

QUESTION BANK (IMPORTANT QUESTION ANSWERS)

ENVIRONMENT AND ECOLOGY (BAS-104)

Short Answers

Unit 1

Q1 Write the importance of the environment.

Ans.: Importance of Environment

- The environment is our life support system and it is truly impossible to estimate its value.
- For ex- Forest prevents soil erosion, landslides & flooding maintains the purity of air and water, affects local & global rainfall.
- Biodiversity provides the problem-solving raw material for shelter & useful products.
- Bacteria and insects break down organic material to produce nutrients and plants can grow.
- Plants provide oxygen and food for animals and manage other benefits.
- Bees and other insects disperse their seeds and spores.
- Nature provides us with penicillin, aspirin, morphine, steroids the medicine “Taxol” which fights breast cancer and ovarian cancer.
- The fragile balance of plants and animals that share the earth took millions of years to develop.
- So, nature must not be taken for granted – it must be cared.

Q2 How environmental science is of multidisciplinary nature?

Ans. Environmental Studies is a **multidisciplinary subject**. It employs subjects like chemistry, physics, botany, zoology, physiology, geography, geology, geophysics, and metrology to describe our environment's biological and physical nature. In order to understand how people function separately and also in a group, Environmental Studies involves an understanding of philosophy, ethics, psychology, anthropology, demography, archaeology, economics and political science. Laid against an ecological format, the information gleaned through the study of all these varied disciplines gives us a holistic view of the environment for sustaining life on earth on an infinite time scale.

Q3 What are the basic environmental segments?

Ans.: Environment Segments – There are four major environmental segments such as-

Atmosphere – It is the blanket of suspended liquids, solids & gases that envelop the earth.

Biosphere – It includes plants, animals and other organisms.

Hydrosphere – It includes the water present on the earth's surface.

Lithosphere – It is the solid part of the earth's crust – ie crust and outer.

Q4 Define the terms ecosystem and ecology.

Ans.: Ecosystem: The term ecosystem was introduced by the British ecosystem “Sir Arther Tansley” (1935) who defined it as” the system resulting from integrative of all living and non-living factors of the environment.

OR

Can be defined as a structural and functional unit of the biosphere or segment of nature consisting of community a of living beings & physical environment interacting and exchanging materials between them.

Ecology: “Ecology is the study of organisms, the environment and how the organisms interact with each other and their environment.”

Q5 Discuss Forest ecosystem in brief.

Ans. Forest Ecosystem- 30% of area should be covered with forest. At present it is only 8-10%.

Abiotic Components- Light conditions may vary due to complex stratification in plants. Minerals are abundant. Organic matter adds to the soil from debris and litter accumulation.

Biotic Components-

Producers- Much species diversity mainly trees or shrubs. *Shorea robusta*, *Tectona grandis*, *Thuja*, *Juniperous*

Consumers-

Primary- Ants, Flies, Bugs, Spiders (on leaves): Elephant, Deer, Squirrel (leaves, Fruits)

Secondary- Snakes, Birds, Lizards, Wolf

Tertiary- Lion, Tiger

Decomposer-

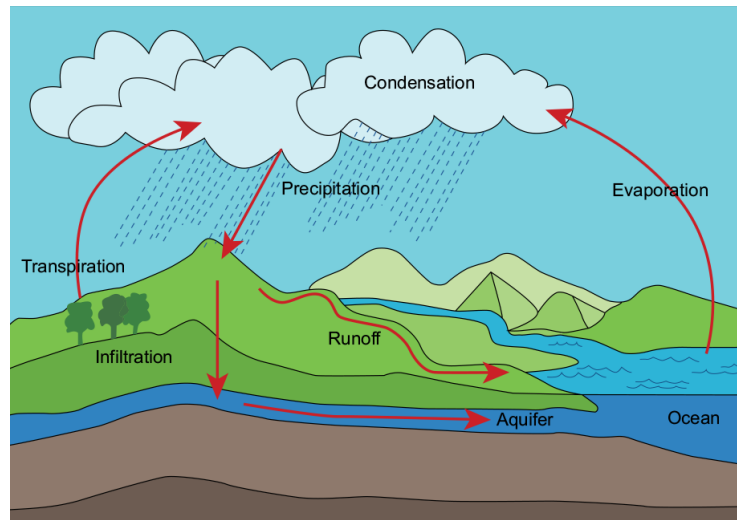
Fungi- *Aspergillus*, *Ganoderma*, *Fusarium*

Bacteria- *Bacillus*, *Clostridium*

Actinomycetes- *Streptomyces*

Q6 Draw hydrological / water cycle.

Ans.:



Q7 Classify food chains with suitable examples.

Ans. There are three important types of Food chains-

1. Grazing food chain- This type of food chain starts from the living green plants (producers), and the grazing herbivores feed on the producers. The grazing forms later form the prey for predators.

Terrestrial: Grasses → Grasshopper → Frog → Snake → Hawk

Aquatic: Phytoplanktons → Zooplanktons → Fish → Crane → Hawk

2. Detritus Food Chain- This type of food chain goes from dead organic matter into microorganisms and then to organisms feeding on detritus and their predators. Such ecosystems are thus less dependent on direct solar energy. These depend chiefly on the influx of organic matter produced in another system.

