ENVIRONMENTAL SCIENCE 1ST (Semester 2024-25)

UNIT-1(ECOSYSTEM) -SET-1

SHORT TYPE QUESTIONS & ANSWERS (2 Marks Each)

1. Define ecosystem. (*Remembering*)

A: Ecosystem is the structural & functional unit of ecology where the living organisms interact with each other & with the surrounding environment.

2. Define autotrophs. *(Remembering)*

A: The organisms which can prepare their own food are called autotrophs.Example: All green plants.

3. Define Food Chain. *(Understanding)*

A: The sequential linking of organisms involving transfer of food energy from one trophic level to another is called food chain.

4. Define Food Web. *(Understanding)*

A: A network of food chains interconnected at various trophic levels is known as food web.

5. Enlist the different stages of Nitrogen Cycle. *(Remembering)*

A: The different stages of Nitrogen Cycle are:

- Nitrogen Fixation
- Nitrogen Assimilation
- Ammonification
- Nitrification
- Denitrification

6. What is carbon cycle ? *(Remembering)*

A: Carbon Cycle describes the way the element carbon moves between the Earth's biosphere,hydrosphere, atmosphere and geosphere.

7. Why is carbon cycle important? *(Understanding)*

A: Carbon Cycle is an important aspect of the survival of all life on earth. Carbon is the building block of life and forms stable bonds with other elements necessary for life. It also provides insulation by trapping the sun's heat.

8. What do you mean by Greenhouse Gases? Give an example. *(Understanding)*

A: The gases present in the atmosphere which are responsible for keeping earth's surface warm are called Greenhouse Gases.Example: Carbon dioxide

9. State any two causes of Global Warming. *(Understanding)*

A: Any two of the following:

- Deforestation which disturbs the atmospheric balance.
- Vehicular emissions releasing greenhouse gases.
- Excessive use of air conditioners & refrigerators releasing CFCs.
- Rapid industrialization.
- Rapid urbanization.

10. State any two effects of Global Warming. *(Understanding)*

A: Any two of the following:

- Melting of ice caps leading to increase in sea level & submerging coastal lands.
- Climate change like excessive floods or droughts.
- Loss of biodiversity.
- High mortality rates.

11. What is Ozone Layer Depletion? *(Understanding)*

A: ThinIng of Ozone layer present in the stratosphere is called Ozone Layer Depletion.

12. State the role of Ozone Layer present in the atmosphere. *(Understanding)*

A: It acts as a shield & protects us from harmful UV radiations of sun.

13. Differentiate between Lentic & Lotic ecosystems with an example. *(Understanding)*

A: **Lentic Ecosystem-** It represents flowing water bodies. Eg; Rivers, Streams

Lotic Ecosystem- It represents standing water bodies. Eg; Ponds, Lakes

14. Define biotic & abiotic components. (*Remembering*)

A: The living organisms present in the ecosystem are called biotic & the non living factors of ecosystem are called abiotic components.

15. What are the different categories of consumers? (*Remembering*)

A: The different categories of consumers are:

- Primary Consumers or Herbivores
- Secondary Consumers
- Tertiary Consumers
- Quaternary Consumers

5 MARKS QUESTIONS & ANSWERS

1. Write a note on terrestrial ecosystem.(*Remembering*)

Ans:- Terrestrial ecosystem is a natural and exclusively land-based ecosystem. It comprises a community of organism and their environment that occurs on the land masses of earth surface. It occupies about 28% of the earth surface. Terrestrial ecosystems differ from aquatic ecosystems by the predominant presence of soil rather than water at the surface. There are different types of terrestrial ecosystems distributed around various geological zones. They are as follows:

- Forest Ecosystem
- Grassland Ecosystem
- Tundra Ecosystem
- Desert Ecosystem

Forest Ecosystem

A forest ecosystem consists of various types of microorganisms, plants and animals and all these components live in coordination with each other. Forests help in maintaining the temperature of the earth and plays a major role in carbon sink. They are of great importance in maintaining the ecological balances.

Grassland Ecosystem

The grassland ecosystem is dominated by grasses and herbs. It occupies about 19% of the earth surface and usually occurs in the interior parts of the continent. Some of the examples of grassland ecosystems are Temperate grasslands and savanna grasslands.

Tundra Ecosystem

Tundra is known for large stretches of bare ground and rock. Tundra ecosystems are devoid of trees and it is also known for patchy mantles of low vegetation such as mosses, lichens, herbs and small shrubs. These ecosystems are found in cold climates or where rainfall is in scarce. These are covered with snow for most of the year. The Arctic or mountain tops are the examples of tundra type ecosystem.

Desert Ecosystem

Deserts are found throughout the world and covers about 14 percent of the earth surface. These ecosystems are usually covered with cloudless sky and therefore, the sun radiation heats up the desert quickly, resulting in the highest air temperature on the earth.In contrast, nights are very cold as the temperature goes down fast due to loss of heat into the atmosphere through radiation. These are the regions with very little rainfall and thus produces sparse perennial vegetation of widely spaced shrubs.

2. Describe the fundamental role of producers, consumers and decomposers in an ecosystem? (*Remembering*)

Ans:- The living organisms present in an ecosystem form the biotic component. Based on their mode of obtaining food, the organisms occurring in an ecosystem are classified into three categories:

• Producers (autotrophs)

• Consumers (heterotrophs)

• Decomposers (saprotrophs)

Producers (autotrophs)

Producers or autotrophs prepare their food for themselves with the help of sunlight. These include all green plants, blue green algae, some bacteria and free-floating autotrophic microorganisms called phytoplankton. All these organisms possess photosynthetic pigments (e.g. chlorophyll) and can generate their own energy requirement (food) through photosynthesis in presence of sunlight and chlorophyll.

Consumers (heterotrophs)

They are unable to synthesize food for themselves. Therefore, they are dependent on the producers for their food & utilise materials and energy stored by them. These are mainly the animals. They are also known as heterotrophs.

The consumers are of four types:

• Primary or first order consumers or herbivores: These are the animals which feed on plants or producers. Cattle, deer, goat, rabbit, rats, grasshoppers etc. are the common herbivores in terrestrial ecosystem and snails, mosquito, tadpoles etc. are the common herbivores in the aquatic ecosystem.

• Secondary or second order consumers or primary carnivores: The animals which feed on the herbivores are called the pri¬mary carnivores or secondary consumers. Examples: cats, foxes, snakes etc. are secondary consumers in the terrestrial

ecosystem and water bugs, water beetles, frogs, small fish etc. are secondary consumers in the aquatic ecosystem.

• Tertiary or third order consumers: These are the large carnivores which feed on the secondary consumers. Common examples include large fish, water birds etc. in aquatic ecosystems, and wolves, snake etc. in terrestrial ecosystems.

• 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. Lions, tigers, eagle etc. are the examples in land ecosystems and shark, crocodiles etc. are the examples in aquatic ecosystems.

Decomposers or reducers (saprotrophs)

The decomposers are known as Saprotrophs. Bacteria and fungi belong to this category. They breakdown the dead organic materials of producers (plants) and consumers (animals) for their food. During metabolism process, they release simple inorganic and organic substances as by-products to the environment. These simple substances are reused by the producers resulting in a cyclic exchange of materials between the biotic organism and the abiotic environment of the ecosystem.

3. What is a food chain and a food web? Explain the difference between them. ***(Understanding)***

Ans:-

Food Chain:- A food chain represents the flow of energy and nutrients among different organisms in an ecosystem. It tells us how energy and nutrients are transferred from one trophic level to another and how the organisms interact in an ecosystem. In a food chain, each organism represents a particular trophic level according to its food behaviour.

Food Web:- The food web represents multiple interconnected food chains and the complex relationships between producers, consumers, and decomposers. Organisms are arranged into different trophic levels, with producers at the base, followed by primary, secondary, and tertiary consumers. Each level in the food web depends on the lower level for energy and nutrients.

The difference between Food chain and Food web are as follows: -

Sl. No.	**Food Chain**	**Food Web**
1.	It contains a series of organisms	It as a network of

	each dependent on the next as a source of food.	interconnected food chains.
2.	It consists of a linear pathway showing the flow of energy.	It consists of a multitude of networks showing the flow of energy.
3.	It shows direct interactions between organisms in a linear manner.	It shows complex interactions among various organisms.
4.	It usually involves a shorter chain with fewer levels.	It involves many levels of consumers.
5.	Removal of one organism can collapse the chain.	Removal of one organism has less impact due to multiple pathways.
6.	It is less flexible and any change can have a significant impact.	It is more flexible and can handle changes better.
7.	It is less stable as it depends on a single path.	It is more stable due to multiple paths.
8.	Example:- Grass → Rabbit → Fox	Example:- Grass → Rabbit, Grass → Mouse, Mouse → Snake, Rabbit → Fox

4. Describe component of nitrogen cycle. ***(Understanding)***

Ans:-

Nitrogen Cycle is a biogeochemical process through which nitrogen is converted into many forms, consecutively passing from the atmosphere to the soil to organism and back into the atmosphere.

