layers and anaerobic growth in the lower layers.

**Types**

Trickling filters can be classified as high rate or low rate, depending on the organic and hydraulic loading applied to the unit.

Uses

Trickling filters can treat municipal and hazardous wastes, as well as wastewater from a variety of industrial processes.

Bioreactor

Bioreactors are chambers in wastewater treatment systems that support the growth of bacteria and protozoa, which consume substances in the wastewater. There are several types of bioreactors, including**:**

**There are several types of bioreactors, including:**

**Membrane bioreactor (MBR)**

Combines a biological system with a membrane process to treat wastewater. MBRs use activated sludge to convert particle waste into flocs, which are then separated into solid and liquid phases by the membrane.

Extractive membrane bioreactor (EMBR)

Uses a membrane to remove toxic compounds from wastewater and gases. EMBRs are considered an advanced process that improves sludge quality and biological stability.

Uses living material to capture and biologically degrade pollutants. Biofilters can be used to process wastewater, capture harmful chemicals, and more.

The bioreactor reduces the liquid component in the waste mixture that then provides an opportunity to treat the remaining with an activated sludge process. The filtration unit with the MBR is usually either an internal or submerged system or the external side stream system**.**

**TERITARY METHOD**

Tertiary treatment of wastewater is a process that uses advanced treatment systems to remove contaminants that secondary treatment was unable to clean. It's the final step in the wastewater treatment process, after primary and secondary treatment.

Tertiary treatment is important for improving the quality of treated water before it's released into the environment. It's used in many situations, including: Public water supplies, discharging water into sensitive aquatic ecosystems, Industrial pulp and paper applications, and Textiles manufacturing.

Tertiary treatment can involve a combination of physical and chemical processes, such as:

Filtration: Rotary drum filters are often used to separate liquids and solids.

Alum: Can be used to remove phosphorus particles and cause solids to group together so they can be removed by filters.

Carbon adsorption: A physical-chemical separation technique.

Flocculation/precipitation: A physical-chemical separation technique.

Ion exchange: A physical-chemical separation technique.

DE chlorination: A physical-chemical separation technique.

Reverse osmosis: A physical-chemical separation technique.

Tertiary treatment adds a third, more advanced and rigorous level of treatment. Primary and secondary treatment typically get wastewater only clean enough to discharge safely into the environment. Tertiary treatment, on the other hand, can achieve levels of water purification that make the water safe for reuse in water-intensive processes or even as drinking water.

Not all wastewater treatment plants use tertiary treatment. Primary and secondary treatment are often sufficient for many purposes. Those that do use tertiary treatment achieve more stringent levels of cleanliness to meet the exacting standards that govern water reuse, especially in public water supplies. Tertiary treatment is also beneficial when facilities must discharge water into sensitive aquatic ecosystems such as estuaries, sluggish rivers or waters close to coral reefs.

It is more effective than primary or secondary treatment at removing unwanted cooler from wastewater, so it is essential in industrial pulp and paper applications and textiles manufacturing.

**MEMBRANE SEPARATION TECHNOLOGY**

Membrane separation technology is a scientific process that uses semipermeable membranes to separate components in a solution or gas and liquid streams. The membranes can be made of a variety of materials, including ceramic, metal, or polymeric films.

The main membrane separation technologies include microfiltration, ultrafiltration, reverse osmosis and Nano filtration, electro dialysis, gas-separation and evaporation [1].

What are the four types of membrane separation?

Types of pressure-driven membrane separation techniques are categorized according to membrane pore size, which, in turn, dictates the degree of separation achieved. These categories are microfiltration (MF), ultrafiltration (UF), Nano filtration (NF), and reverse osmosis (RO).

**REVERSE OSMOSIS**

Reverse osmosis (RO) is a water purification process that uses a semipermeable membrane to remove contaminants from water. It works by applying pressure to water, forcing it through the membrane and leaving behind contaminants.

Reverse osmosis (RO) is a water purification process that removes ions, unwanted molecules and larger particles from drinking water using a partially permeable membrane. As a result, the solute is kept on the membrane's pressurised side and the pure solvent is allowed to pass to the other side.

**How does Reverse Osmosis work?**

An easy experiment can be conducted by taking some freshwater and a concentrated aqueous solution. The solutions should be kept on opposite sides with a semipermeable membrane placed in between to separate the two solutions. Pressure should be applied on the side with the concentrated solution. Now this will result in water molecules moving through themembrane to the freshwater side. This basically sums up the process of reverse osmosis.

Benefits of Reverse Osmosis

Some of the benefits of reverse osmosis are discussed below.

This process can be used to effectively remove many types of dissolved and suspended chemical particles as well as biological entities (like bacteria) from the water.

This technique has a wide application in treating liquid wastes or discharges.

It is used in purifying water to prevent diseases.

It helps in desalinating seawater.

It is beneficial in the medical field.

Advantages of Reverse Osmosis

Reverse Osmosis has several advantages, including the following:

Bacteria, viruses and pyrogenic materials are rejected by the intact membrane. In this respect, RO water approaches distilled water in quality.

Available units are relatively compact and require little space. They are well suited to home dialysis.

In average use, the membrane has a life of a little more than one to two years before replacement is necessary.

Periodic complete sterilization of the RO system with formalin or other sterilant is practical.

Disadvantages of Reverse Osmosis

The disadvantages of RO systems include the following;

Cellulose acetate membranes have limited pH tolerance. They degrade at temperatures greater than 35oC. They are vulnerable to bacteria. They eventually hydrolyse.

Polyamide membranes are intolerant of temperatures greater than 35oC. They have poor tolerance for free chlorine.

Thin-film composites are intolerant of chlorine. High flux polysulfide’s require softening or deionization of feed water to function properly.

**CAUSES, EFFECTS AND PREVENTIVE MEASURES OF SOIL POLLUTION.**

Soil pollution is caused by a variety of human activities, including:

Agriculture: The use of chemical fertilizers, pesticides, and herbicides in intensive farming practices can contaminate soil.

Industrial waste: Industrial waste dumping can contaminate soil.

Mineral utilization: Mineral oil can seep into the soil, clogging pores and reducing oxygen supply.

Deforestation: The lack of tree roots can lead to soil erosion and runoff, which can contaminate water supplies.

Improper waste disposal: Landfills and dumpsites can leach harmful substances into the soil.

Soil pollution can have a number of consequences, including:

Air pollution

Contaminated soil can release volatile compounds into the atmosphere, contributing to air pollution.

Reduced soil fertility and biodiversity

The use of chemical fertilizers, pesticides, and herbicides can affect soil fertility and biodiversity.

Some ways to prevent soil pollution include:

Educating yourself: Learn about the causes and effects of soil pollution, and how to stop it.

Reforestation: Reforestation is an effective way to prevent soil pollution.

Reducing paper usage: Reducing paper usage or using recycled paper can help reduce deforestation**.**

**What is Soil Pollution?**

Soil pollution refers to the contamination of soil with anomalous concentrations of toxic substances.

It is a serious environmental concern since it harbours many health hazards. For example, exposure to soil containing high concentrations of benzene increases the risk of contracting leukaemia. An image detailing the discolouration of soil due to soil pollution is provided

**Excessive use of fertilizers and pesticides**

The excessive use of fertilizers and pesticides can cause a number of environmental and health problems, including:

Soil pollution: The chemicals from fertilizers and pesticides can contaminate soil, air, and water.

Reduced soil fertility: Excessive use of fertilizers can harden soil and reduce its fertility.

Eutrophication: Excessive use of fertilizers can cause eutrophication in bodies of water.

Greenhouse gas emissions: The breakdown of fertilizers by bacteria releases nitrous oxide, a greenhouse gas.

Damage to non-target organisms: Pesticides can damage plants, birds, mammals, fish, and crops.

Human health problems: Pesticides can cause short-term effects like headaches and nausea, and long-term effects like cancer and reproductive harm.

Reduced field productivity: Excessive use of fertilizers and pesticides can reduce field productivity.

Changes in soil pH: Excessive use of fertilizers and pesticides can change the pH of soil.