Detritus → Microorganisms → Crabs and Shrimps → Small Fishes → Large Fishes

3. Parasitic Food Chain

This food chain in which parasites live on or inside the body of the host derives benefit from the host the parasite gets the nutritional benefit and the host is harmed.

Tree → Birds → Insects/Mites → Microorganisms

Q8 Differentiate between the food chain and the food web.

Ans.:

Food – Chain	Food – Web
- The transfer of food energy from the source in plants through a series of organisms with repeated costing and being eaten up is known as the food chain.	- A network of food chains which are interconnected at various trophic levels so as to form as the number of feeds
- The transfer or of energy from the trophic level to the other is known as the food chain.	- A food web opens several alternate pathways for the flow of energy.
- For Ex.- i) Vegetation – Rabbit – fox – wolf – tiger	-For Ex.-i) A field mouse may be eaten by a wild eat, a snake, or an owl.

ii) Phytoplanktons – Zooplanktons – small fish – shark large fish	ii) A wolf or jackal can eat rabbit or a deer.
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Q9 Trace the effects of transportation.

Ans.: **Transportation Effects** – With increasing industrialization & urbanization, transportation activities are also increasing and posing damage to the environment, as-

- Emission: Vehicle emission cause air pollution. Pollutants are CO, NO_x, benzyne, and particulate contained in burnt hydrozoans. Diesel engines emit NO_x, smoke, and particulates
- Expansion: Construction of new roads, flyovers, and railway tracts, is required transport allows urban expansion which consumes valuable agricultural land and natural habitat.
- Noise pollution: Arbitrations and noise affect people, who live near busy roads, highway, airports, etc. Affects our eardrums and leads to deafness.
- By Products: Heavy metals and petroleum products from vehicles contaminate land and water, harbors, and estuaries areas.
- Marine oil spills: Marine oil spills can devastate marine and coastal environments. Excessive oil leakage leads to the death of aquatic plants & animals due to suffocation and non-availability of oxygen.
- Urban transportation & their wastes disposed of into the oceans & seas harms biodiversity & environment.
- Impact on security: International travel and trade allow organisms or diseases to enter a country or region.
- Automobiles emit toxic gases, smoke& dust which have ill effects on human health.

Q10 Give the impacts of mining.

Ans.: Impacts of mineral extraction / Mining

- Pollution of surface and groundwater sources due to the release of harmful trace elements such as cobalt, copper, lead etc.
- Soil is degraded, and the land has been destroyed in a known as derelict or mine spell.
- Loss of biodiversity and changes of extinction of wildlife.
- Pollution of air due to emission of mine dust, harmful gasses, and transport vehicles.
- Accidental hazards during the operations.
- Stress on local services including water supplies, and solid waste management.
- Causing a wide variety of diseases due to toxic water.
- Rehabilitation problems for those who have lost their habitats.

Q11 Write about the significant impacts of industrialization on the environment.

Ans.: **Industrialization Effects**

The environmental effects of Rapid industrialize are as follows:-

- Over – exploitation of Natural Resources.
- Energy Problems.
- Environmental Pollution.
- Adverse effect on Human Health.
- Stress on Transportation.
- Improper disposal of Solid Waste due to lack of land surface area.
- Generation of solid-waste increases.

Q12 List out eight steps of the EIA process.

Ans. The eight steps of the EIA process are presented in brief below-

- Screening
- Scoping
- Impact analysis
- Mitigation
- Reporting
- Review of EIA
- Decision-making
- Post monitoring

Q13 Define sustainable development.

Ans.: **Sustainable development-** Gro Harlem Brundtland (1939), former P.M. and Director of WHO (world health organization) defined the term as a form of development or progress as “meeting the needs of the present without compromising the ability of future generations to meet our own needs.”

Or

Sustainable development is defined as “the successful management of resources for development and to satisfy the human needs maintaining and concerning the resources.”

In order to achieve a sustainable life, a balance and equal distribution of natural resources is necessary.

Unit 2

Q1 What are natural resources?

Ans.: Natural resources occur naturally within environments that exist relatively undisturbed by humanity, in a natural form. Natural resources are derived from the environment. Some of them are essential for survival, while most are used to satisfy our wants. A natural resource can be a substance, an energy unit or a natural process or phenomenon, eg. Land, soil, water, forests, grassland etc.

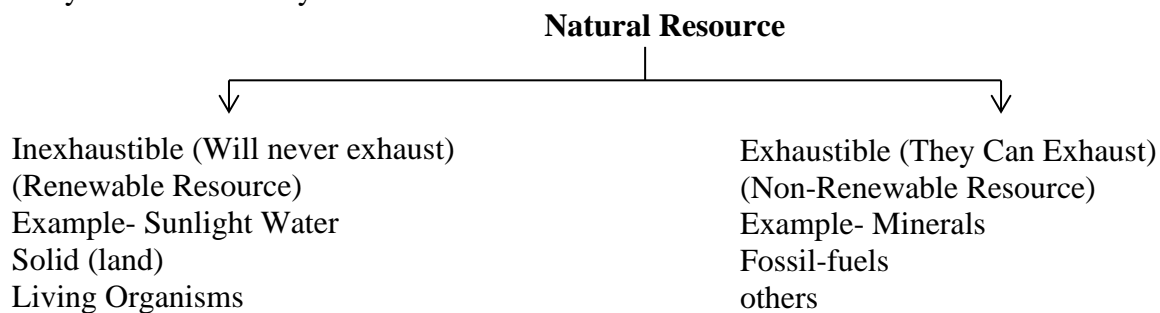
Q2 How do you classify our natural resources?