There are five stages in the nitrogen cycle which include:

- Nitrogen fixation
- Nitrification
- Nitrogen assimilation
- Ammonification
- Denitrification.

Stage 1: Nitrogen Fixation:- Conversion of atmospheric N_2 to Ammonia (NH_3)

It is the initial step of the nitrogen cycle. Here, Atmospheric nitrogen (N2) which is primarily available in an inert form, is converted into the usable form -ammonia (NH3).

Nitrogen fixation is mainly completed by symbiotic bacteria, which are known as Diazotrophs. *Azotobacter* and *Rhizobium* play a major role in this process. These nitrogen-fixing bacteria have an enzyme called “nitrogenase” which has the capability to combine gaseous nitrogen with hydrogen to form ammonia.

A small amount of nitrogen can be fixed when lightning provides the energy needed for nitrogen to react with oxygen, producing nitrogen oxide (NO) and nitrogen dioxide (NO2). These forms of nitrogen then enter soils through rain or snow.

Nitrogen can also be fixed through the industrial process that manufactures fertilizer. This form of fixing occurs under high heat and pressure, during which atmospheric nitrogen and hydrogen are combined to form ammonia (NH3), which may then be processed further, to produce ammonium nitrate (NH4NO3), a form of nitrogen that can be added to soils and used by plants.

Stage 2: Nitrification:- Conversion of NH_3 to NO_2^- and NO_3^- by bacteria

In nitrification process the ammonia is converted into compounds called nitrites (NO_2) and nitrates (NO_3). These nitrates are used by plants and also animals that consume the plants. Although nitrite is not usable by plants and animals directly, other bacteria can change nitrites into nitrates, a form that is usable by plants and animals. The process of nitrification is important to plants, as it produces an extra stash of available nitrogen that can be absorbed by the plants through their root systems.

Stage 3: Nitrogen Assimilation:- Absorption of fixed Nitrogen from soil by roots

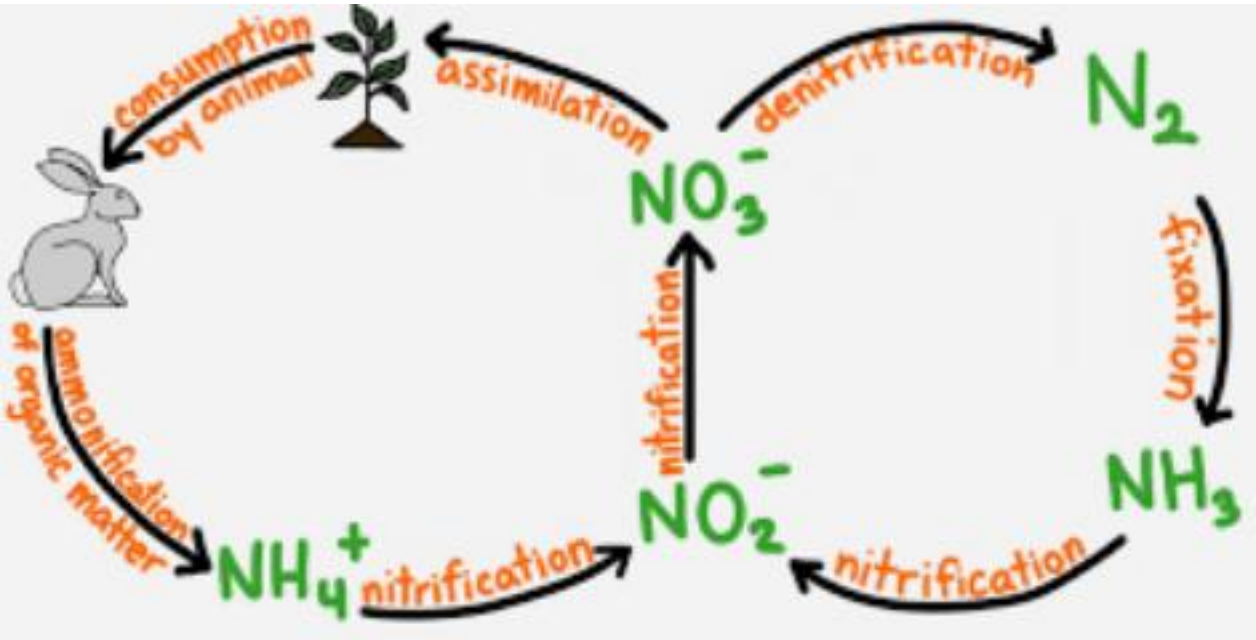
In this process inorganic nitrogen in the form of nitrates, nitrites and ammonia is absorbed by the green plants via their roots and then it is converted into nitrogenous organic compounds. Nitrates are first converted into ammonia which combines with organic acids to form amino acids. Amino acids are used in the synthesis of proteins, enzymes, chlorophylls, nucleic acids etc.

Stage 4: Ammonification :- Generation of Ammonia by Microbes

It is the process of releasing ammonia by certain microorganisms utilising organic compounds derived from the dead organic remains of plants and animals and excrete of animals. The microorganisms specially involved are actinomycetes and bacilli.

Stage 5: Denitrification:- Conversion of Nitrites and nitrates to N_2

In the fifth stage of the nitrogen cycle, nitrogen returns to the air as nitrates and are converted to atmospheric nitrogen (N_2) by bacteria through the process called denitrification. This results in an overall loss of nitrogen from soils, as the gaseous form of nitrogen moves into the atmosphere back.



NIROGEN CYCLE

5. Explain ozone layer and its importance. How it is being affected? ***(Understanding)***

Ans:- Ozone is a tri-atomic molecule made up of three atoms of oxygen, O_3. Very little quantity of ozone is present in the troposphere. However, good amount of ozone is present in stratosphere which is about 18-50 km above the equator. Its maximum concentration is at 23-25 km above equator. This rich zone of ozone in the stratosphere is called ozone layer or ozonosphere. The ozone layer act as a shield for life on earth as it protects from high energy ultraviolet (UV) radiations and allows low energy UV radiations to reach the earth's surface.

The thinning of ozone layer is commonly called ozone depletion. Air pollutants and chlorofluorocarbons (CFCs) are mainly responsible for depletion of ozone layer in stratosphere. Chlorofluorocarbons (CFCs) are synthetic, harmful chemicals, widely used in fire extinguishers, in air conditioners as coolants; in aerosol sprayers and as propellants. Once released in the air, these harmful chemicals produce 'active chlorine' (CI and CIO radicals) in the presence of UV radiations. These radicals through chain reactions, then destroy the ozone by converting it into oxygen. Due to this, the ozone layer in the upper atmosphere (i.e. stratosphere) becomes thinner. It has been found that a single 'active chlorine' converts one lakh molecules of ozone into oxygen. Inaddition to this, methane (CH_4) and oxides of nitrogen (NOx) also contribute in thinning of ozone layer.

Amount of atmospheric ozone is measured by Dobson spectrometer and is expressed in Dobson units (DU).

The thinning of ozone layer allows more UV radiations to pass through and strike the earth. These causes harmful effects on man, animals and plants such as skin cancer, herpes, dimming of eye sight, cataract in eyes, lowering the immune system, increased embryos in the mother’s uterus, global warming etc.

QUESTION BANK (1st Semester 2024-25)
AIR POLLUTION AND NOISE POLLUTION
UNIT-2(SET-1)

Short questions & Solutions (each question carries 2 marks)

1. Define air pollution. Classify air pollutants. BL-REMEMBERING

Ans:- Air pollution refers to the release of harmful contaminants (chemicals, toxic gases, particulates, biological molecules, etc.) into the earth's atmosphere. These contaminants are quite detrimental and in some cases, pose serious health issues.

Air pollutants are classified into two main groups according to the source of emission
(i) Primary Pollutants
(ii) Secondary Pollutants

2. Define pollutants. Classify different types of pollutants. BL-REMEMBERING

Ans:-Pollutants are the harmful substances which bring undesirable and harmful changes in the physical, chemical or biological characteristics of air, water and soil.
There are different types of pollutants present in the environment such as

a. Water Pollutants
b. Soil Pollutants
c. Air Pollutants
d. Noise Pollutants
e. Radioactive Pollutants

3. Define primary pollutants. Give example. BL-REMEMBERING

Ans: The Primary Pollutants are emitted from a source and directly enter the atmosphere either by natural processes such as sand storms, volcanic eruption or manmade process such as industrial and vehicle emissions.

Ex- oxides of sulphur, nitrogen, carbon, particulate matter, methane, ammonia, chlorofluorocarbons, toxic metals etc.

4. Define secondary pollutants. Give example. BL-REMEMBERING

Ans:- The Secondary Pollutants are not emitted directly. They are formed in the atmosphere when the primary pollutants react with themselves or with the other components of the atmosphere.
Ex- **photochemical oxidants,** Particulate Matter **etc.**

5. Define particulate pollutants. Classify different types of particulate matter.

BL-REMEMBERING

Ans: Particulate pollutants are microscopic liquid and solid particles present in the form of the suspension in the air.