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Reduced field productivity: Excessive use of fertilizers and pesticides can reduce field productivity.

**Use of insecticides**

* Insecticides are chemicals used to kill insects. Some insecticides are also dangerous to humans. Many insecticides can cause poisoning after being swallowed, inhaled, or absorbed through the skin. Symptoms may include eye tearing, coughing, heart problems, and breathing difficulties.
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* Many insecticides can cause poisoning after being swallowed, inhaled, or absorbed through the skin.
* Symptoms may include eye tearing, coughing, heart problems, and breathing difficulties.
* The diagnosis is based on symptoms, blood tests, and a description of events surrounding the poisoning.
* Several drugs are effective in treating serious insecticide poisonings

**Irrigation**

Irrigation is the practice of supplying water to land in a controlled way to help plants grow. It's been used for over 5,000 years and has been developed by many cultures around the world.

Irrigation is the artificial application of water to the soil through various systems of tubes, pumps, and sprays. Irrigation is usually used when natural water sources and rain are not sufficient to provide plant water demand and in areas where rainfall is irregular or dry times or drought is expected

* Irrigation water can come from groundwater, springs or wells, surface water, rivers, lakes, or reservoirs, or even other sources, such as treated wastewater or desalinated water.
* It is critical that farmers protect their water sources and minimize the potential for overuse and contamination. As with any groundwater removal, users of irrigation water need to be careful not to pump groundwater out of an aquifer faster than it is being recharged.
* Food security
* With a growing population around the world and growing demand for food, the farming industry must be able to meet those demands. Without irrigation, this seems impossible. To ensure food security, farmers have to adopt the latest and most advanced technologies, namely irrigation and fertigation.

**E-waste**

* E-waste, or electronic waste, is the term for discarded electrical and electronic devices. It's also known as waste electrical and electronic equipment (WEEE) or end-of-life electronics. Every year millions of electrical and electronic devices are discarded as products break or become obsolete and are thrown away. These discarded devices are considered e-waste and can become a threat to the environment and to human health if they are not treated, disposed of, and recycled appropriately.
* How can we recycle e-waste?
* What is E-Waste? E-Waste Management
* The e waste recycling process involves disassembling and separating electronic devices into their individual components. Materials such as copper, aluminium, glass, and plastic are extracted and recycled to produce new products, while hazardous materials such as lead, cadmium, and mercury are safely disposed of.

SHORT QUESTION WITH ANSWER

1.What are the sources of water pollution?

Ans- 1. Water pollution is caused by a variety of sources including human activities, natural causes and accidental spills

2. What do you mean by BOD and COD?

Ans- 2. BOD, bio-chemical oxygen demand and COD, chemical oxygen demand are both measurements of water quality

3. What do you mean by pH?

Ans- pH stands for potential of Hy drogen . It is a measure of acidity and alkalinity of a solution.

LONG QUESTION

1. what are the effects of water pollution?

2. what are the control measures of water pollution?

3. what are the causes, effects and preventive measures of soil pollution?

ANSWER OF SHORT QUESTION

1. Water pollution is caused by a variety of sources including human activities,natural causes and accidental spills.
2. BOD, bio-chemical oxygen demand and COD, chemical oxygen demand are both measurements of water quality.
3. pH stands for potential of Hydrogen . It is a measure of acidity and alkanity of a solution.

**Unit-04**

**Renewable energy resources and efficient process of harvesting**

**SOLAR ENERGY**

* Solar energy is the radiant light and heat from the sun that can be harnessed to generate electricity and heat. It can be captured using a variety of technologies, including solar panels, solar thermal energy, and solar architecture.
* Solar power is energy from the sun that is converted into thermal or electrical energy. Solar energy is the cleanest and most abundant renewable energy source available, and the U.S. has some of the richest solar resources in the world.

**Basics of solar Energy**

* Solar energy is energy from the Sun, which can be harnessed in several ways. Solar panels use the photovoltaic effect to generate electricity directly from sunlight. The Sun’s heat can be used directly to heat water or air, or it can be concentrated to boil water, driving steam turbines that generate electricity. Solar energy is a form of renewable energy.
* Solar power generation is most effective in places that have a lot of direct sunlight throughout the year. Low-latitude, desert areas are ideal, such as southern California, Arizona, and Nevada. However, most areas of the United States are sunny enough to use solar energy to some extent. Solar energy is only available when the sun is shining, so even in the sunniest places, night-time energy needs must be provided by other energy sources. Scientists and engineers are working to develop advanced batteries to store energy generated from solar power and therefore make solar energy usable 24 hours a day.

**Flat plate collector**

* A Flat plate collector is a solar panel device that uses solar energy to generate thermal energy. It converts solar power into thermal energy, i.e., cheaper energy utilising water as an operating fluid.
* A Flat plate solar collector takes in solar radiation and transmits heat to the functioning medium. It is suitable for several thermal applications. The average temperature range of FPC devices is 100° C. Besides, these devices have an economical cost of investment.
* The FPC devices are the backbone of solar thermal devices. They have diverse applications from household to commercial sectors. Flat plate collector devices are commonly used for active space heating and water heating for further usage.

**How does A Flat Plate Collector Work?**

* The working of a flat plate collector (FPC) involves the transfer of heat or thermal energy. The operating medium exchanges heat from the sun’s rays.
* An unglazed liquid flat plate collector is not covered and, due to increased heat losses, is often used for lower temperature applications such as pool heating. Air flat plate collectors typically consist of a glazed, insulated metal box with a dark metal absorber plate.

**Theory of flat plate collector**

A Flat plate collector is a solar panel device that uses solar energy to generate thermal energy. It converts solar power into thermal energy, i.e., cheaper energy utilising water as an operating fluid.

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**Importance of coating**

Coating a flat plate collector is important because it can:

Increase efficiency

A coating can improve the performance of a flat plate collector by increasing the amount of energy that is transmitted through the glass cover.

Reduce heat loss

A selective coating on the absorber plate can help prevent heat loss from radiation.

Increase useful energy gain

A coating on the inner surface of the cover plate can reduce top heat loss, which increases the useful energy gain.

Here are some other things to consider about flat plate collectors:

Glazing

A glazed cover can create a greenhouse effect, trapping infrared radiation and reducing heat loss. This makes glazed collectors more efficient for applications that require higher temperatures, like space heating or domestic hot water.

* The heat-absorbing plate of the collector is exposed to sunlight. As the sun rays hit the flat plate surface, a portion of their energy is transformed into heat. This leads to a rise in the temperature of the flat plate solar collector.
* When a fluid is passed inside the collector, the temperature of the fluid increases as the heat from the absorbing plate heat is transmitted to the fluid.
* Eventually, the fluid transmits the thermal energy from collectors to the functioning energy systems for different uses. It works on the principles of the 1st & 2nd Laws of Thermodynamics. activities. It includes burning of fossil fuels in industries, vehicles and thermoelectric plants, gaseous emission from industries, mining, processing and stone crushing.Resources: Growing energy need, renewable and non-renewable energy sources, use of alternate energy sources, case studies.
* Land Resources: Land as a resource, land degradation, man induces landslides, soil erosion, and desertification.

B) Role of individual in conservation of natural resources.

c) Equitable use of resources for sustainable life styles.

**Solar pond**

A solar pond is a solar energy collector, generally fairly large in size, that looks like a pond. This type of solar energy collector uses a large On the other hand, man made source of air pollution include:

Solar Ponds are solar thermal energy systems that collect and store solar energy, thereby providing a sustainable source of heat and power. These are typically sizable human-made bodies of water that use the sun's heat as a stable temperature source in areas where traditional cooling technologies cannot be implemented. As you already know man-made sources of pollution, it’s time to discuss their impact on our health and well-being. Note that long-term exposure to harmful substances may cause:

**History of Solar Ponds**

Around the last century, the solar pond was discovered as a natural phenomenon in the Medve Lake in Transylvania, Hungary, as Kalecsinsky (1902) noted.