OR

What are non-renewable and renewable resources?

Ans.: **Natural Resources:** Natural Resources are those components that are inherently created by the environment for supporting life. A natural resource can be a substance, an energy unit or a natural process or phenomenon, eg Land, soil, water, forests, grassland etc. These are classified into the following major categories-

- Renewable natural resources are those resources have the capacity to replenish or reappear or regenerate themselves within a limited period of time. For example soil, water, plants, animals & micro-organisms etc.
- Non-renewable resources.
 - Non-renewable resources are those resources lack the ability or cannot be generated, replenished or reappear within a limited period of time. For Ex.- Fossil fuel, minerals.
 - They take millions of years to form.



Q3 What are the different techniques of water conservation?

Ans.: Conserving water helps us by supplying more amount of water for longer usage. It has become necessary in all areas because these natural resources are reducing along with the increasing population and their usages.

There are several ways to conserve water. Here are some important and easy ways for the conservation of water-

- Keeping the tap closed when not in use.
- Check for openings or leaks in water distribution pipes.
- Make sure to use collected rainwater for gardening or washing purpose.
- Always have a measure of how many buckets of water is wasted in a day and try to reduce.
- Do not run more water than necessary while washing and cleaning clothes, utensils, etc.
- Do not prolong your bathing. Go for a quick shower rather than wasting buckets of water
- Rainwater harvesting is one of the best methods used for conserving water. There are different methods used to preserve rainwater instead of getting it wasted.

Q4 What are waterborne diseases?

Ans.: **Waterborne disease-** Waterborne diseases are caused by pathogenic microorganisms, which are directly transmitted by the consumption of contaminated drinking water. Waterborne diseases can be caused by protozoa or bacteria. For Example- Dysentery caused by *Entamoeba histolitica*

Botulism caused by *Clostridium botulinum* bacteria

Cholera caused by *Vibrio cholerae* bacteria

Typhoid caused by *Salmonella Typhi*

Q5 Define fluorosis.

Ans.: **Fluoride Problem**

- Fluoride is an essential element required by our body in our daily diet or drinking water.
- The maximum tolerance level in the human body is 1.5 ppm (WHO Standards).
- The daily intake of (F) from food and drinking water is less than 1 ppm.
- The prolonged intake of water containing excess fluoride causes the disease known as fluorosis.
- In India, there are several places where fluorosis has been reported such as Andhra Pradesh, Orissa, Punjab, Haryana, Delhi etc.

Symptoms of Fluorosis – Fluoride does not concentrate in any tissue but only in the bones & teeth.

1. Dental Fluorosis -
 - i) Teeth discoloration
 - ii) Damage to enamel
 - iii) Mottling of teeth.
2. Skeletal Fluorosis -
 - i) Deformation of bones.
 - ii) Stiffening of bones, joints.
 - iii) Back pain
 - iv) Gastrointestinal effects & diarrhea.

Skeletal Fluorosis is also known as crippling disease due to the deformation of bones.

Q6 What are biogeochemical cycles?

Ans.: **Biogeochemical cycles-** “Biogeochemical cycles are the cyclic pathways in which a regular and continuous transition of an element occur from the environment into the organism and from the organisms into the environment.” Biogeochemical cycles are of two types-

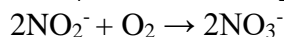
- A) Sedimentary cycles: In this cycle main reservoir of the nutrients is the soil. For ex- sulfur (s) and phosphorus (p) cycle.
- B) Gaseous Cycle: In this type of cycle the main reservoir of nutrients is in the atmosphere and oceans. For ex.- carbon (c), oxygen (O_2), and Nitrogen (N_2)

Q7 Enlist nitrifying bacteria which operate nitrogen cycle.

Ans.: Nitrifying bacteria are microorganisms that play a very vital role in the nitrogen cycle as converters of soil ammonia to nitrates. The process of nitrification, involves two different groups of bacteria, one that converts ammonia to nitrites (*Nitrosomonas*, *Nitrospira*, *Nitrosococcus*, and *Nitrosolobus*) and the other to convert nitrites to nitrates (*Bacteria Nitrobacter*, *Nitrospina*, and *Nitrococcus*). In the process of agriculture, irrigation if the solution is diluted with ammonia results in an increase in the soil nitrates, through the action of nitrifying bacteria.

Nitrification- In the process of bacteria nitrification, ammonia is converted into nitrate with the presence of bacteria in the soil, nitrites are formed by the oxidation of ammonia with the help of *Nitrosomonas* bacteria species. further, the produced nitrites are converted into nitrates with the help of *Nitrobacter* bacteria, this conversion is very important as ammonia gas is very toxic for plants.

The process of bacteria nitrification involves the following reaction:



Q8 Classify mineral resources.

Ans.: **Types of Mineral Resources-** Mineral resources can be divided into two major categories.