- Particulate matter is sub-divided into different categories based on particle size i.e. PM10, PM2.5 and PM0.1.

6. Define PM 10 and PM 2.5 particles. **BL-REMEMBERING**

Ans: PM10 also known as coarse particles, is defined as all particles with an aerodynamicdiameter of 10 µm or smaller.

PM2.5 also known as fine particles, is defined as all particles with an aerodynamics diameter of 2.5 µm or smaller.

7. Define Bag Filters. Mention different types of bag filters. **BL-REMEMBERING**

Ans: Bag filters is a pollution control device used to remove particulate matter from the contaminated gas stream by depositing the particles on bag filters.

There are three types of bag filters.

1. Shaker bag filters
2. Reverse air bag filters
3. Pulse jet type bag filters

8. Write the working principle of cyclone separator. **BL-UNDERSTANDING**

- Cyclone separators are separation device used for removing the particulate matter from air or other gas stream.
- It works in the principle of inertia to remove particulate matter. The size of the cyclone may vary from 1.2 meters to 9 meters depending upon the volume of air or other gas stream to be filtered.
- These are basically centrifugal separators and work much like a centrifuge.

9. Enumerate the utility of a catalytic converter. **BL-UNDERSTANDING**

- The car emissions contain harmful toxic by-products. A catalytic converter is a simple device that uses oxidation and reduction reactions to covert the harmful fumes like nitrogen oxides, carbon monoxide and hydrocarbons emitted from vehicles to less harmful fumes.

- It is composed of a metal housing with a ceramic honeycomb interior with insulating layers. This honeycomb interior is coated with precious metals like platinum, rhodium, and palladium. It is located near front portion of the car.

10. State two way type catalytic converter. **BL-UNDERSTANDING**

Ans:- In this type of converter, only oxidation catalysts are used, which converts carbon monoxide to carbon dioxide and hydrocarbons to carbon dioxide and water by oxidation process.

11. State three way type catalytic converter. **BL-UNDERSTANDING**

Ans:- In this converter, both oxidation & reduction catalyst are used. Hence, it converts carbon monoxide to carbon dioxide and hydrocarbons to carbon dioxide and water by oxidation process and converts nitrogen oxide to nitrogen and oxygen gases by reduction process.

12. Write the effects of air pollution due to refrigerants. **BL-UNDERSTANDING**

Ans:

- Chlorofluorocarbons (CFCs) were once commonly used as refrigerants but were found to be major contributors to ozone layer depletion.
- Hydrofluorocarbons (HFCs) and hydrochlorofluorocarbons (HCFCs), used as refrigerants, are potent greenhouse gases. Like CFCs, they absorb infrared radiation, trapping heat in the atmosphere and preventing it from escaping into space, thereby contributing to the greenhouse effect and global warming.

13. Name the air pollutants released from I.C boilers. **BL-UNDERSTANDING**

Ans:

- I.C. Boilers emit a variety of hazardous air pollutant (HAPs), particle pollutant and volatile organic compounds.
- Some of the pollutants emitted are Nitrogen oxide, Sulfur dioxide, Carbon monoxide, Hydrogen chloride, cadmium, mercury etc.

14. Mention different sources of noise pollution. **BL-UNDERSTANDING**

- The source of noise pollution can be categorized into two categories: Industrial sources and Non-industrial sources.
- Industrial sources include noise from various industries and big machines working at very high speed and with very high noise intensity.
- Non-industrial sources include noise created by transport/vehicular traffic, loudspeaker, radio etc.

15. Define the term 'Sound Pressure'. **BL-UNDERSTANDING**

- Sound pressure is used as the fundamental measure of sound (amplitude) as it can be measured directly by instruments.
- The weakest sound pressure disturbance that can be detected by an average person at 1000 Hz has been found to be 20 µN/m2 and the largest sound pressure perceived without discomfort is of the order of 10^7 µN/m2.
- The sound pressure level is expressed in the unit of decibel (dB).

Long Questions & Solutions (each question carries 5 marks)

1. Describe different sources of Air Pollution? BL-ANALYZING

Air Pollution may be caused by various Natural and Man-made processes.

Natural Sources of Air Pollution:-

- **Volcanic Eruptions**: Volcanic activity releases toxic gases, such as sulfur dioxide and chlorine, along with particulate matter like ash particles, which contribute to air pollution.
- **Winds and Air Currents**: Winds can mobilize soil and other pollutants, dispersing them over large areas and leading to widespread contamination of the air.
- **Wildfires**: Wildfires emit harmful gases such as carbon monoxide, along with particulate matter, into the atmosphere, degrading air quality.
- **Microbial Decomposition**: The breakdown of organic matter by microorganisms, especially in wetlands or landfills, releases methane gas, a potent greenhouse gas and air pollutant.
- **Rising Temperatures**: Increasing temperatures can enhance the volatilization of contaminants from polluted soil and water bodies into the air, exacerbating air pollution.

Manmade sources of Air Pollution:-

- **Mining and Smelting**: The extraction and processing of minerals release a variety of metals and particulate matter into the atmosphere, contributing to pollution.
- **Industrial Processes**: Various industrial activities emit both organic and inorganic pollutants, including gases, particulates, and volatile compounds, which affect air quality.
- **Transportation**: Motor vehicles are a major source of air pollution, emitting gases such as carbon monoxide, sulfur oxides, nitrogen oxides, and particulate matter.
- **Construction and Demolition**: Activities related to construction and the demolition of old buildings release dust, particulates, and various chemicals into the air.
- **Coal Power Plants**: The combustion of coal in power plants generates a range of pollutants, including sulfur dioxide, nitrogen oxides, particulate matter, metals (such as arsenic, lead, and mercury), and organic compounds like polycyclic aromatic hydrocarbons (PAHs).
- **Agriculture**: Agricultural activities contribute to air pollution through the release of ammonia gas, the use of synthetic fertilizers, and the spraying of pesticides and herbicides, which contain volatile organic compounds (VOCs).
- **Military and Defense Activities**: Military operations, including training exercises and weapons testing, can release toxic gases and particulate matter into the air.
- **Smoking**: Tobacco smoke contains a wide range of toxic chemicals, including carcinogenic organic and inorganic compounds, which degrade air quality.
- **Household Products**: The use of household items like paints, varnishes, and aerosols often involves the release of volatile organic compounds (VOCs), which contribute to indoor and outdoor air pollution.
- **Refrigerants**: Used in air conditioners, refrigerators, and other cooling devices, refrigerants are a major source of greenhouse gases, contributing to global warming and ozone depletion.
- **Internal Combustion Boilers**: Boilers used in industrial, commercial, and residential settings can emit hazardous pollutants, including particulate matter and various toxic gases, into the air.

2. Discuss the effects caused due to Air Pollutants. BL-ANALYZING

Ans: Air pollutants have significant harmful effects on both human health and the environment. The impacts depend on the type of pollutant, its concentration, and the duration of exposure. Here's an overview of the effects caused by air pollutants:

1. Health Effects

- **Respiratory Diseases**: Exposure to air pollutants like **particulate matter (PM10, PM2.5)**, **ozone (O_3)**, and **nitrogen dioxide (NO_2)** can cause or worsen conditions like asthma, bronchitis, emphysema, and chronic obstructive pulmonary disease (COPD).
- **Cardiovascular Problems**: Pollutants, especially **PM2.5** and **ozone**, are linked to heart diseases such as heart attacks, strokes, and hypertension. These particles can enter the bloodstream and cause inflammation in blood vessels.
- **Cancer**: Long-term exposure to certain air pollutants, such as **benzene**, **formaldehyde**, and **radon**, can increase the risk of cancers, particularly lung cancer.
- **Neurological Impacts**: **Ultrafine particles (PM0.1)** can reach the brain and are associated with cognitive decline, memory loss, and increased risk of neurodevelopmental disorders in children.
- **Premature Death**: Chronic exposure to high levels of pollutants like **PM2.5** and **ground-level ozone** can lead to premature death from respiratory and cardiovascular diseases.

2. Environmental Effects

- **Acid Rain**: **Sulfur dioxide (SO_2)** and **nitrogen oxides (NOx)** can combine with water vapor to form sulfuric and nitric acids, leading to acid rain. This acidifies soil, lakes, and rivers, damaging ecosystems and affecting plant life.
- **Smog Formation**: **Ground-level ozone** and other photochemical pollutants contribute to the formation of **smog**, which harms plants, reduces agricultural yields, and causes visibility issues.
- **Climate Change**: **Methane (CH_4)**, a potent greenhouse gas, and **black carbon** (a component of PM) contribute to global warming by trapping heat in the atmosphere.
- **Ozone Depletion**: **Chlorofluorocarbons (CFCs)** and other halogenated compounds can damage the ozone layer, leading to increased UV radiation reaching the Earth's surface, which has harmful effects on human health, wildlife, and ecosystems.