In 1963, a pond feasibility study was conducted by Tabor to check power generation. He achieved a temperature for small ponds up to 90°C, however, there were technical problems encountered for larger ponds.Consequently, Rabl and Nielsen studied the solar pond as a solution to space heating of residences in Ohio and similar areas in 1975.

Rabl calculated that a pond equal in volume to a well-insulated three-bedroom home could meet all of the winter space heat requirements of that home. Nielsen developed a unique salt gradient establishment procedure using a small pool and laboratory models.

Rabl and Nielsen's previous work, a full-scale experimental solar pond designed to meet all winter heat requirements, was built next to the Department of Agricultural Engineering Greenhouse Some of the natural sources of air pollution are organic compounds from plants, sea salt, suspended soils and dusts (e.g. from the Sahara).

**How It Works**

Solar ponds work based on a fundamental principle. When the sun's rays heat the water in an ordinary pond, the heated water becomes lighter and rises upward, losing its heat in the atmosphere. This means that the pond water remains at its atmospheric temperature.However, the Solar pond prevents this occurrence by dissolving salt in the bottom layer of the pond, which makes the water heavier and unable to rise.

Simply, solar ponds work by using the sun to collect solar radiation and absorb it as heat, which is stored in the top layers of the pond. It is used to provide temperature stability, allowing Types of Solar PondsWith the various types of Solar Ponds, there are two classifications for each type, convicting and non-convicting Solar Ponds.

**Convicting Solar Pond**

In a convicting Solar Pond, the gradient zone is separate from the top and bottom zones, allowing heat to transfer from top to bottom without assistance from the gradient zone.Solar Ponds of this type are very inefficient, as Solar Pond heat must be transferred from the top zone to Solar Pond's bottom zone before being used. Covering the pond's surface prevents heat loss since no evaporation takes place.

Shallow Solar Ponds - also known as Solar Dip Ponds, both the Solar Pond top and Solar Pond bottom zones are shallow and separated by the gradient zone. Solar ponds of this type have a top zone that only covers the gradient zone. Solar Dip Ponds quickly reach maximum temperature since heat is not transferred through a thermal diode.

**Non-Convicting**

A Solar Pond of this type has both Solar Pond top and Solar Pond bottom zones that are shallow, yet the Solar Pond gradient zone is deep.

This reduces heat loss by preventing the transfer of heat from one place to another by the movement of fluids with a concentration of 20–30 percent salt to the bottom level.

Partitioned Solar Ponds - have gradient zones that are divided, separating the top and bottom zones. Partitioning allows for more gradual temperature changes within the pond, making solar ponds of this type less likely to fluctuate in temperature.

Viscosity Stability Solar Ponds - for this type, the gradient zone is made up of a mixture of salt and water with high viscosity and density. This Solar Pond's gradient zone provides Solar Pond heat for more extended periods by preventing Solar Pond heat from escaping from the bottom and top zones.

Membrane Stratified Solar Ponds - have two Solar Pond layers that create a gradient zone where the top and bottom zones are separated by a membrane with extremely thin pores, allowing for efficient heat transfer and retention over extended periods. They transfer heat through convection currents created by Solar Pond water flowing through the membrane.

Membrane Viscosity Stabilized Solar Ponds - have gradient zones stabilized using a chemical compound that prevents heat from transporting from the bottom to the top. Solar ponds of this type are not as efficient as other types, but these Solar Ponds often have a lifespan of 30 – 50 years due to their high durability.

Salt Gradient Solar Ponds (SGSP) - have gradient zones made up of a mixture of water and salt. Solar pond heat transfers through the gradient zone due to convection currents created by Solar Pond's salinity. These Solar Ponds do not require dividers, as the heat can still be prevented.

Saturated Solar Ponds- have top and zones that are shallow and separated by the gradient zone. Solar ponds of this type hold heat over extended periods due to the high viscosities of the water.

**Benefits and Drawbacks of Solar Ponds**

The following are the benefits of using a solar pond.

* It can be constructed at a minimal cost.
* The built-in thermal energy storage allows it to be used all year round, regardless of season and weather.
* An alternative to fossil fuel technologies.

Energy derived from a solar pond is more cost-effective.

It is safe for the environment since it does not emit harmful toxins and pollutants while conserving traditional energy resources.

However, using solar ponds also has drawbacks.

Since it requires a large piece of land to be constructed, it may be unsuitable for populated areas.

It requires a high level of solar energy input.

It needs to be supplied with an extensive reservoir of water.

Constant maintenance is required even if any qualified engineer can construct it.

**Solar Water Heating System**

Solar water heating system is a device that helps in heating water by using the energy from the SUN. This energy is totally free. Solar energy (sun rays) is used for heating water. Water is easily heated to a temperature of 60-80o C. Solar water heater of Solar water heaters (SWHs) of 100-300 litters capacity are suited for domestic use. Larger systems can be used in restaurants, canteens, guest houses, hotels, hospitals etc. A 100 litter’s capacity SWH can replace an electric geyser for residential use and may save approximately 1500 units of electricity annually. The use of 1000 SWHs of 100 litter’s capacity each can contribute to a peak load saving of approximately 1 MW. A SWH of 100 litter’s capacity can prevent emission of 1.5 tons of carbon dioxide per year.

Main Components of Solar Water Heating System

Main components of solar water heater system are

Solar Collector (to collect solar energy)

Insulated tank (to store hot water)

Supporting stand

Connecting pipes and instrumentation etc**.**.

**Applications of Solar Water Heater**

Water heating is one of the most cost-effective uses of solar energy. Every year, several thousands of new solar water heaters are installed worldwide. Solar water heaters can be used for Homes, Community Centers, Hospitals, Nursing homes, Hotels, Restaurants, Dairy plants, Swimming Pools, Canteens, Ashrams, Hostels, Industry etc. Use of solar water heater can curtail electricity or fuel bills considerably.

Usage of solar water heater for any application where steam is produced using a boiler or steam generator can save 70-80% of electricity or fuel bills. A residence can save 70-80% on electricity or fuel bills by replacing its conventional water heater with a solar water heating system. Solar water heaters are known to have the fastest repayment of investment in 2 to 4 years depending upon use and fuel replaced.

**Types of Solar Water Heater**

Basically two types of solar water heater are available in the market

Flat Plate solar water heater – Solar radiation is absorbed by flat plate collectors which consist of an insulated outer metallic box covered on the top with glass sheet.

Evacuated Tube Collector – The Collector is made of double layer borosilicate glass tubes evacuated for providing insulation**.**

**SOLAR DRYER**

A **solar dryer** is another technology to harness the solar energy that is used to dry fruits, vegetables, and crops for preservation. Solar dryers are of two ...)

Solar dryers are used to eliminate the moisture content from crops, vegetables, and fruits. The solar dryer consists of a box made up of easily available and cheap material like cement, galvanized iron, brick, and plywood. The top surface of the dryer is covered by transparent single and double-layered sheets**.**

**Highlights**

* Solar drying showed significant influences on commercial, ecological, and social features.
* Hybrid drying systems are encouraging and practicable when contrasted with other kinds.
* Solar dryers of various categories are accessible, depending on the individual conditions.
* Advanced modelling is paramount for creating next-generation drying technologies.
* Economical and practical potentialities

**SOLAR STILLS**

Solar still is a device to desalinate impure water like brackish or saline water. It a simple device to get potable/fresh distilled water from impure water, using solar energy as fuel, for its various applications in domestic, industrial and academic sectors.

**PRINCIPLE OF SOLAR STILLS**

This technology is based on the simple evaporation-condensation principle by the virtue of which the sun evaporates the sea-water and then condenses it to culminate into pure rain water. Saline water is fed into the tank which is exposed to the sun. The black bottom of the tank absorbs solar energy and gets heated.

**OBJECTIVE OF SOLAR STILLS**

A solar still is a simple device which can be used to convert saline, brackish water into drinking water. Solar stills use exactly the same processes which in nature generate rainfall, namely evaporation and condensation.

**BENEFITS OF SOLAR STILLS**

Solar stills are a simpler and more effective method for smaller units because they're low-cost. Solar water treatment is a viable solution for cleaning a variety of water sources, including seawater, groundwater, surface water, and various types of wastewater, such as pharmaceutical, industrial, and urban.