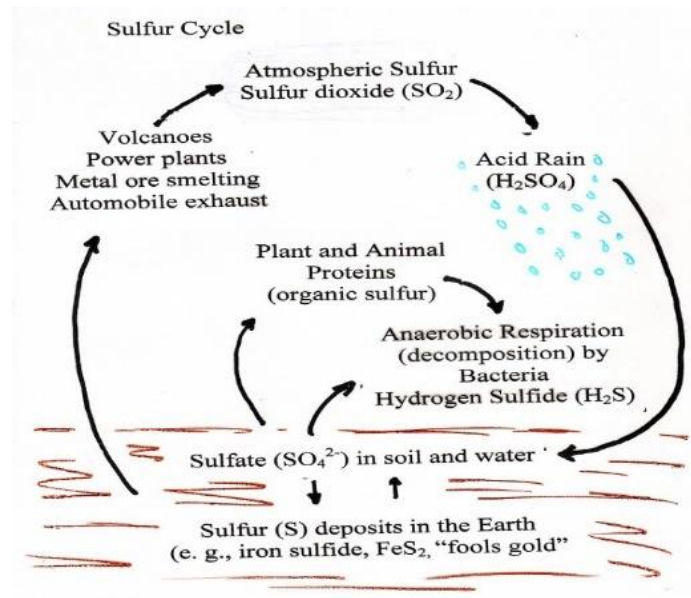
- **Metallic Mineral Resources**
- **Non-metallic Mineral Resources**

Another classification is-

- **Critical Minerals**- decides economy of any nation
- **Strategic Minerals**- used in defense activities

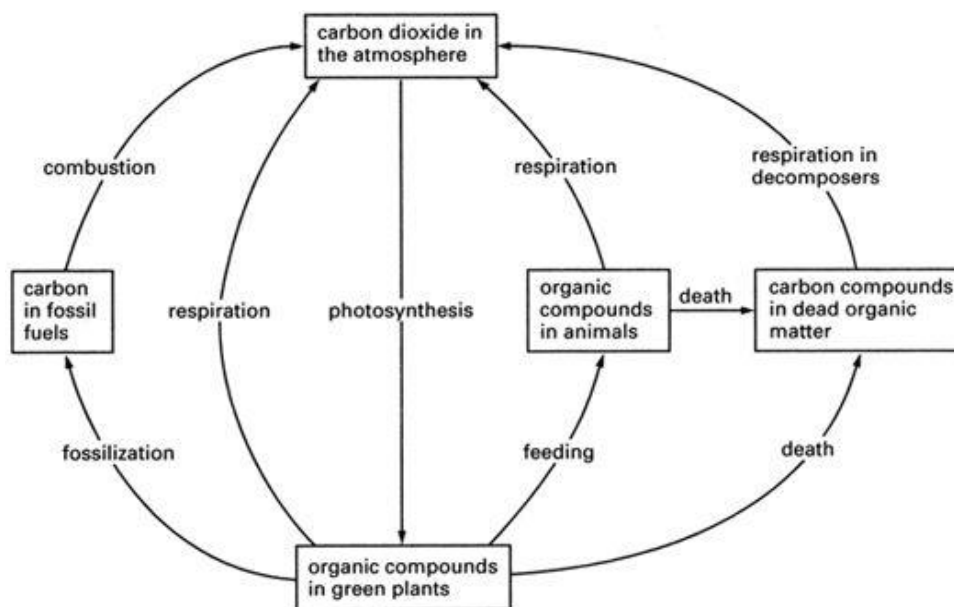
Q9 Draw a neat sketch of sulfur cycle.

Ans.:



Q10 Draw the carbon cycle (only a neat sketch).

Ans.:



Q11 Give a brief account of renewable and non-renewable energy resources.

Ans.: A source of energy is one that can provide an adequate amount of energy in a usable form. On the basis of availability of energy resources can be divided into two groups.

1. Renewable energy – (non-conventional energy)

⇒ They can be replenished a short period of time and can be regenerated continuously in nature.

⇒ They are inexhaustible. eg wood, solar energy, wind energy, hydropower, biomass energy etc.

2. Non-renewable energy (conventional energy)

⇒ They have accumulated in nature over a long period of time.

⇒ They cannot be replenished quickly when exhausted e.g. coal, petroleum, natural gas, and nuclear fuels like thorium.

Q12 Describe merits and demerits of wind energy.

Ans.: **Merits of wind energy**

- Wind is free, wind farms need no fuel.
- Produces no waste and green-house gases.
- The land be health can usually will be used for forming.
- Good method for supplying energy for coastal area.

Demerits of wind energy

- The wind is not always predictable.
- It can kill birds & migrating flocks.
- Creates ample noise.

Q13 Give some advantages of hydrogen energy.

Ans.: **Hydrogen-** As hydrogen burns in air, it combines with oxygen to form water and a large amount of energy (150 kilojoules per gm.) is released. Due to its highest calorific value, hydrogen serves as an excellent fuel. Moreover, it is non-polluting. It can be easily produced. Its production becomes possible by thermal dissociation, photolysis or electrolysis of water.

- Hydrogen is a perfect fuel that can be manufactured by the decomposition of water.
- It is regarded as an alternative future source of energy/fuel.
- It can be used as a fuel cell to power electric-motors or burned in ICE.

Q14 Differentiate between nuclear fusion and nuclear fission.

Ans.: **Nuclear fission & Nuclear fusion-** Nuclear energy is regarded as a conventional form of energy. It is derived from the nucleus of an atom. Nuclear energy is basically derived by two types of reactions i.e.