3. Effects on Plant Life

- **Reduced Photosynthesis**: Pollutants like **ozone** can damage plant tissues, reducing photosynthesis, growth, and agricultural productivity.
- **Forest Damage**: Long-term exposure to air pollutants, especially **SO_2** and **ozone**, can weaken trees, making them more susceptible to disease, pests, and extreme weather conditions.

4. Economic Impacts

- **Healthcare Costs**: The rise in respiratory and cardiovascular diseases caused by air pollution leads to increased healthcare expenditures.

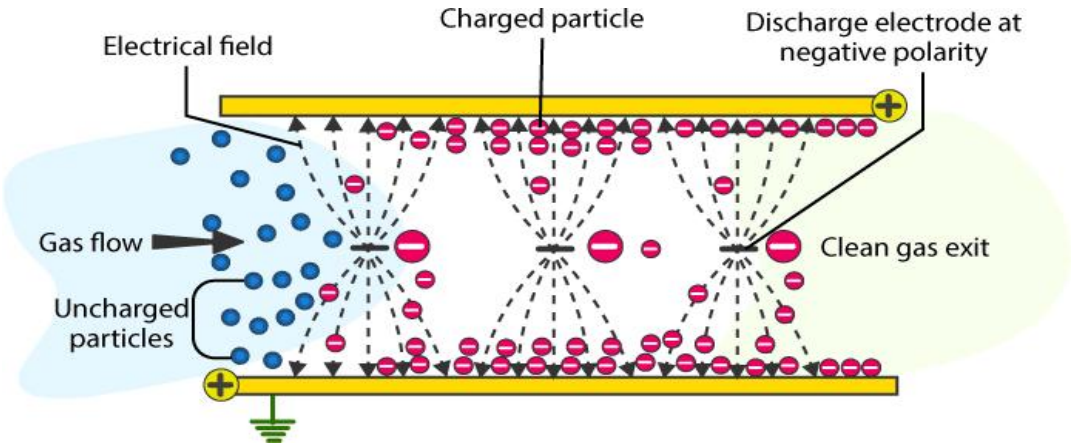
- **Agricultural Losses**: Ozone and particulate pollution reduce crop yields and forest productivity, affecting food security and the economy.
- **Reduced Worker Productivity**: Poor air quality can lead to sick days, reduced labor productivity, and a general decline in workforce health.

In summary, air pollutants are harmful to both human health and the environment, causing a range of respiratory, cardiovascular, and neurological diseases, contributing to environmental degradation, and impacting economic productivity. Efforts to reduce air pollution are essential to mitigate these widespread consequences.

3. **Explain the working principle of electrostatic precipitator?** BL-ANALYZING

Ans:- Electrostatic Precipitators are used to remove the fine particles like smoke and dust fromthe flowing gas.

- The operation of electrostatic precipitators is quite simple. It uses an electric charge to remove particulate matter either in the form of solid or liquid droplets from air.
- They are extremely effective and are capable of removing more than 99% of particulate matter of size smaller than 10 μm size.



- It consists of two sets of electrodes: positive and negative. The negative electrodes are in the form of a wire mesh, and the positive electrodes are plates. These electrodes are vertically placed and are alternate to each other.

- One of the electrodes is charged with a high negative voltage whereas second electrode charged with high positive charge.
- The gas stream flows horizontally between the wires and through the stack of plates. The particulates present in the gas stream are charged with the negative charge by the high voltage discharge electrode by the corona effect.
- The particulates thus charged with the negative charge are pulled towards the positive electrode (plate) and deposited on plates.
- The flue gas is free from the dust particles as it flows through the electrostatic precipitator and is discharged to the atmosphere through the chimney.

- When sufficient quantity of particles is accumulated on the collector devices, they are shaken off mechanically from the collectors.
- The particulates which can be dry or wet, fall into a hopper at the bottom of the unit and are transported to the disposal or recycling site through belt conveyor.

4. Discuss the effects of noise pollution on human health and on the ecosystem?

BL-ANALYZING

Ans:-EFFECTS OF NOISE POLLUTION ON HUMAN HEALTH:

1. **Hypertension:** It is a direct result of noise pollution which is caused due to elevated blood levels for a longer duration.
2. **Hearing loss:** Constant exposure of human ears to loud noise that are beyond the range of sound that human ears can withstand damages the eardrums, resulting in loss of hearing.
3. **Sleeping disorders:** Lack of sleep might result in fatigue and low energy level throughout the day affecting everyday activities. Noise pollution hampers the sleep cycles leading to irritation and an uncomfortable state of mind.
4. **Cardiovascular issues:** Heart-related problems such as blood pressure level, stress and cardiovascular diseases might come up in a normal person.

EFFECT ON ANIMALS:

5. Pets react more aggressively due to exposure to constant noise. They become disoriented more easily and face many behavioural problems.
6. Overexposure to high intensity of noise affects the hearing ability of many animals.
7. At an ecosystem level, noise pollution could lead to migration of animals.

EFFECT ON NON-LIVING THINGS:

The noise booms cause cracks in walls of buildings as well as in hills. Sonic boom can break window panes and buildings.

8. Discuss briefly Noise pollution (Regulation and control) Rules, 2000.

BL-ANALYZING

The rising levels of ambient noise in public spaces, caused by various sources, have detrimental effects on both human health and psychological well-being. It is therefore essential to regulate and control noise-producing activities and sources in order to maintain acceptable standards of environmental noise quality, thereby safeguarding public health and well-being.

- In order to address above issues, the principal rules were published in the Gazette of India, vide S.O.123(E), dated 14.2.2000 and subsequently amended several times.
- The main features of the **Noise Pollution (Regulation and Control) Rules, 2000** are described under the sub-headings:

  1. Short-title and commencement

  2. Definitions

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

4. Responsibility as to enforcement of noise pollution control measures.

5. Restrictions on the use of loud speakers/public address system and sound producing instruments (5A) Restriction on the use of horns, sound emitting construction equipment and bursting of fire crackers.

6. Consequences of any violation in silence zone/area.

7. Complaints to be made to the authority.

8. Power to prohibit etc. continuance of music sound or noise.

Environmental Science
Unit-3(SET-1)
Water and Soil pollution

Short Answer type questions (each 2 marks)		
Q.N.	**Questions and Solutions**	**BL**
1	**What is soil pollution?** **Ans:** Soil pollution is the contamination of the soil by harmful chemicals, waste, or toxins that negatively impact the environment and human health.	**1**
2	**Define e- waste with example.** **Ans:** E-waste, or electronic waste, refers to discarded electrical or electronic devices, including outdated or broken gadgets such as computers, smartphones, televisions, and household appliances, that are no longer in use and may contain harmful substances.	**1**
3	**What do you mean by reverse osmosis?** **Ans:** Reverse osmosis (RO) is a water purification process in which polluted water is forced through a semi-permeable membrane under pressure, removing impurities, contaminants, and dissolved solids by allowing only clean water molecules to pass through, leaving behind unwanted substances.	**2**
4	**Define pesticide and give an example of it**. **Ans:** A pesticide is a chemical substance used to prevent, control, or eliminate pests such as insects, weeds, fungi, or rodents that can harm crops, animals, or humans. Example: Glyphosate, a widely used herbicide for controlling weeds.	**1**
5	**Define insecticide and give one example.** **Ans:** An insecticide is a chemical substance used to kill or control insects that are considered pests. Example: DDT (dichlorodiphenyltrichloroethane)	**1**
6	**What is eutrophication and its ill effect?** **Ans:** Eutrophication is the process in which a water body becomes enriched with nutrients such as nitrogen and phosphorus, leading to the large growth of aquatic plants, especially algae causing coloration of water known as algal bloom. It leads to depletion of dissolved oxygen in water resulting in killing of aquatic organisms (e.g., fish).	**2**

7	**Which out of BOD & COD has a higher value and why?** **Ans:** COD values are always higher than BOD values. Because COD includes both the chemical oxidation of biodegradable and non- biodegradable substances whereas BOD value is only for the breakdown of biodegradable/ organic matter.	**4**
8	**What is turbidity of water? Write down the most common causes of high turbidity.** **Ans:** The turbidity of water is a measurement of how clear or cloudy it is. The cloudier the water, the higher its turbidity. The most common causes of high turbidity are phytoplankton, erosion, urban runoff, wastewater discharge, algae and sediment disruption.	**2**
9	**Define water pollution.** **Ans:** Water pollution is defined as the alteration of any of the physical, chemical or biological properties of water thereby causing detrimental effects on living/non-living objects.	**1**
10	**What is waste-water treatment?** **Ans:** Wastewater treatment or sewage treatment generally refers to the process of cleaning or removing all pollutants, treating wastewater and making it safe and suitable for drinking before releasing it into the environment.	**2**
11	**What do you mean by sedimentation?** **Ans:** Sedimentation is the process of removing the suspended heavier solid particles from dirty water through gravitational settling. This procedure is carried out in a basin or tank known as a sedimentation tank by allowing the water to stand undisturbed for several hours/days to settle down at the bottom of the container.	**1**
12	**What is the difference between total solids and total suspended solids of water?** **Ans:** The key difference between total solids and total suspended solids is that total solids are the material residue that is left in a vessel after the evaporation of a sample water, whereas total suspended solids are the dry weight of suspended particles that remain undissolved in a sample of water.	**4**
13	**How does pH affect the quality of water?** **Ans:** Excessively high and low pHs can be detrimental for the use of water. A high pH makes the taste bitter and decreases the effectiveness of chlorine disinfection, thereby causing the need for additional chlorine. The amount of oxygen in water increases as pH rises. Low-pH water will corrode or dissolve metals and other substances.	**2**