**TYPES OF SOLAR STILLS**

In this experimental work, four different solar stills (SSs) have been tested. The SS systems are conventional SS (CSS), Double Slope SS (DSSS), Pyramid SS (PSS) and Tubular SS (TSS).

**BIOMASS**

Biomass is renewable organic material that comes from plants and animals. Biomass can be burned directly for heat or converted to liquid and gaseous fuels through various processes.3The following sections provide a quick overview of the major gaseous pollutants that are regulated or are precursors to regulated pollutants.

**WHERE IS BIOMASS USED**

Biomass is used for heating and electricity generation and as a transportation fuel. Biomass is an important fuel in many countries, especially in developing countries for cooking and heating.

Biomass is an important fuel in many countries, especially in developing countries for cooking and heating. Biomass sources for energy include: Wood and wood processing waste—firewood, wood pellets, and wood chips, lumber and furniture mill sawdust and waste, and black liquor from pulp and paper mills

**THERMAL CHARACTERISTICS OF BIOMASS AS FUEL**

**.** Several characteristics affect the performance of biomass fuel, including the heat value, moisture level, chemical composition, and size and density of the fuel. These characteristics can vary noticeably from fuel to fuel. In addition, natural variations of a given fuel type can be significant

We use four types of biomass today—wood and agricultural products, solid waste, landfill gas and biogas, and alcohol fuels (like Ethanol or Biodiesel). Most biomass used today is home grown energy.

**Anaerobic digestion**

Anaerobic digestion is a process through which bacteria break down organic matter—such as animal manure, wastewater bio solids, and food wastes—in the absence of oxygen.

**Anaerobic process**

Anaerobic digestion is a process through which bacteria break down organic matter—such as animal manure, wastewater bio solids, and food wastes—in the absence of oxygen**.**

**EXAMPLES**

A range of anaerobic digestion technologies are converting livestock manure, municipal wastewater solids, food waste, high strength industrial wastewater and residuals, fats, oils and grease (FOG), and various other organic waste streams into biogas, 24 hours a day, 7 days a week.

**BIOGAS PRODUCTION MECHANISM**

The organic matter naturally decomposes inside the landfill, i.e. inside a pit in the land, and biogas is produced by the activity of the microbes. The Methane bacteria present in the organic waste decompose the waste and produce the mixture of gases known as biogas.

**STAGES OF BIOGAS PRODUCTION**

Biogas is produced by anaerobic bacteria that degrade organic matter in four general stages: hydrolysis, acidification, acetic acid production, and methane production. The gas phase product of anaerobic digestion is named biogas and its yield depends significantly on the substrate (raw material).

**PRINCIPLES OF BIOGAS PRODUCTION**

The working of a biogas plant is, the biomass is mixed with water and then is decomposed by the anaerobic bacteria into the products like gasses (methane, hydrogen, carbon dioxide) and the other side products (manure, fertilizers).

**Stages in biogas production**

Bio waste is crushed into smaller pieces and slurrified to prepare it for the anaerobic digestion process. ...

Microbes need warm conditions, so the bio waste is heated to around 37 °C.

The actual biogasproduction takes place through anaerobic digestion in large tanks for about three weeks.

**Biogas Utilization**

Biogas can be used readily in all applications designed for natural gas such as direct combustion including absorption heating and cooling, cooking, space and water heating, drying, and gas turbines**.**

Biogas a renewable fuel that's produced when organic matter, such as food or animal waste, is broken down by microorganisms in the absence of oxygen. This process is called anaerobic digestion. For this to take place, the waste material needs to be enclosed in an environment where there is no oxygen

**HOW IS BIOGAS STORED**

. The primary aims of biogas storage are on-site usage and before or after transportation to off-site distribution systems. Several modes of storage include low-pressure balloons, high-pressure storage cylinders, gas pipeline and low-pressure storage vessels

Biogas storage volumes vary from 20 m3 to 10.000 m3. The MSE biogas balloon has a ¾ or hemisphere shape

**WIND ENERGY; CURRENT STATUS AND FUTURE PROSPECTS OF WIND ENERGY**

**WIND ENERGY**:-

The moving air has huge amount of Kinetic energy and this can be transferred into electrical energy.

Wind turbines converts the Kinetic energy into mechanical power and a generator can converts this mechanical power into electricity.

Wind turbine costs are assumed to decrease by 10% to 12% between 2010 and 2020, and wind turbine performance, or capacity factor, is assumed to increase to 50%, up from today's capacity factors of 35%, by the year 2030.

The Indian offshore wind market is expected to accelerate towards 2027 with annual installations increasing from 1.8 GW in 2022 to 2.8 in 2023, 3.7 GW in 2024, and peaking at 5 GW in 2025 in the base case. Overall, India's wind market offers an opportunity for 21.1 GW of installations from 2023-2027.

Wind power accounts for nearly 10% of India's total installed utility power generation capacity and generated 71.814 TWh in the fiscal year 2022–23, which is nearly 4.43% of total electricity generation. The Muppandal Wind Farm, located in Muppandal, Kanyakumari district, Tamil Nadu, is India's largest operational onshore wind farm. The project was developed by Tamil Nadu Energy Development Agency.

 **WIND ENERGY IN INDIA**

India has the fourth largest installed wind power capacity in the world. Wind power capacity is mainly spread across the southern, western, and north-western states. The onshore wind power potential of India was assessed at 132 GW with minimum 32% CUF at 120 m above the local ground level (

STATE TOTAL CAPACITY (MW)

KARNATAKA 5,303.05

RAJASTHAN 5,193.42

MAHARASHTRA 5,026.33

ANDHRA PRADESH 4,096.65.

Tamil Nadu is the largest producer of wind energy in India, with an installed capacity of over 10 GW as of 2021. The state has been a leader in developing wind energy in India, with favourable wind conditions along its coastline

**ENVIRONMENTAL BENEFITS AND PROBLEM OF WIND ENERGY**

. Wind is a renewable energy source. Overall, using wind to produce energy has fewer effects on the environment than many other energy sources. Wind turbines do not release emissions that can pollute the air or water (with rare exceptions), and they do not require water for cooling.

**Environmental benefits**

Generating energy from the wind does not release any carbon emissions. By replacing electricity generated from other sources such as fossil fuel power stations, wind energy can lead to an overall reduction in carbon emissions**.**

**PROBLMS**

Wind power must compete with other low-cost energy sources. ...

Ideal wind sites are often in remote locations. ...

Turbines produce noise and alter visual aesthetics. ...

Wind plants can impact local wildlife

**Pros Of Wind Energy Cons Of Wind Energy**

Renewable & clean source of energy Intermittent

Low operating costs Noise and visual pollution

Efficient use of land space Some adverse environmental impact

Wind energy is a job creator Wind power is remote

Low operating costs Noise and visual pollution

Efficient use of land space Some adverse environmental impact

Wind energy is a job creator Wind power is remote

**NEW ENERGY SOURCES**

New resources that are being researched or developed include hydrogen, nuclear fusion, ocean thermal energy conversion, and tidal and wave energy.

**Types of renewable energy**

Solar energy.

Wind energy.

Hydro energy.

Tidal energy.

Geothermal energy.

Biomass energy

**NEED OF NEW SOURCES**

 Energy is a backbone of complete production activity. Any production activity cannot operate without energy as it an important aspect of a development process. Not only in the industrial sector but also in agriculture sector, energy is used on a large scale.

**DIFFERENT TYPES OF NEW ENERGY SOURCES**

New energy resources include: nuclear fission, solar power, hydroelectric power, wave power, tidal power, wind power, biofuels, and geothermal power. Energy resource of the future may include nuclear fusion, hydrogen fuels, ocean thermal energy conversion, solar fuels, and space-based solar power.