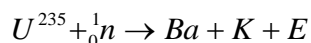
✚ Nuclear fission

✚ Nuclear fission

✚ Nuclear fission –

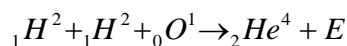
In this process, the heavy nucleus splits into two lighter nuclear with a huge release of energy. This reaction involves the bombardment of neutrons.

It is a chain mechanism reaction, that involves the reaction of radioactive materials such as: Uranium, Plutonium, Thorium



✚ Nuclear fusion -

In this process, the lighter nuclear (Hydrogen) fuse together to form heavy nuclei (Helium)., with the release of energy.



Q15 What are the impacts of hydropower plants or DAMS?

Ans.: The negative environmental consequences of hydropower- *Hydroelectricity is technically a “clean” energy source, but there are environmental ramifications of harnessing it for large amounts of power. Here are a few of the consequences that come with developing hydropower systems:*

Damage to wildlife habitats and migratory paths

Constructing large storage or pumped storage hydropower plants involves blocking, diverting, or changing the natural course of river systems. One issue that arises with blocking a river's natural flow is the simultaneous blocking of important migration routes for fish. Additionally, damming rivers also often reduces water and sediment flow to dangerous levels, which impacts downstream wildlife populations. Low water flow downstream, as well as low nutrient flow, can lead to loss of habitat and healthy water for animals.

Land use

Many large hydropower facilities lead to an altering of the surrounding landscape, especially around reservoirs created by damming rivers. Just as reducing downstream water flow can cause a loss of habitat, creating reservoirs to generate electricity in storage and pumped storage hydropower systems often cause upstream flooding that destroys wildlife habitats, scenic areas, and prime farming land. In some instances, this flooding can even force human populations to relocate.

Greenhouse gas emissions from reservoirs

While generating power by spinning turbines with water, organic material trapped in the reservoirs, such as dead plants, breaks down and releases gases like carbon dioxide and methane into the reservoir water.

Q16 Write the ill effects of deforestation.

Ans.: **Deforestation Effects** – The major detrimental effects of deforestation are as follows-

- Decrease in Rainfall.
- Soil – erosion
- Loss of fertile land
- Lowering down of water table i.e. the level of water below the ground surface becomes low.
- Global warming.
- Increase of CO₂ in the atmosphere.
- Increase in concentration of pollutants in the air

Q17 What are the difference between gully and rill erosion?

Ans.: A rill is a much smaller channel. A gully was once a rill that got broader and deeper. There are other differences too:

- 1- Ratio of width to depth: In gully that ratio is approximately 1:1, but in rills width is greater than depth.
- 2- In agricultural activities, rills can be removed, but gullies cannot.
- 3- In specific area, number of rills are higher than gullies.
- 4- Sediment production of gullies is much higher than Rills.

Q18 Briefly talk about national forest policy.

Ans.: **Salient Features and Goals of National Forest Policy**

- ✚ Maintenance of environmental stability through preservation and restoration of ecological balance.
- ✚ Conservation of Natural Heritage (existing).
- ✚ Checking Soil Erosion and Denudation in catchment areas of rivers, lakes, and reservoirs.
- ✚ Checking extension of sand dunes in desert areas of Rajasthan and along coastal tracts.
- ✚ Substantially increasing Forest/Tree Cover through Afforestation and Social Forestry.
- ✚ Taking steps to meet requirements of fuel, wood, fodder, minor forest produces, soil and timber of Rural and Tribal Population.
- ✚ Increasing the productivity of Forests to meet National Needs.
- ✚ Encouraging efficient utilization of Forest Produce and Optimum Use of Wood (Timber).
- ✚ Generation of Work Opportunities, the involvement of Women.

Unit 3

Q1 Define air pollutants and air pollution.

Ans.: Air pollutants refers to the presence of certain contaminates or pollutants in the atmosphere which may posses undesirable characteristics, maybe present in large quantities or may remain suspended in the atmosphere for long period of time and hence may have detrimental effects on the survival and normal functioning of human being plants and animals.

The presence of one or more contaminants such as dust, twist, smoke, smog or vapour in the atmosphere, in quantities of characteristics and of duration so as to be injurious to human, plant or animal life or which interferes with the comfortable enjoyment of life & property is known as Air Pollution.

Q2 Give the name of some air pollutants.

Ans.: Principal air pollutants are –

- a) CO₂ - Due to complete combustion of fuel- cause global warming.
- b) CO –Due to incomplete combination of fuel- Reduces O₂ carrying capacity of blood.
- c) SO₂ - Due to impurities in the fuel- Causes irritation is the respiratory tract.
- d) NO_x –Due to impurities in the fuel- Causes information of lungs.
- e) Hydrocarbons -Mode up of unburned on partially burned fuel- Causes urban smog