14	**What is RAS and what is its purpose in the water treatment?** **Ans:** RAS stands for Return Activated Sludge, which is a process in water treatment that involves returning settled activated sludge to the aeration basin. The purpose of RAS is to maintain the population of microorganisms in the aeration tank and prevent them from being lost.	**2**
15	**What are the main types of water pollution based on its origin?** **Ans:** There are two main types of water pollution based on its origin: point source and non-point source. Point source pollution occurs when pollutants are released from a specific location, such as a factory or wastewater treatment plant. Non-point source pollution happens when pollutants come from multiple diffuse sources, such as runoff from farmland or urban areas.	**2**

Long answer type questions (each 5 marks)		
Q.N.	**Questions and Solutions**	**BL**
1	**Explain various causes of soil pollution.** **Ans:** **Industrial Activities**: The disposal of toxic waste, heavy metals, and chemicals from factories, refineries, and manufacturing units directly into the soil is a major cause of soil contamination. **Agricultural Practices**: Excessive use of chemical fertilizers, pesticides, and herbicides in farming leads to the accumulation of harmful chemicals in the soil, affecting its quality and biodiversity. **Deforestation**: Clearing forests for agriculture or urbanization reduces the natural soil protection, leading to soil erosion and the infiltration of pollutants. **Waste Disposal**: Improper disposal of municipal and industrial waste, including plastics, electronic waste, and chemicals, pollutes the soil, leading to long-term degradation. **Mining Activities**: Mining operations release harmful substances like mercury, arsenic, and lead, which contaminate the soil around mining sites.	**2**
2	**Explain the effects of fertilizers on soil pollution.** **Ans:** • Chemical fertilizers, especially those rich in nitrogen, phosphorus, and potassium, can leave harmful residues in the soil when applied in excess. • Over time, these chemicals accumulate, leading to soil acidification, nutrient imbalances, and degradation of soil structure. • Excess nutrients from fertilizers, especially nitrogen and phosphorus, can leach into nearby water bodies, causing eutrophication. • This leads to algae blooms, depletion of oxygen in water, and negative impacts on aquatic ecosystems, which in turn affect the soil-water interaction.	**2**

- High concentrations of synthetic fertilizers can disrupt the natural microbial community in the soil.
- Beneficial microorganisms, such as nitrogen-fixing bacteria, may be suppressed, while harmful ones may thrive, leading to reduced soil fertility and health.

3 **Differentiate between BOD and COD.** **4**

Ans:

BOD	COD
BOD stands for Biological Oxygen Demand.	COD stands for Chemical Oxygen Demand.
It is the amount of oxygen the microbes require to decompose organic matter under aerobic conditions.	It is the total amount of oxygen required to break down both the biodegradable and non-biodegradable organic matter by chemical oxidation.
BOD is a biochemical oxidation process	COD is a chemical oxidation process.
It can be determined by putting a sealed water sample under specific temperature conditions(20^{o}c) for five days.	It can be determined by placing a water sample with a strong oxidizing agent under specific temperature conditions(150^{o}c) for a short period.
It takes several days for the incubation period.	Can be measured relatively quickly, often within a few hours.
Specifically measures biodegradable organic matter.	Measures both biodegradable and non-biodegradable organic substances.
It is always lower than COD.	It is always higher than BOD.
It is used to assess the level of organic pollution, microbial activity, and treatment efficiency.	It is used to quantify the amount of oxidisable pollutants found in water bodies.

4 **Explain the sources of water pollution.** **2**

Ans:

The most significant sources of water pollution are:

- **Sewage (Wastewater):** The sewage water carries pathogens, a typical water pollutant, other harmful bacteria, and chemicals that can cause serious health problems and thereby diseases.
- **Agricultural Pollution:** Chemical fertilizers and pesticides are used by farmers to protect crops from insects and bacteria. However, when these chemicals are mixed up with water, they produce harmful pollutants for plants and animals.
- **Oil spillage:** Oil spill poses a huge threat to marine life when a large amount of oil spills into the sea and does not dissolve in water. It causes problems for local marine wildlife, including fish, birds, and sea otters.

	• **Industrial Waste:** Industries produce a tremendous amount of waste, which contains toxic chemicals and pollutants, causing air pollution and damage to our environment and us. • **The burning of fossil fuels:** Fossil fuels like coal and oil, when burnt, produce a substantial amount of ash in the atmosphere. The particles which contain toxic chemicals when mixed with water vapour result in acid rain. • **River dumping and Marine Dumping:** The garbage produced by households in the form of paper, plastic, food, aluminium, rubber, glass, is collected and dumped into the rivers and seas., they not only cause water pollution but also harm aquatic animals.	
5	**What is the main purpose of Secondary treatment of wastewater? Describe about Trickling filter used in this method.** **Ans:** In secondary treatment, dissolved or colloidal organic matters are present in sewage are removed by utilizing microorganisms. In this step, microorganisms utilize organic matter and converts them into inorganic minerals. Following changes occurs in sewage during secondary treatment: ▪ Organic matter (carbon) is oxidized into CO_2 and H_2O ▪ Organic nitrogen compounds are first converted into NH_3 and then into NO_3 ▪ Colloidal matters are coagulated or precipitated out. Thus, main purpose of secondary treatment of sewage is to reduce BOD level. **Trickling filter:** ▪ Trickling filter consists of filtering bed, spraying arm and water collecting chamber. ▪ Filtering bed consists of well graded gravel, broken stone of size (40-150mm diameter). ▪ Effluent or sewage from primary treatment tank is sprayed uniformly over the filter bed. During filtration a gelatinous layer of bacteria, algae, protozoa and some fungi is produced on the surface of filter bed. This layer is called Zoogleal layer. ▪ As the water trickles through the filter bed, organic matter present in it is oxidized by microorganism of zoogleal layer. ▪ Although trickling filter is classified as aeration process of sewage treatment, it is facultative system. It is because aerobic bacteria lie on the top of the filter bed whereas anaerobic bacteria lie in middle or bottom of filter bed. ▪ Trickling filter can reduce BOD of sewage by about 65-85% depending on the rate of filtration.	**4**

ENVIRONMENTAL SCIENCE (1st Semester Diploma Engg. 2024-25)

Unit-4 (Renewable sources of Energy) (SET-1)

02 Marks Questions & Solutions ***Taxonomy Level***

1. **Define renewable sources of energy. Give one example.** **Level-1 (Remembering)**
   Ans: These are the sources of energy which will never be finished. These sources of energy can be used again and again. For example -solar energy, wind energy, hydro energy etc.

2. **What is flat plate Collector?** **Level-1 (Remembering)**
   Ans: The flat plate collector is the most fundamental solar power collector mainly used for domestic hot water system.

3. **What is water based flat plate collector?** **Level-1 (Remembering)**
   Ans: In water based flat plate collector, water is used as a medium of heat transfer.

4. **What is air based flat plate collector and where it is used?** **Level-1 (Remembering)**
   Ans: In air based flat plate collector, air is used as the medium of heat transfer. This type of plate collector is used for space heating or crop drying.

5. **What is the importance of special coatings on flat plate collector?** **Level-1 (Remembering)**
   Ans: A special coating helps in enhancing the plate absorber properties such as high temperature tolerance, resistance to UV and moisture degradation, durability, optical characteristics etc.

6. **What is the importance of advanced collector?** **Level-1 (Remembering)**
   Ans: Using advanced plate collector temperature can be enhanced to 150^0C thereby enhancing application range of the collector to power generation, solar air conditioning system etc.

7. **What is solar pond? Name the different zones of solar pond.** **Level-1 (Remembering)**
   Ans: Solar pond is a solar energy collector, fairly large in size and looks like a pond. A solar pond mainly has three zones: Upper Convective Zone, Middle Non-Convective Zone and Lower Convective Zone.

8. **What is the principle of solar drying?** **Level-2 (Understanding)**
   Ans: The principle of solar drying technique is to collect solar energy by heating up the air volume in solar collectors and transmit the hot air from the collector to an attached drying food chamber where food to be dried are kept.

9. **What is solar still?** **Level-1 (Remembering)**
   Ans: A solar still is a green energy product that uses natural sun energy to purify water.

10. **Define Biomass.** **Level-1 (Remembering)**

Ans: Biomass refers to the mass of renewable organic materials that comes from living organism, including plants, animals and microorganisms or from a biochemical perspective; cellulose, lignin, sugars, fats and proteins.