**APPLICATIONS OF HYDROGEN ENERGY, OCEAN ENERGY RESOURCES, TIDAL ENERGY CONVERSION**

Hydrogen is a clean fuel. It is an energy carrier that can be used for a broad range of applications. Also it could serve as a possible substitute to liquid and fossil fuels. Its physical properties could be stated as following. At standard temperature and pressure, hydrogen is a nontoxic, non-metallic, odourless, tasteless, colourless, and highly combustible diatomic gas with the molecular formula H2.

**Applications**

Production of electricity, heat and water for various end uses

Industrial applications

Vehicular transportation

Residential applications

Commercial applications, including in telecom towers for providing back-up power

Applications of Hydrogen as an energy source in India

Current sources of Hydrogen production in India

Current hydrogen utilization in India accounts for 6 million tones

The refinery sector accounts for almost 3 million tonnes of hydrogen demand, representing 46% of the total hydrogen demand in the country

Ammonia production contributes to 48% of the current hydrogen demand

Steel production via natural gas-based DRI-EAF (Direct Reduced Iron in Electric Arc Furnace) contributes to 0.3 million tonnes of hydrogen demand currently.

Fuel cell vehicles are unlikely to hit the road on a commercial scale, at least until 2030, subject to the concurrent development of Hydrogen supply infrastructure (under the consideration of competitive pricing)

Regarding the use of Hydrogen in conventional engine technology, there are 50 Hythane (18% Hydrogen and 82% Compressed Natural Gas) buses plying on the roads of New Delhi, and there are plans afoot to expand the footprint of such buses across the country.

**OCEAN ENERGY RESOURCES**

Ocean energy is all forms of renewable energy derived from the sea. There are three main types of ocean energy technology: wave, tidal & thermal.

What are the main energy resources from the ocean?

The three main contenders for renewable, non-polluting energy are wave and tidal power and ocean thermal energy conversion. There are three main types of ocean resources: renewable, non-renewable, and potential. Renewable resources are things like fish and seaweed that can grow back after being harvested. Non-renewable resources are things like oil and minerals that cannot be replaced once they have been used.

**APPLICATION**

Ocean thermal energy is used for many applications, including electricity generation. There are three types of electricity conversion systems: closed-cycle, open-cycle, and hybrid. Closed-cycle systems use the ocean's warm surface water to vaporize a working fluid, which has a low-boiling point, such as ammonia.

**TIDAL ENERGY CONVERSION**

Tidal energy is a form of power produced by the natural rise and fall of tides caused by the gravitational interaction between Earth, the sun, and the moon. Tidal currents with sufficient energy for harvesting occur when water passes through a constriction, causing the water to move faster.

The oldest and second-largest operating tidal power plant is in La Rance, France, with 240 MW of electricity-generation capacity. Smaller tidal power plant are in Canada, China, Russia, and South Korea.

**APPLICATION**

Applications of Tidal Energy

It is used to produce tidal electricity.

Tidal Energy is used for the crushing of grains in grain mills.

It is also used for energy storage purposes in hydroelectric dams.

It is also used to protect the coast from any kind of damage which can be caused due to high storms.

There are currently three different ways to get tidal energy: tidal streams, barrages, and tidal lagoons. For most tidal energy generators, turbines are placed in tidal streams. A tidal stream is a fast-flowing body of water created by tides. A turbine is a machine that takes energy from a flow of fluid.

**CONCEPT, ORIGIN AND POWERPLANTS OF GEOTHERMAL ENERGY**

The first geothermal power plant was built in 1904 in Tuscany, Italy, where natural steam erupted from the earth. Flash steam plants take high-pressure hot water from deep inside the earth and convert it to steam that drives generator turbines

It comes from heat generated during the original formation of the planet and the radioactive decay of materials. This thermal energy is stored in rocks and fluids in the centre of the earth.

Geothermal power plants draw fluids from underground reservoirs to the surface to produce heated material. This steam or hot liquid then drives turbines that generate electricity before it is rejected back into the reservoir.

**POWERPLANTS OF GEOTHERMAL ENERGY**

Geothermal power plants use steam to produce electricity. The steam comes from reservoirs of hot water found a few miles or more below the earth's surface. The steam rotates a turbine that activates a generator, which produces electricity.There are three main types of geothermal power plant technologies: dry steam, flash steam, and binary cycle. The type of conversion is part of the power plant design and generally depends on the state of the subsurface fluid (steam or water) and its temperature.

The main components in a geothermal power plant at The Geysers are the steam turbine, generator, condenser, cooling tower, gas removal system and hydrogen sulfide abatement system. Thermal energy in the form of pressurized steam flows from wells, through pipelines and to the power plant. Around 350 geothermal energy locations have been discovered in India by the Geological Survey of India.

**Types of power plants for energy generation**

Nuclear power plants. ...

Hydroelectric power plants. ...

Coal-fired power plants. ...

Diesel-fired power plants. ...

Geothermal power plants. ...

Gas-fired power plants. ...

Solar power plants. ...

Wind power plants

Solar power plants. ...

SHORT QUESTION WITH ANSWER

1. what is called Bio-mass?

Ans- Bio-mass is renewable organic material that comes from plant and animal.

1. what are the basics of solar energy?

Ans- Solar energy is energy from the sun that can be captured and converted into electricity and heat

1. what is renewable energy?

Ans- Renewable energy is energy that comes from a source that won’t run out . They are natural and replenish

LONG QUESTION

1. What are the new energy sources?

 2. What are the different types of new energy resources?

 3. What are the causes, effects, and preventive measures of soil pollution?

**UNIT-5**

**SOLID WASTE MANAGEMENT, ISO14000 AND ENVIRONMENTAL MANAGEMENT**

**SOLID WASTE GENERATION**

The generation of solid waste is the inevitable consequence of all processes where materials are used. Extraction of raw materials, manufacture of products, consumption, and waste management all generate wastes.

Generally, the term of kg/capita/day is used to express the rate of generation of municipal solid waste. For the total solid waste produced, it can be calculated by multiplying the total population by the generation rate of daily waste per capita [The rate of change of quantity of solid waste generation with respect to stipulated time is termed as waste generation. The waste generation rate is governed by various factors (i.e) it depends mainly upon the geographical location, customs, climate, living conditions and economic standard of the area.

**SOURCES AND CHARACTERISTICS OF MUNICIPAL SOLID WASTE, E-WASTE, BIO-MEDICAL WASTE**

The greatest source of municipal solid waste-

Paper and paperboard products made up the largest percentage of all the materials in MSW, at 23.1 percent of total generation. Generation of paper and paperboard products declined from 87.7 million tons in 2000 to 67.4 million tons in 2018.

The physical and chemical characteristics of municipal solid waste-

Physical properties encompass density and moisture content, while chemical characteristics include lipids, carbohydrates, proteins, natural fibres, and synthetic organic materials.

The physical parameters of MSW characterised are: particle size distribution, geometry and classification of the waste, moisture and organic matter content, unit weight, and temperatures of the landfilled waste

**E-WASTE**

Characteristics of e-waste: they composed of various plastic elements and metallic elements which may be harmful for the environment. Disposal of e-waste: e-waste are hard to dispose. The plastic components are collected and sent to recycling unit. The non harmful metallic units like the steel also sent for recycling. Characteristics of e-waste: they composed of various plastic elements and metallic elements which may be harmful for the environment

E-waste (electronic waste) includes anything with plugs, cords and electronic components. Common sources of e-waste include televisions, computers, mobile phones and any type of home appliance, from air conditioners to children's toys.

**Sources of E-waste**

In the fast-paced digital era, with the rapid advancements in technology and the ever-growing demand for the latest gadgets, a pressing concern has emerged: electronic waste, or e-waste. As a responsible society, it is imperative that we understand the sources of e-waste and take actionable steps to mitigate its impact on the environment.