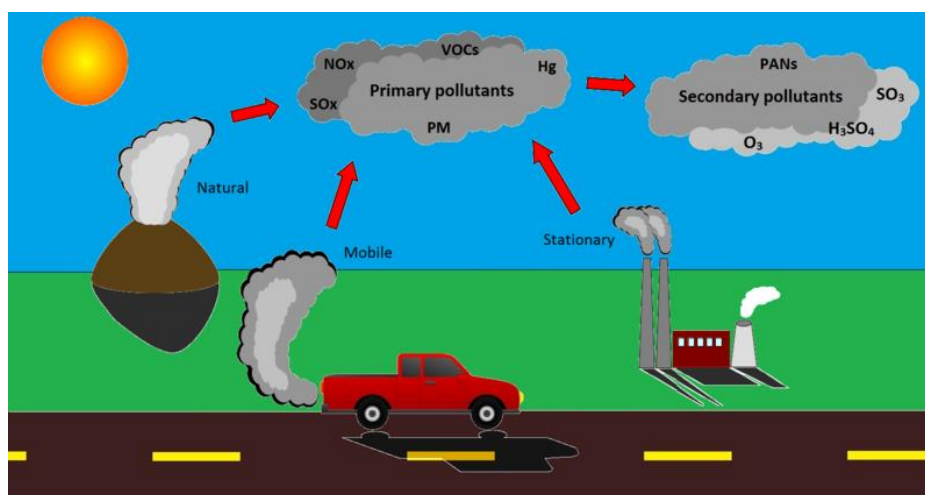
Q3 Classify pollutants.

Ans.: **Pollutants Categorization**– Pollutants are classified on the basis of their nature & state as follows-

Solid Pollutants	Liquid Pollutants	Gaseous Pollutants
⇒ Mining waste (Metals, Non-metals)	⇒ Industrial effluent (Hg, Zn, Pb)	⇒ Primary Air Pollutants
⇒ Industrial Waste (Cu, Al, Pb, Hg)	⇒ Agricultural Pollutants (Fertilizers & Insecticides, Produce acidic effects, DDT.	⇒ CO, Ashes, NO, SO _x , HCs.
⇒ Agricultural waste (artificial/chemical fertilizers DDT)	⇒ Urban Pollutants [ions, SO_4^{2-} , NO_3^- , Ca^{H+}]	⇒ Secondary Air Pollutants
⇒ Aerosols & POPs. (Persistent Organic Pollutants)	⇒ Natural Pollutants (Volcanic dust, sediments, debris decomposed organic matter)	⇒ PAN, O ₃ , NO Particulate Matter or Aerosols.

Q4 What is the Smog?

Ans. Smog- An important secondary pollutant is the Smog, which has made up of Smoke and Fog. Traditionally, the smog has resulted from large amounts of coal burning in an area caused by a mixture of smoke and sulphur dioxide. Now-a-days, the Vehicle emissions and Industrial emissions that are acted on in the atmosphere by ultraviolet light from the sun to form secondary pollutants that also combine with the primary emissions to form photochemical smog.

**Q5 Differentiate between stationary and mobile sources of air pollution.**

Ans. **Anthropogenic (man-made) sources:** These are mostly related to the burning of multiple types of fuel. These may be-

- **Stationary sources** include smoke stacks of power plants, manufacturing facilities (factories) and waste incinerators, as well as furnaces and other types of fuel-burning heating devices.
- **Mobile sources** include motor vehicles, marine vessels, and aircraft.

Q6 What are the harmful effects of water pollution?

Ans.: **Effects of Water Pollution**

Industrial Effluents-containing harmful chemicals such as (Arsenic, Cadmium, lead etc) which kills aquatic organisms.

Biomagnification – Effluent chemicals may reach the human body through contamination of food such as fishes and causes a process of biomagnification.

Eutrophication – Nitrogen and Phosphorus elements contaminate the water by promoting the growth of oxygen-consuming algae which reduces the DO level & kill the aquatic organisms.

Waterborne Infectious Diseases – Health Hazards such as cholera, typhoid, and dysentery can occur due to the consumption of impure water.

Thermal Pollution – Heat of water reduces the DO level of the aquatic system.

Oil Pollutants – oil spills & leakages choke the respiratory system of birds & other aquatic animals.

Q7 How BOD differ from COD?

Ans.: **Biochemical oxygen demand (BOD) and Chemical oxygen demand (COD)**- Biochemical oxygen demand (BOD) is the amount of oxygen microorganisms require to break down organic materials. In contrast, chemical oxygen demand (COD) is the amount of oxygen required to break down the organic material via oxidation. Hence, the value of COD is greater than BOD.

BOD	COD
BOD is a biological oxidation process	COD is a chemical oxidation process
BOD is performed by aerobic organisms	COD is performed by chemical reagents - potassium dichromate ($K_2Cr_2O_7$) in combination with boiling sulfuric acid (H_2SO_4)
BOD is measured by keeping a sealed water sample for incubation for a period of 5 days at 20 degree Celsius. The reduction in dissolved oxygen gives the amount of oxygen consumed by the aerobic organisms.	In COD test, the water sample is incubated with a strong oxidant in combination with boiling sulphuric acid for a specific period of time and temperature.
BOD value is determined by 5 days.	COD can be measured within few days.
BOD value is lower than COD	COD value is always greater than BOD
BOD is used to oxidize the natural organic matter and organic waste in the water	COD is capable of degrading the industrial sewage. COD does not measure the amount of oxygen consumed by acetates present in the water sample

Q8 Comment on the salinity of soil.

Ans.: Soil salinity is the salt content in the soil; the process of increasing the salt content is known as salinization. Salts occur naturally within soils and water. Salination can be caused by natural processes such as mineral weathering or by the gradual withdrawal of an ocean.