11. **What is anaerobic digestion?** **Level-1 (Remembering)**

Ans: Anaerobic digestion is a chemical process through which organic matter such as animal manure, food wastes, wastewater biosolids etc. is broken down by microorganisms (bacteria) in the absent of oxygen.

12. **What is wind energy?** **Level-1 (Remembering)**

Ans: Wind energy is the kinetic energy associated with the movement of atmospheric air. It captures the natural wind in our environment and converts the air's motion into mechanical energy.

13. **What do you mean by alternative energy?** **Level-1 (Remembering)**

Ans: The energy produced from any source other than fossil fuels may be termed as new energy or alternative energy.

14. **What is geothermal energy?** **Level-1 (Remembering)**

Ans: The word geothermal comes from the Greek word Geo means earth and theme means heat. Geothermal energy is basically heat stored within the earth. People all over the world use geothermal energy primarily to heat buildings and to produce electricity.

15. **What is ocean energy?** **Level-1 (Remembering)**

Ans: Ocean energy refers to all forms of energy derived from sea. Ocean energy is environmentally friendly and renewable source of energy.

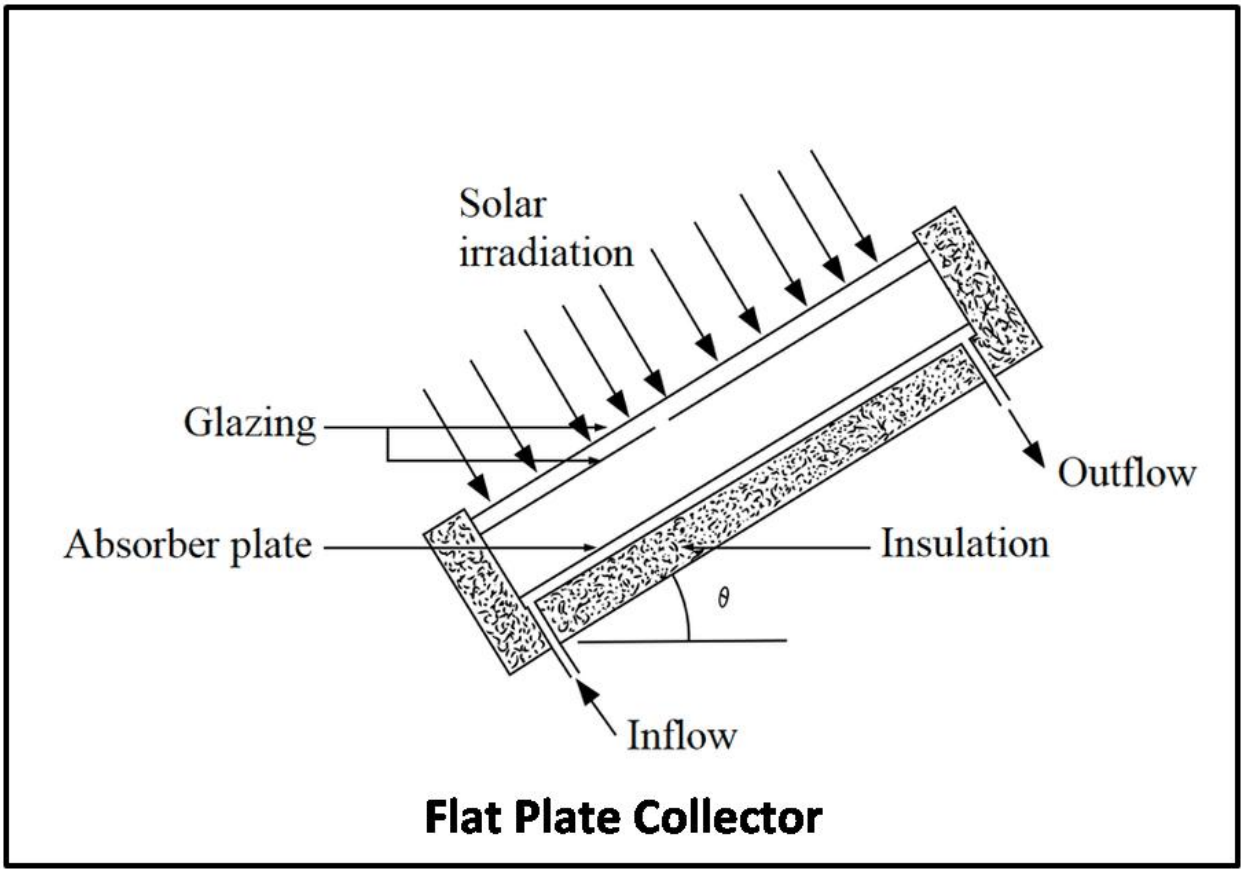
05 Marks Questions & Solutions ***Taxonomy Level***

1. Briefly explain flat plate collector and what are it's advantages. Level-2 (Understanding)

The flat plate collector is the most fundamental solar power collector mainly used for domestic hot water system.

The typical flat-plate collector includes following features:

- Black plate surface – to absorb incident solar radiation
- Glass cover – a transparent layer of glass to transmit radiation to the absorber at the same time prevent heat loss from the surface
- Tubes containing the fluid/air to transfer the heat from the collector
- Support structure to provide protection and hold the collector components
- Insulation in sides and bottom of the collector to prevent heat losses



In the plate collector, the solar radiation is absorbed by the plate having black surface and then absorbed heat get transferred to the fluid/air filled in the tubes. The thermal insulation in the bottom and sides of the collector, and the glass screen above the plate prevents heat loss during transfer of heat.

The flat-plate systems normally operate within the temperature range from 30° to 80° C. However, advanced collectors that employ vacuum insulation and selective coatings can achieve temperature up to 200° C.

For transfer of heat, either a medium, liquid or air can be used in the flat plate collectors. For liquid, water is one of the common options due to its accessibility and good thermal properties.

Advantages of flat plate collector- Easy to manufacture, low manufacturing cost, little maintenance etc.

2. Write short notes on solar dryer. **Level-2 (Understanding)**

Ans: Solar energy has become a viable alternative energy and can be converted into heat energy for various applications such as heating water, power generation, food drying, drying of agricultural products particularly vegetables and fruits etc.

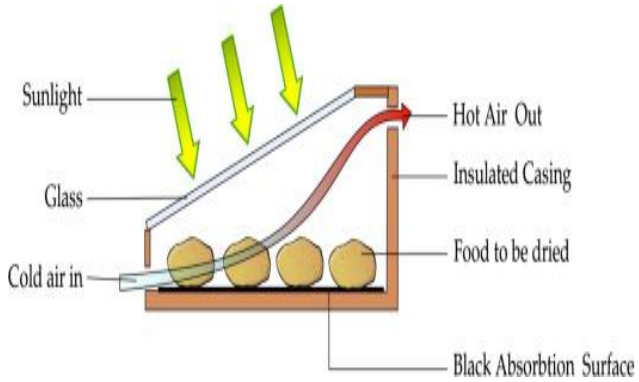
In old days, the traditional method of food drying was to place the foodstuffs in the sun in the open air. Although, this method was effective for small quantity of food but the food may easily be contaminated as was kept in open air.

In contrast to the sun drying, where the food is exposed directly to the sun, the solar drying uses indirect solar radiation.

The principle of solar drying technique is to collect solar energy by heating up the air volume in solar collectors and transmit the hot air from the collector to an attached drying food chamber where food to be dried are kept.

This is more hygienic technique of food drying as there is no secondary contamination of food products through rain, dust, insects, birds etc.

The products are drying by hot air only and there is no direct impact of solar radiation (sunshine) on the products. Solar dryer are suitable for drying large quantity of food products and for small scale farmers and food producers.



3. Explain production mechanism of biomass. Level-2 (Understanding)

Ans: The mechanism of biogas production from biomass involves following steps:

1. Biogas production starts from the arrival of bio wastes.

2. After that, it is crushed to make its consistency as even as possible. In this step, any unwanted non biodegradable waste, is separated from the mixture.

3. The crushed bio waste is made in slurry form by adding liquid to prepare it for the anaerobic digestion process. 4. Biomass is then delivered in the form of slurry to the biogas plant and pumped into the pre-digester tank where enzymes secreted by bacteria break down the biomass into an even finer consistency. 5. In the next step, the biomass is sanitized by heating the mixture at 70^0 C and above for minimum one hour. During this process any harmful bacteria present in the biomass is removed.

6. After sanitization process, the mass is pumped into the main biomass reactor in which biogas production takes place.

7. In the biogas reactor, microbial action begins and the biomass enters into a gradual process of fermentation. In this process, microbes feed on the organic matter, such as proteins, carbohydrates and lipids, and their digestion transforms these matters into methane and carbon dioxide.

8. Most of the organic matter is broken down into biogas which is mainly a mixture of methane and carbon dioxide, water vapour and other gases, approximately in three weeks duration.