**Discarded Electronics**

The constant pursuit of upgraded gadgets and devices has led to a surge in discarded consumer electronics. Smartphones, laptops, tablets, and other devices that once held our attention are now swiftly replaced with newer models,

Contributing significantly to the e-waste stream. It is crucial for consumers to be aware of recycling programs and options

**Medical and Laboratory Equipment**

The healthcare and research sectors heavily rely on electronic equipment for diagnostics, treatment, and experimentation. However, the constant evolution of medical and laboratory technology leads to the disposal of older equipment. Collaborative efforts between manufacturers, healthcare institutions, and regulatory bodies are essential to establish guidelines for the proper disposal and recycling of medical e-waste.15

**Outdated Appliances**

Household appliances, from refrigerators and washing machines to microwaves and air conditioners, have become indispensable in modern living. Yet, as technology advances, older appliances are often replaced, leading to the accumulation of e-waste. Encouraging appliance manufacturers to implement eco-friendly designs, promote repairability, and establish take-back programs can greatly reduce the impact of this source of e-waste, creating a huge solid waste when mixed with other types of waste.

**E-waste generated by Manufacturing**

The manufacturing of electronic devices and components results in a significant volume of e-waste. Leftover materials, defective products, and outdated parts contribute to this source. Manufacturers can adopt sustainable practices, such as efficient resource utilization and recycling programs, to minimize the environmental repercussions of their operations.

**Entertainment and Leisure Devices**

From televisions and gaming consoles to audio systems, the entertainment industry has provided us with a myriad of electronic devices for leisure and enjoyment. As technology evolves, these devices become outdated, resulting in a substantial accumulation of e-waste. Promoting consumer awareness about recycling options and advocating for sustainable design within the entertainment industry can address this source of e-waste.

**Battery Disposal**

Batteries, a critical component of many electronic devices, pose a unique challenge in terms of e-waste. Improper disposal of batteries can lead to hazardous materials leaching into the environment. Encouraging battery recycling programs, adopting alternative battery chemistries, and developing innovative solutions for battery disposal are imperative to tackle this specific e-waste pollution.

**BIO-MEDICAL WASTE**

Bio-medical waste means “any solid and/or liquid waste produced during diagnosis, treatment or vaccination of human beings or animals. Biomedical waste creates hazard due to two principal reasons: infectivity and toxicity. Figure 1 shows some of the biomedical waste

**Sources:**

The source of biomedical waste is the place or the location at which biomedical waste has been generated. The source of biomedical waste is classified into two types based on the quantity of waste generated. They include major and minor source. Major source generates more amount of biomedical waste compared to minor source and also there is regular generation of biomedical waste in the major source which includes government hospitals, private hospitals, nursing home and dispensaries. Minor source includes physicians and dental clinics. Figure 2 shows the details of the various source of biomedical waste generation

**CHARACTERISTICS**

Biomedical waste comprises of all liquid and solid wastes generated from medical establishments and activities involving biological materials. Besides health care, the relevant activities include clinical research, research involving animals, animal farms, dead animals, and others**.**

Many of these waste materials are categorized as biomedical because as they will have any or all of the following property: (1) infection, (2) contaminated with body fluids, (3) expired or active drugs.

**METALLIC WASTE AND NON-METALI CWASTE**

**(LUBRICANTS,PLASTICS,RUBBER) FROM INDUSTRIES**

**What is metallic and nonmetallic waste?**

**Classification of metallic and non-metallic fractions of e ...**

E-waste comprises of many useful recyclable materials such as metallic fractions (MFs), like aluminum and copper and non-metallic fractions (NMFs), such as plastic, printed circuit boards (PCB) and glass**.**

Metallic minerals are good conductors of electricity as well as heat. Non-metallic minerals are basically good insulators of electricity and heat. Metallic minerals have high malleability and ductility. Non-metallic minerals, lack malleability and ductility and these minerals break down easily

**LUBRICANT, PLASTICS, RUBBER FROM INDUSTRIES**

Types of industrial waste include dirt and gravel, masonry and concrete, scrap metal, oil, solvents, chemicals, scrap lumber, even vegetable matter from restaurants. Industrial waste may be solid, semi-solid or liquid in form. It may be hazardous waste (some types of which are toxic) or non-hazardous waste.

**COLLECTION AND DISPOSAL: MSW**

. Processing of MSW is essential before its disposal to protect the environment and human health. MSW should be collected and transported to a suitable site regularly as per MSW (management and handling rules). Segregation of MSW at the source plays a vital role in proper management..

Organizing house-to-house collection of municipal solid wastes through any of the methods, like community bin collection (central bin), house-to-house collection, collection on regular pre-informed timings and scheduling by using musical bell of the vehicle.

Organizing house-to-house collection of municipal solid wastes through any of the methods, like community bin collection (central bin), house-to-house collection, collection on regular pre-informed timings and scheduling by using musical bell of the vehicle.

Devising collection of waste from slums and squatter areas or localities including hotels, restaurants, office complexes and commercial areas.

Wastes from slaughter houses, meat and fish markets, fruits and vegetable markets, which are biodegradable in nature, shall be managed to make use of such wastes.

Bio-medical wastes and industrial wastes shall not be mixed with municipal solid wastes and such wastes shall follow the rules separately specified for the purpose.

Collected waste from residential and other areas shall be transferred to community bin by hand-driven carts or other small vehicles.

Construction or demolition wastes or debris shall be separately collected and disposed off following proper norms. Similarly, wastes generated at dairies shall be regulated in accordance with the State laws.

Waste (garbage, dry leaves) shall not be burnt.

Stray animals shall not be allowed to move around waste storage facilities or

**Disposal of municipal solid wastes**

Land filling shall be restricted to non-biodegradable, inert waste and other waste that are not suitable either for recycling or for biological processing. Land filling shall also be carried out for residues of waste processing facilities as well as pre-processing rejects from waste processing facilities. Land filling of mixed waste shall be avoided unless the same is found unsuitable for waste processing. Under unavoidable circumstances or till installation of alternate facilities, land filling shall be done following proper norms.

3R

The 3Rs are used to refer to the three terms that are – Reduce, Reuse and Recycle. While recycling is easily using the material again, once it is finished, reusing is discovering a new, alternate way to utilize the trash instead of discarding i

**Reduce**

As you can likely deduce from its being the first of the three R’s, reducing is the best way to go about managing solid waste. It’s quite simple really, the less you use the less waste you will produce. This R causes the most unease in consumers because we tend to think we need to cut back on everything or we won’t be making an impact. This is not the case, though. By just doing a few things to cut back you can noticeably reduce your waste without totally altering your lifestyle. You could do this by:

Buying products with less packaging. Did you know that 30% of the waste in our landfills comes from product packaging? When shopping for items choose the ones in just one bog or bag as opposed to those that are double and triple packaged.

Buying products in bulk. By buying more of the same item all at once you reduce the overall amount of packaging you will encounter.

Try to stay away from disposable goods. In particular, paper plates, cups, and plastic utensils.

Buy durable goods. Especially when making a big purchase look into the history and reviews of the item you are buying. By buying something that will last you help to make sure wastes will stay out of landfills for longer.

**Reuse**

The second R is for reuse. This one is becoming more and more popular with the surge of upcycling and craft projects all over the web. If you reuse something as opposed to throwing it away you keep waste out of landfills and create something new. A quick internet search can open a world of ideas or you can try any of the follo

Don’t automatically throw away items that are broken, several can be reused and turned into great new things!

Use sealable containers rather than plastic wrap.

Invest in some reusable shopping bags or bring old plastic ones with you to the store.

Look into upcycling ideas for common household items, many have alternate uses you may never have thought about.

Embrace hand-me-downs. As a younger sibling I can understand wanting clothes of your own but if you have kids of similar ages try to supplement wardrobes with some hand-me-downs as well. Another option is to shop second hand stores or consignment shops. That way the items will be totally new to you while still helping to reuse someone else’s potential waste.

**Recycle**

The final, and probably the best known, R stands for recycling. As you probably know, recycling is the process of remanufacturing a product to be sold as new. Along with the basics of paper, plastic, glass, and cardboard there are tons of items which can be recycled that you may not even realize. And remember, recycling only works if you complete the process by buying recycled materials. Start recycling today by doing any of the following:

**ENERGY RECOVERY**

Energy recovery from waste is the conversion of non-recyclable waste materials into usable heat, electricity, or fuel through a variety of processes, including combustion, gasification, pyrolization, anaerobic digestion and landfill gas recovery. This process is often called waste to energy.