Salinity due to irrigation. Salinity from irrigation can occur over time wherever irrigation occurs, since almost all water (even natural rainfall) contains some dissolved salts. When the plants use the water, the salts are left behind in the soil and eventually begin to accumulate.

Here are some typical methods to prevent soil salinization: Optimize irrigation (reduce salty water usage, implement drip irrigation, use desalinated, recycled, rain-harvested water, and don't over irrigate). Add organic matter and manure to keep moisture and reduce irrigation.

Q9 What is solid waste and toxic waste? Discuss its sources and effects.

Ans.: **Solid Waste** – Solid wastes are those solids that are discarded and considered as useless by human beings. It includes all types of organic, inorganic, electronic, animal refuse, agricultural wastes etc. Toxic wastes comprise of hospital and industrial waste which are very harmful in nature.

Sources of Waste generation –

1. **Domestic Waste** – Household waste, paper, plastic glass pieces, leather, metal objects, remains of food, fruit & vegetables. Garden waste, batteries.
2. **Industrial Waste** – Chemical industry, refineries Paper mill, thermal plants.
3. **Agricultural Waste** – Farms, livestock yards, paddy luck, tobacco, corn-residue, Testing.
4. **Hospital Waste** – Disposable needles, syringes, blades, blood-soaked bandages flesh, tissues.
5. **Mining Waste** – Rocks, topsoil, acid-mine drawing.
6. **Commercial Waste** – Plastic, packaging material, paper.

Effects –

1. There are several effects of urban & industrial was Accumulation of solid wastes leads to an increase in the population of disease-causing organisms such as mosquitoes, flies etc.
2. The solid waste run off with the rainwater, mixes with the nearby water-bodies causing water pollution.
3. Burning of solid waste leads to air pollution.
4. Radioactive substances present in solid-waste cause a no. of diseases in human beings.
5. Presence of large dumps of solid waste reduces the aesthetic value of the land.
6. The non-biodegradable substances choke the sewerage system and disturb the drainage system.
7. Open dumps of solid wastes emit toxic fumes and obnoxious gases.

Q10 Write a note on collection and transport of solid waste.

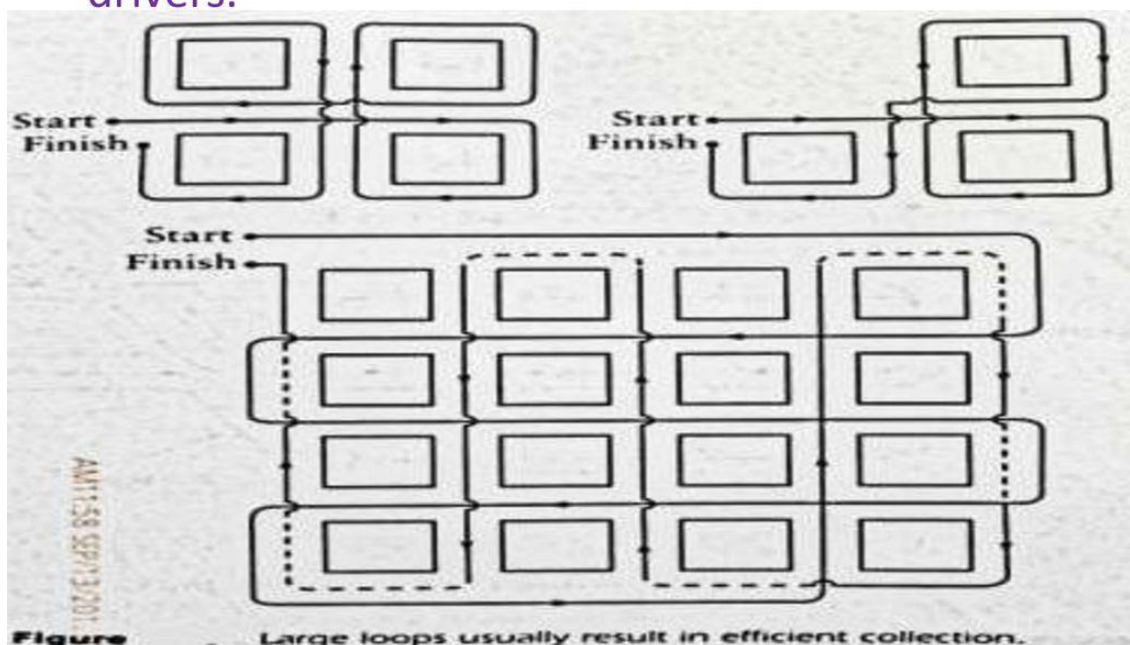
Ans.: **Collection, Transport and Disposal of SW**

Collection- According to mode of operation collection system classified into two categories:

1. Hauled Container system (HCS) Storage containers hauled to disposal site, emptied and return to original or some other locations.
2. Stationary Container System (SCS) Storage containers remain at the point of generation, except moved to curb or other location to empty.