9. The biogas thus generated is collected in a spherical gas holder placed at the top of the biogas reactors. After this, the biogas is ready for use by industries, enterprises and consumers. The residual solids and liquids created in biogas production are referred to as digestate. This digestate goes into a post-digester reactor and from there further into storage tanks. Digestates are well suited for uses such as fertilization or for other gardening purpose.

4. Explain thermal characteristics of biomass. Level-2 (Understanding)

Ans: Biomass can be a source of liquid fuel or gaseous fuel or solid fuel. Out of these fuels, solid fuel is most commonly used. The important thermal characteristics of solid biomass fuel may include:

- Heat value
- Moisture content
- Composition
- Fuel size and density

Heat Value:

Amount of heat available in a fuel (kJ/kg) denotes its heat value. It is one of the most important characteristics of a fuel as it indicates the total amount of energy available in a particular fuel.

The heat value in a given fuel type is mostly a function of the fuel's chemical composition. The heat value of a fuel can be expressed as: the higher heating value or the lower heating value.

Moisture Content:

Moisture content affects the burning property of a biomass fuel. Biomass fuel with high moisture content burn less readily than a low moisture content biomass fuel, hence provide less useful heat per unit mass.

Composition:

In addition to heat and moisture content, composition of various biofuels affects its performance. The main compositional properties includes; ash content, susceptibility to slagging and fouling, and percent volatiles.

Fuel size and density:

The size and density of the biomass fuel particles is also one of the important factors that affects its thermal characteristics. They affect the rate of heating and drying during the combustion process and thus burning characteristics of the fuel gets affected.

5. Describe advantages and disadvantages of wind energy. Level-1 (Remembering)

Ans:

<u>Advantages</u>

- Wind is an unlimited, freely available renewable resource. Therefore, it is a sustainable technology.
- As the wind is a natural occurrence resource, harvesting the kinetic energy of wind doesn't affect currents of wind cycles in any way.
- It is a clean, non-polluting way to generate electricity.
- Unlike other types of power plants, it does not emit air pollutants or greenhouse gases. The wind turbines harmlessly generate electricity utilizing the kinetic energy of passing by wind.
- Wind energy is far more eco-friendly than the burning of fossil fuels for generating electricity.
- Once the turbines and energy centres are installed, the maintenance cost of turbines and generation of wind power is minimal.
- Wind power turbines can be placed wherever necessary as it needs very little space.

<u>Disadvantages</u>

- The giant size of wind power turbines distracts viewers from the beautiful surroundings.
- Wind turbines may be dangerous to flying animals. Many birds and bats have been killed by flying into the rotors.

- Usually, the wind turbines are located in the remote areas. Hence, the cost of travel and maintenance on the turbines increases and is time consuming.
- Offshore wind turbines require boats and can be dangerous to manage.
- Some wind turbines tend to generate a lot of noise which can be unpleasant.
- In the darkness/at night it may be difficult for incoming boats to see wind turbines thus may lead to collisions.

ENVIRONMENTAL SCIENCE (1ST SEMESTER 2024-25)

UNIT-5 QUESTIONS AND ANSWERS (SET-1)

2 Marks Questions and Answers

Bloom's taxonomy level	Q. No.	Questions & Solutions
Remembering	1	**Define Solid Waste management.** **Ans:-** Solid Waste Management may be defined as the application of technique that will ensure the orderly execution of the function of collection, processing & disposal of solid wastes. I. Collection refers to gathering of solid wastes from places such as residences, commercial, institutional & industrial establishments and public places. II. Processing refers to the activity applied to solid waste to prepare for its subsequent operation. III. Disposal refers to the placing of solid waste in its ultimate resting place.
Remembering	2	**Define Municipal Solid Waste (MSW).** **Ans:-** Municipal waste is defined as waste collected and treated by or for municipalities. It comprises of both liquid and solid wastes. Municipal solid waste (MSW) is generally used to describe most of the non-hazardous solid waste from a city, town or village that requires routine collection and transport to a processing or disposal site. Sources of MSW include private homes, commercial establishments and institutions as well as industrial facilities. However MSW does not include wastes from industrial processes, construction and demolition debris, sewage sludge, mining wastes or agricultural wastes.
Remembering	3	**Define Bio-Medical waste.** **Ans:-** Biomedical wastes can be defined as wastes which are generally generated in hospitals, biological activities, veterinarian clinics and health care units. There are generally five different kinds of medical waste; infectious waste, pathological waste, radioactive waste, pharmaceutical and general waste.
Understanding	4	**Explain the environmental effects of improper waste management?** **Ans:-** Improper waste management can cause air, water, land, visual, noise, and odour pollution, as well as explosion hazards. It can also create breeding grounds for flies, mosquitoes, roaches, rodents, and pigs, which can spread diseases.
Remembering	5	**State two methods of sanitary landfill.** i) **Area method/daily cover**: In the area method, waste is spread over a large, flat area and covered regularly with soil or other materials. The waste is disposed of in horizontal layers, with each new layer being placed over the previous one. The area is expanded as needed until it reaches its capacity. This method is used, when excavation is not possible, especially when the ground water level is high. ii) **Trench method/ Bottom Liner System**: In the trench method, a trench or

		pit is excavated into the ground, and waste is dumped into the trench. Once the trench is filled, it is covered with soil or other materials to form a new layer, and the process is repeated. The trench method is typically used in areas where the land is more suitable for excavation, especially when the ground water level is low.
Understanding	6	**Define sanitary landfill. How it is different from an open dump?** Ans: A sanitary landfill is a waste disposal site where trash is buried in a controlled manner to prevent environmental contamination. Sanitary landfills are designed with protective liners and systems to prevent leachate and gas emissions, & isolated from the environment, while open dumps lack such safeguards.
Understanding	7	**Describe the importance of energy recovery in MSW management?** Ans: Energy recovery is an important part of MSW management, as it reduces landfill dependency, provides renewable energy, and helps in resource conservation.
Understanding	8	**What is a Carbon Credit? Explain how does it work.** Ans: A carbon credit is a permit that allows a company to emit a certain amount of carbon dioxide or other greenhouse gases. One credit permits the emission of one ton of carbon dioxide or an equivalent amount of another greenhouse gas. Companies that reduce their emissions can sell their excess credits to other companies that need them to comply with regulations. This creates a financial incentive for companies to lower their emissions.
Remembering	9	**Defines hazardous waste in MSW. Give some examples of hazardous waste in households.** **Ans:** i) Waste that is toxic, flammable, corrosive, or reactive are called hazardous waste. ii) Some examples of hazardous waste in households are Batteries, pesticides, and cleaning chemicals.
Understanding	10	**Explain any 2 methods that can be adopted for safe disposal of hazardous wastes.** **Incineration:** By burning the waste materials in high temperature can destroy the toxic wastes. Although the method of incineration releases toxic gases which may affect our environment, but now a days more effective incinerators are developed that limit the quantity of emissions released in the atmosphere. Flammable wastes can also be burned and used as energy sources. **Recycling:** It is one of the best methods to reduce quantity of hazardous wastes. We must try to reuse the used materials instead of just throwing them away, although it may need some creativity. Most flammable materials can be recycled into industrial fuel. Some materials with hazardous constituents can be recycled, such as lead acid batteries etc.
Remembering	11	**What are the 3Rs in waste management?** **Ans:-** The 3Rs in waste management stand for **Reduce, Reuse, and Recycle**, which are key principles to minimize waste generation and promote sustainability.
Understanding	12	**What is ISO 14000, and why is it significant for industries?** Answer: • ISO 14000 is a family of standards related to environmental management that helps organizations to minimize their operations that negatively impact the environment, comply with applicable regulations, and

		continuously improve in environmental management. • For industries, implementing ISO 14000 helps them enhance environmental performance, reduce waste, and improve compliance, which can result in cost savings and a positive public image.
Understanding	13	**Explain the importance of carbon footprint calculation for fabrication industries.** Answer: Calculating the carbon footprint helps fabrication industries understand the extent of their greenhouse gas emissions and identify opportunities for reduction. It allows them to set goals, track progress, and communicate their environmental efforts to stakeholders, which can lead to enhanced brand reputation and regulatory compliance.
Remembering	14	**Define Solid waste.** **Ans:-** Solid waste is defined as the material arising from human & animal activities & is being discarded as useful stuffs. The waste materials may be in gaseous form (e.g., automobile exhaust, smoke from chimney etc.), in liquid form (e.g., sewage water, effluents from industry etc.), or in solid form (e.g., food waste, farm waste etc.)
Understanding	15	**How does the carbon footprint impact the environment?** **Answer:** • A carbon footprint measures the total greenhouse gas emissions caused by an individual, organization, event, or product, expressed as carbon dioxide equivalents. High carbon footprints contribute to climate change by increasing the concentration of greenhouse gases in the atmosphere, which traps heat and raises global temperatures, leading to adverse environmental effects like extreme weather and habitat loss.