**SANITARY LANDFILL**

The sanitary landfill is a method of disposing waste on land without disturbing the environment and public health by efficiently utilizing engineering skills to confine them in the smallest practical area possible, before reducing the volume by covering with a layer of earth to ensure the least exposure to the air.

Open dumps involve the presence of a field where the garbage is deposited. Sanitary landfills are found to be covered with fresh soil on a daily basis. Open dumps are seen covered occasionally. Sanitary landfills are greatly responsible for reducing impact.

**What are landfills**?

A landfill is a place where solid waste is collected. They are designed to separate waste from the surrounding environment.

**What is the main purpose of a landfill**?

The main purpose of a landfill is to control solid waste to prevent the spread of diseases. It also protects the environment from air, water, and soil contamination.

**What are the advantages and disadvantages of sanitary landfill?**

The advantage of a sanitary landfill is that it creates a barrier between the solid waste and the soil and water at the site. The disadvantage of a sanitary landfill is the negative environment

**HAZARDOUS WASTE**

Hazardous wastes are wastes or products that have the potential to harm humans or the environment, either now or in the future. There are many options to help you dispose of household hazardous wastes safely, protect the environment and keep your home safe.Hazardous waste is defined as any substance or material that can have harmful effects on the health of people and the environment.

Typically produced by manufacturers and other industrial organizations, hazardous waste has been identified by the EPA as containing elements and properties that can produce potentially detrimental effects.

With that being said, there are very specific protocols to undertake when a waste is identified as hazardous. In determining how to properly treat the waste that has been produced, it’s important to be able to identify what classifications that hazardous waste falls into

**AIR QUALITY ACT 2004**

* This act regulates air quality and provides measures for the prevention of pollution and ecological degradation. It further aims to provide for national norms and standards regulating air quality monitoring, management and control by all spheres of government; for specific air quality measures; and related matters.

Section 12 provides for air quality monitoring and emission measurements.

Section 17 outlines requirements for reporting the implementation of air quality management plans. Accordingly, every organ of state must submit an annual report containing information on the implementation of its air quality management plan.

Section 21 refers to activities that result in atmospheric emissions with significant impacts. A list detailing related activities shall be published, including minimum emission standards in respect of air polluting substances. These will outline permissible emissions volumes, rates or concentrations as well as measurement procedures. For such activities, an atmospheric emission licence is required before commencement of operations.

 The act establishes the procedure for the application for and issuance of atmospheric emission licences. The licence will specify maximum allowed volume, emission rate or concentration of pollutants that may be discharged in the atmosphere; other operating requirements relating to atmospheric discharges, or fugitive emissions; measurement and reporting requirements for point source emission, on-site ambient air quality, and greenhouse gas emission measurement and reporting requirements.

Section 23 refers to controlled emitters and pertaining emission standards.

Section 26 refers to controlled fuels and related requirements for commercialisation and use.

 Section 29 indicates that the authorities may declare substances contributing to air pollution as a priority air pollutant; and require persons falling within specified categories to prepare and submit related pollution prevention plans.

Section 63 establishes ambient air quality standards.

Other provisions relate to the provisional licences, transfer and renewal or change of licences; Trans boundary air pollution; as well as offences and penalties.

**AIR POLLUTION CONTROL ACT 1981**

An Act to provide for the prevention, control and abatement of air pollution, for the establishment, with a view to carrying out the aforesaid purposes, of Boards, for conferring on and assigning to such Boards powers and functions relating thereto and for matters connected therewith.

. These resource are non-eco friend of the environment because they are polluted the atmosphere

The Air (Prevention and Control of Pollution) Act of 1981, or the Air Act, in short, was a law passed by the Parliament of India to prevent and control the harmful effects of air pollution in India. This act is seen as the first concrete step taken by the government of India to combat air pollution.

The following are the definitions under the Air (Prevention and Control of Pollution) Act.

Section 2(a) defines an ‘air pollutants’ as any solid liquid or gaseous substance which may cause harm or damage the environment, humans, plants, animals or even damage property. A 1987 amendment to the act also added ‘noise’ in the list of harmful substances.

The air act defines ‘air pollution’ as the presence of any dangerous pollutant that makes the air unbreathableSection 2 (g) of the Act also set up the Central Pollution Control Board (CPCB) whose powers extended to the whole of India. To carry out the directives of the CPCB the act also called for the setting up of the State Pollution Control Board (SPCB) for the individual states of India

**Penalties and Procedure under the Air Act**

The failure to comply with the Central Pollution Control Board directives would result in imprisonment of 1 year. It can be extended to 6 years with a fine with the additional fine of 5000Rs per day added provided the directives are still not met.

Any environmental complaint will only be taken into consideration by a court if it is made by the following:

**An officer authorised by the CPCB**

A person who has made a complaint to the board or an officer authorised by it. The complaint must be made within sixty days of the offence committed

WATER POLLUTION AND CONTROL ACT 1996

What is the water pollution Act 1996?

An Act to provide for the prevention and control of water pollution and the maintaining or restoring of wholesomeness of water, for the establishment, with a view to carrying out the purposes aforesaid, of Boards for the prevention and control of water pollution, for conferring on and assigning to such Boards powers ...The following years saw India‘s residual forest wealth dwindle sharply .Timber extraction continued to remain the forest Department’s main concern up to the 1970s .The fact that forest degradation and deforestation was creating a serious loss of the important functions of the forest began to override its utilisation as a source of revenue from timber .

* **S.I. No. 184 of 1996.**
* **LOCAL GOVERNMENT (WATER POLLUTION) (AMENDMENT) REGULATIONS, 1996**
* The Minister for the Environment, in exercise of the powers conferred on him by section 30 of the Local Government (Water Pollution) Act, 1977 (No. 1 of 1977) hereinafter called the "Act of 1977", by sections 6 and 19 of that Act as amended respectively by sections 4 and 14 of the Local Government (Water Pollution) (Amendment) Act, 1990 (No. 21 of 1990) and by section 26 of the Act of 1977, as amended by sections 18 and 29 of the Local Government (Water Pollution) (Amendment) Act, 1990 , hereby makes the following Regulations:—
* 1. (1) The Regulations may be cited as the Local Government (Water Pollution) (Amendment) Regulations, 1996.
* (2) These Regulations, the Local Government (Water Pollution) Regulations, 1978 ( S.I. No. 108 of 1978 ) and the Local Government (Water Pollution) Regulations, 1992 ( S.I. No. 271 of 1992 ), shall be construed together and may be collective
* ely cited as the Local Government (Water Pollution) Regulations, 1978 to 1996**.**
* **STRUCTURE AND ROLE OF CENTRAL AND STATE POLLUTION CONTROL BOARD**
* The Central Pollution Control Board (CPCB) of India is an organisation under the Government of India responsible for Air and Water Quality Monitoring Services and any other pollution-related issues.
* Central Pollution Control Board (CPCB) is one of the important government bodies. What is CPCB?
* The Central Pollution Control Board (CPCB) of India is a statutory organisation under the Ministry of Environment, Forests and Climate Change. (Know the difference between the statutory and quasi-judicial body in the linked article.)
* Established in 1974 under the Water (Prevention and Control of Pollution) Act and later entrusted with functions and responsibilities under the Air (Prevention and Control of Pollution) Act, 1981.
* Water Pollution:
* Water pollution can be defined as the contamination of water bodies. Water pollution is caused when water bodies such as rivers, lakes, oceans, groundwater, and aquifers get contaminated with industrial and agricultural effluents.
* Air Pollution:
* Air pollution refers to any physical, chemical or biological change in the air. It is the contamination of air by harmful gases, dust and smoke which affects plants, animals, and humans drastically. Click here to read about Air Pollutants.
* It coordinates the activities of the State Pollution Control Boards by providing technical assistance and guidance and also resolves disputes among them.

**CPCB Organisational Structure**

CPCB is led by its Chairman followed by the Member Secretary, and other members. The CPCB performs its various functions through the following nine major project budget heads.

Pollution assessment (survey and monitoring).

R&D and laboratory management.

Development of standards and guidelines for industry-specific emissions and effluent standards

Training

Information database management and library

Pollution control technology

Pollution control enforcement

Mass awareness and publications

Hazard waste management

ROLE

To co-ordinate the actions of the State Board and resolve disputes among them. To provide technical assistance and guidance to the State Boards to carry out research in prevention and control of water pollution problems. To organize training of persons engaged in pollution control.

**STATE POLLUTION CONTROL BOARD**

To plan and execute a comprehensive programme for the prevention, control and abatement of water and air pollution. To advise the State Government on any matter concerning the prevention, control or abatement of water and air pollution.

* State Pollution Control Boards (SPCBs) play a pivotal role in India’s environmental governance framework, acting as regulatory and advisory bodies at the state level. These boards are instrumental in ensuring the environmental health of their regions by implementing the directives and standards set by the central authority and the specific legislations under which they operate**.** After independents a number of multipurpose river valley projects has worked
* The Water (Prevention and Control of Pollution) Act, 1974, vide Sec. 3, empowers the Central Government to constitute a Central Board for the prevention and control of water pollution in the Union Territories of India. Under the same Act, vide Sec. 4, the State Governments have also been empowered to constitute State Boards for the prevention and control of air pollution in the respective States. Accordingly, the Central Pollution Control Board and the State Pollution Control Boards have been constituted for the prevention and control of water and air pollution. Central Pollution Control Board acts under the directions of the Central Government.
* Advisory Role
* SPCBs serve as key advisors to the state governments on various matters related to air and water pollution. Their expert recommendations are important in shaping state policies on environmental conservation.
* This includes advising on the implementation of laws, suggesting modifications to existing policies based on ground realities and helping draft new regulations that address emergent environmental issues.
* Information Collection and Dissemination
* An important function of the SPCBs is to gather and disseminate information regarding air and water pollution. This involvesmonitoring pollution levels, maintaining records of environmental data and conducting environmental assessments and audits..

**Collaboration and Training**

Collaboration with the Central Pollution Control Board and other agencies is essential for the SPCBs. These collaborations help in organising training programs for individuals engaged in activities related to pollution control.

Such training initiatives enhance the capabilities of personnel to tackle pollution effectively and ensure that the workforce is updated with the latest technologies and methodologies in pollution abatement.

**Technical Assistance and Research**

SPCBs provide technical assistance and guidance to local bodies, industries and research institutions dealing with pollution-related issues.

They sponsor and conduct research on various environmental problems, particularly those that have a significant impact on water and air quality within the state. This function is vital for developing new solutions and strategies to combat pollution effectively

**Conclusion**

The State Pollution Control Boards are fundamental to India’s environmental regulatory mechanism. They not only enforce environmental laws and standards but also play a proactive role in planning, monitoring and managing the ecological balance within the states. Their multifaceted functions are important for ensuring that development is both sustainable and environmentally responsible. Through their diligent efforts, SPCBs help pave the way for a cleaner, healthier environment, thus contributing significantly to the overall well-being of the country’s populace

.**CONCEPT OF CARBON CREDIT,CARBON FOOTPRINT**

Carbon credits were devised as a mechanism to reduce greenhouse gas emissions. Companies receive a set number of credits that decline over time. They can sell any excess credits to another company. Carbon credits create a

**monetary incentive**

A carbon credit (often called a carbon offset) is a credit for greenhouse emissions reduced or removed from the atmosphere by an emission reduction project, which can be used by governments, industry, or private individuals to compensate for the emissions they generate elsewhere

Carbon footprint, amount of carbon dioxide (CO2) emissions associated with all the activities of a person or other entity (e.g., building, corporation, country, etc.).

**ENVIRONMENTAL MANAGEMENT IN FABRICATION INDUSTRY**

By implementing lean manufacturing principles, companies performing industrial fabrication can reduce the energy and materials they use and improve the quality of their products. This can be done by conducting analysis and identifying the areas of waste.

Uncovering the Environmental Impacts of Industrial Fabrication

**Resource consumption**

One of industrial fabrication's main impacts on the environment is the extraction of materials. During manufacturing, the workers use non-renewable sources, including minerals like iron and aluminium and fossil fuels such as coil and oil, plastics, and other resources.The demand for these resources puts pressure on the natural ecosystem. The most common side effects are deforestation and disruption of aquatic ecosystems. Moreover, these resources' extraction, processing, and transportation can lead to environmental impact.

**Energy consumption**

* The fabrication process can be energy-intensive, especially when there are high-temperature operations. Manufacturing plants and factories require a vast amount of electricity.
* The process of transforming sheet metal into finished products requires the use of a wide range of machinery. If the energy comes from non-renewable sources such as fossil fuels, industrial fabrication can contribute to greenhouse emissions and air pollution.etc .
* ISO14000:IMPLEMENTATION IN INDUSTRIES,BENEFITS
* The primary objective of the ISO 14000 series of standards is to promote effective environmental management systems in organizations. The standards seek to provide cost-effective tools that make use of best practices for organizing and applying information about environmental management.
* ISO 14001 is an internationally agreed standard that sets out the requirements for an environmental management system. It helps organizations improve their environmental performance through more efficient use of resources and reduction of waste, gaining a competitive advantage and the trust of stakeholders
* BENEFITS

**ISO 14000**

It is a set of standards created to help companies around the world reduce their adverse impact on the environment. It's a framework for improved and more environmentally-conscious quality management systems by organizations large and small. Water resources

ISO 14000 standards refer to a family of standards concerning environmental management. It exists to assist organisations in fulfilling the following: To minimise how the operations or processes negatively impact the environment. Also, it covers how air, water, or land changes adversely.

Not all of the benefits mean the same thing to everyone at your company, but here are just a few of the benefits you can discuss.

1) Improve your image and credibility. ...

2) Help you comply with legal requirements. ...

3) Improvement in cost control. ...

4) Higher rate of success when implementing changes.

1) **Improve your image and credibility**

If your contracts or tenders require an ISO 14001 certification, then this is an obvious benefit. But, even if it is not a formal requirement, very often your customers, neighbors, and the local community will be interested in how you care for the environment around you. Increasingly, consumers are concerned about the environmental practices of the companies that produce the products they use. One way to assure all of these people that you are committed to managing your environmental impacts is to have a demonstrable environmental management system to identify and control these impacts. This can enhance your image, help you maintain a good public image, and improve community relations – which can help improve your market share with these interested parties.

2. **Help you comply with legal requirements**

One of the most important benefits that can be derived from implementing ISO 14001 is to provide you with a framework for identifying, monitoring and complying with the various environmental requirements that apply to your processes. Of course you try to follow all applicable laws before implementing an environmental management system, but the system itself can aid in maintaining your compliance. Additionally, implementation will tell people that you care about the environment, and have a proven framework for identifying and complying with the various legal, regulatory and contractual requirements, thus boosting your image and credibility as above.

**3. Improvement in cost control**

All companies want to reduce costs – this is a fact of life in today’s world economy – but you may wonder how an environmental management system can help with cost control. The first way that this can happen is by using your system to identify, control, and reduce the number of environmental incidents that occur, which can cost your company through liability costs of fines, clean-up, and reparations. Secondly, you can use the improvement aspect of the environmental management system to help reduce costs by working to conserve the energy and input materials required by your company processes.

SHORT QUESTION WITH ANSWER

1. What is solid waste?

Ans- A solid waste is any material that is discarded by being: Abandoned.

1. What is called E-waste?

Ans- E-Waste is a term used to cover items of all types of electrical and electronic equipment (EEE) and its parts that have been discarded by the owner as waste without the intention of re-use."

 3. What is metallic waste?

Ans-Metallic waste (called also chips or swarf) is formed in large quantities upon machining various devices and alloys. This debris can be recycled by using mechanochemistry.

LONG QUESTION

1.What is the role of state pollution control board?

2. Write a note on Air quality act 2004 and water pollution and control act1986

3. What are the sources and characteristics of municipal solid waste?