5 Marks Questions and Answers

1. **State and explain 3Rs and its principles in waste management. (Bloom's taxonomy Level: Understanding)**

Answer:

i) The principle of reducing waste, reusing and recycling resources and products is referred to as 3Rs.

All 3Rs help us to cut down the amount of waste we generate.

ii) It is one of the principles of solid waste management. Basically, the 3R concept is a sequence of steps on how to manage waste properly.

iii) The first of 3Rs, reducing

It is the best way to go about managing solid waste.

It is quite simple, the less you use the less waste you will produce. Some of ways mentioned below may help in reducing the waste generation:

- Buying products with less packaging to minimize the waste generated from product packaging.
- Avoiding disposable goods such as paper plates, cups, napkins, etc.
- Buying durable goods to avoid frequent disposal.
- Use electronic mail for communication wherever possible.

iv) The second of 3Rs, is reuse.

It makes economic and environmental sense to reuse products. If you reuse something as opposed to throwing it keeps away the waste from landfills. Sometimes it involves creativity also. Some of the ways are mentioned below:

- Reuse products in different ways. For example, use a coffee can to pack tiffin; use plastic microwave dinner trays as picnic dishes.
- Sell old clothes, appliances, toys and furniture or donate them to charities.
- Use ceramic coffee mug instead of paper cups.
- Use grocery bags or bring your own bags to the store. Do not take a bag from the store unless you need one.

v) The final and probably the best-known R of 3Rs stands for recycling.

It involves manufacturing of new products from the old and used materials, using necessary recycling process. Begin recycling at home and at work:

- Buy products from recycled materials.
- Purchase recycled materials for office supply, equipment etc.
- Use recycled paper for letterhead, copier paper, newsletter etc.

2. Describe the sources and characteristics of Municipal Solid Waste. (Bloom's taxonomy Level: Remembering)

Ans:- The main sources of municipal solid wastes may be classified into the following categories:

1. **Residential sources**: Wastes from household and residential areas. These are the major sources of municipal solid wastes.
2. **Institutional sources**: Wastes from government and public institutions such as schools, colleges universities, government offices etc.
3. **Commercial establishments**: Wastes from business centers such as food and drink establishments, shops, banks etc.
4. **Health facilities**: Wastes from hospitals and other health facilities.
5. **Construction and demolition activities**: Wastes from various types of construction and demolition activities such as construction of apartments, demolition of slums etc.
6. **Industrial sources**: Wastes from various types of industrial processes.
7. **Agricultural sources:** Wastes from agricultural activities.
8. **Open areas:** Wastes from roadside dustbins, street sweeping and other public places.
9. **Electronic and electrical wastes (e-wastes):** Waste from electronic devices like computers, phones, radio etc. and household appliances such as cookers, washing machines etc

Characteristics of Muncipal Solid Waste are:-

PHYSICAL CHARACTERISTICS

They are important for the selection and operation of equipment and also for the analysis and design of disposal facilities. It may include following parameters:

I. **Density**: Density of a waste is its mass per unit volume (Kg/m3). It is required for the design of landfills, storage, type of collection and transport vehicles.
II. **Moisture content**: It is the ratio of the weight of water to the total weight of waste. Cost of collection, transport and economic feasibility of waste treatment by incineration depends upon the moisture content of the waste.
III. **Size of waste constituents**: Size of raised constituents are required for the design of mechanical separators, shredder and waste treatment processes.
IV. **Calorific value**: It is the amount of heat generated from combustion of unit weight of a substance, expressed in kcal/kg. Solid Waste Management, ISO 14000 & Environmental Management 77
V. **Permeability**: The permeability of compacted wastes is an important physical property because it governs the movement of liquids and gases in a landfill.
VI. **Compressibility**: It is the degree of physical changes in the solid waste when subjected to pressure.

CHEMICAL CHARACTERISTICS

For understanding the behaviour of solid waste materials, the knowledge of its chemical composition is also important. Its chemical characteristics may include PH value, Nitrogen, Phosphorus, and potassium, total carbon etc. and bio-chemical characteristics may include carbohydrates, proteins, natural fiber etc. Heavy metals, pesticides, insecticides etc. may fall under toxicity characteristics.

3. **Differentiate between energy recovery and sanitary landfills in terms of waste management. (Bloom's taxonomy Level: Analyzing)**

Answer:

Energy Recovery	**Sanitary landfills**
Purpose: **i) Energy Recovery** (e.g., WTE) aims to convert waste into useful energy, reducing landfill volume and providing an alternative energy source. **Environmental Impact:** **ii) Energy Recovery** can reduce the volume of waste going to landfills and mitigate methane emissions, but it requires careful management of air pollutants (such as dioxins and particulate matter). **Energy Generation:** **iii) Energy Recovery** provides an energy output, converting waste into heat or electricity **Waste Reduction** **iv) Energy Recovery** helps reduce the volume of waste that ends up in landfills and can recover some energy value from non-recyclable waste. **Common method used** **v)** Incineration, gasification, pyrolysis, and anaerobic digestion.	**Purpose:** **i) Sanitary Landfills** primarily serve as a disposal method for waste, focusing on isolating waste from the environment and managing it safely. **Environmental Impact:** **ii) Sanitary Landfills** reduce methane emissions through gas capture, but still contribute to land consumption, slow decomposition, and the long-term environmental impact of leachate. **Energy Generation:** **iii) Sanitary Landfills** do not generate energy unless methane recovery is implemented, and even then, the amount of energy produced is relatively small compared to energy recovery plants. **Waste Reduction** **iv) Sanitary Landfills** do not reduce the volume of waste except through natural compaction and decomposition, and they do not recover energy in a direct way (unless gas recovery is implemented). **Common method used** **v)** Area method/daily cover, Trench method/ Bottom Liner System

4. **Define hazardous waste. Discuss some methods for Hazardous waste disposal. (Bloom's taxonomy Level: Understanding)**

Answer:

Definition:

i) The wastes generated from industry, hospital, household containing toxic substances are known as Hazardous waste. These wastes may be in the form of solids, liquids or gases.

ii) These wastes can have very harmful effects on the human health and environment, when left inappropriately treated or managed.

Some methods for Hazardous waste disposal:

i) Incineration: Burning waste at high temperatures to destroy toxic components.

ii) Landfilling: Placing treated or stabilized waste in secure landfills.

iii) Chemical treatment: Using neutralization, precipitation, or oxidation to render waste less hazardous.

iv) Physical Treatment: Methods like filtration, distillation, or centrifugation to remove contaminants from the waste.

v) Bioremediation: Using microorganisms to break down or degrade hazardous waste, especially organic compounds.

vi) Recycling and recovery: Extracting useful materials from waste, such as metals or solvents. Each method is chosen based on the waste type and environmental regulations to ensure safe and effective disposal.

5. Describe the sources & characteristics of Bio-Medical wastes. (Bloom's taxonomy Level: Understanding)

Ans:- **Sources of Bio-medical waste**

The sources of biomedical wastes are the place or location, where these wastes are generated. The sources may be classified into two broad categories; Major and Minor sources.

Major sources generate more amount of the wastes compared to the minor sources and on regular basis. These sources include; Hospitals, Emergency care facilities, dialysis centers, transfusion centers, blood banks, clinical laboratories, research laboratories, mortuaries, veterinarians and nursing homes.

Minor sources include; medical clinics, cosmetic clinics, home care, paramedics and institutions.

Characteristics of Bio-medical waste

Biomedical waste is characterized on the basis of its source of generation and level of hazard to the environment. It can be classified into two categories; non-hazardous wastes and hazardous wastes.
Non-hazardous wastes are type of waste which does not pose any direct threat to the people and environment as they are non-toxic by nature. But still, it should not be thrown be in open areas or sewer line because of the risk it may pose threat to the environment. The non-hazardous wastes may include; wash water, paper cartoons, packaging materials, food remnants etc. These wastes are generated mainly from various organizations, maintenance of hospital and health care centres. **Hazardous wastes** are the waste which pose direct threat to the people and environment because of their toxic and infectious characteristics. The various hazardous wastes may include:
1.**Infectious wastes**: Infectious waste containing pathogens (bacteria, viruses, parasites, fungi etc.) In large quantity may pose threat to the humans. Infectious wastes include human/animal tissue, faeces and urine from the infected patients, blood-soaked bandages, surgical gloves, cultures, swabs used to inoculate cultures, isolation wards waste, equipment that have been in contact with the infected patient etc.
2. **Pathological wastes**: Human tissues or fluids e.g., body parts, blood and other body fluids, foetuses etc.
3. **Pharmaceutical wastes**: It contains pharmaceuticals of expiry date, contaminated pharmaceutical bottles, boxes etc
4. **Radioactive wastes**: The treatment where radioactive isotopes are used generate radioactive waste like nuclear medicine treatments, cancer therapies and medical equipment. Radioactive waste has the potential to harm the human health.
5. **General Wastes**: The waste generated at medical facilities is not very different from the general household or office waste. Waste like paper, plastics, liquids and all the waste which are not included in the above three wastes, falls under this category.