Transport

- Results of micro-routing analysis should also be done by the review of **experienced collection drivers.**



Unit 4

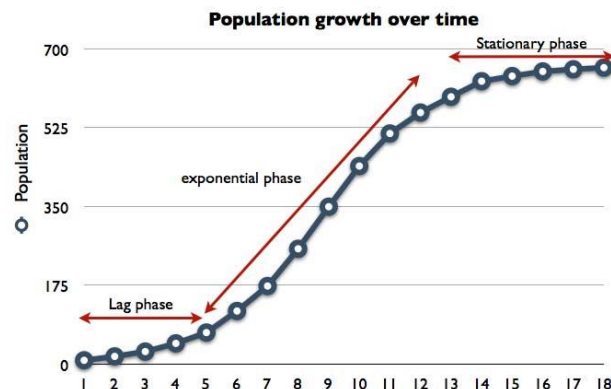
Q1 Define urban explosion and population growth.

OR

Discuss the sigmoid curve of the population.

Ans.: The Urban Explosion means that vast waves of immigration have fueled tremendous rates of urban population growth around the world, leading to dangerous levels of air and water pollution as well as health crises and resource stress that threaten these cities' ultimate viability."

Graph



If we look at a graph of a population undergoing logistic population growth, it will have a characteristic S-shaped curve. The population grows in size slowly when there are only a few individuals. Then the population grows faster when there are more individuals. Finally, having lots of individuals in the population causes growth to slow because resources are limited. In logistic growth, a population will continue to grow until it reaches **carrying capacity**, which is the maximum number of individuals the environment can support.

Q2 List out main greenhouse gases and their prominent sources.

Ans.: The gases which takes part in the process of global warming or which are responsible for the increasing global atmospheric temperature due to the increase or high rise in their concentration are known as greenhouse gases (GHGs). Greenhouse Gases are-

GHGs	Sources
1) CO_2	Fossil fuel burning, Deforestation.
2) CH_4	Livestock, Paddy fields, Biomass burning, Coal-mining.
3) $CFCS$	Refrigeration, foams, Aerosols, fertilizers.
4) Nitrous Oxide (N_2O)	Fossil –fuel burning fertilizers. Biomass burning deforestation Manus management.

Q3 Comment on GWP.

Ans.: **Global warming potential (GWP)**

All gases categorized as greenhouse gases have a global warming potential (GWP) value. This measures how effective each gas is at trapping heat in the Earth's atmosphere, and from that we better understand how a gas warms our planet. Essentially, GWP measures how potent a gas is as a contributor to climate change. The most commonly used metric to quantify greenhouse gas emissions is known as GWP100. This metric looks at the GWP of the greenhouse gases over 100 years. For example, methane has a GWP of 34. This means 1 ton of methane is equal to 34 tons of CO_2 and therefore captures more heat per molecule compared to CO_2 . CO_2 is used as the base comparison gas for all other greenhouse gases, allowing for an easier estimation of the impact of all greenhouse gases in the atmosphere (including non-carbon-based gases, like nitrous oxide).

Unit 5

Q1 How would environmental awareness help to protect our environment?

OR

What is the significance of environmental education?

Ans.: **Environmental Awareness-** The unthoughtful and unabated consumption of natural resources for different purposes such as the development of science & agriculture, industry, transport, etc. has depleted the environmental resources. To improve the deteriorated environment and to avoid pollution, human beings have a great responsibility. For that, individuals should participate in the process of improving the environment. For active participation, public awareness and education about harmonious nature are very necessary. Individuals get involved in the protection of the environment by taking the following actions-

1. By not extracting unnecessarily and exhaustively natural resources such as minerals, water etc.
2. By not wasting energy resources, such as avoiding the burning of fossil fuels.
3. By not cutting trees & using timber for aesthete pleasure such as decoration.
4. By preserving the greeneries on a vast area of land.
5. By maintaining the conventional environment.
6. By obeying & formulating the moral codes for the achievement of a better environment.

Finally, people should be approached to understand inherent harmony and conserve & manage the environment & its resources.

Q2 Point out various issues involved in enforcement of environmental legislation.

OR

What are the drawbacks of pollution related acts.

Ans.: **Issues involved in enforcement of environmental legislation-** A number of laws have been enforced for safeguarding the environmental quality. However, these laws and acts could not be enacted successfully in light of the following problems/ Drawbacks of pollution related acts-

- ❖ The power and authority has been given only to the central government with little power to the state government. This hinders effective implementation of the act in the states.
- ❖ The penalties imposed by this act are very small when compared to the damage caused by big industries due to pollution.
- ❖ A person cannot directly file a petition in the court.
- ❖ Litigation, related to the environment is expensive, since it involves technical knowledge.
- ❖ For small industries, it is very expensive to install an individual custom-made effluent treatment plant
- ❖ The position of chairman of the board of most industries is occupied by a political appointee. Hence it becomes difficult to implement the act without political interference.

Q3 What is the role of an individual in the protection of the environment?

Ans.: **Role of Individual**

- Ensure right understanding through education
- Population stabilization
- Apply 4 'R' Principle in ways of living
- Sustainable development

By adopting "An Eco-friendly lifestyle or a healthy lifestyle", an individual may safeguard the environment, as-

1. Try to maximize usage of day light, this way one can cut greenhouse gas emissions
2. Turn off all unnecessary lighting in your home, office, shops and check for energy star before purchasing new electronics
3. Go on foot and reduce carbon footprint
4. Use bicycle instead of bike
5. Use local transport instead of personal vehicle
6. Travel together or use public transportation
7. Use online platforms for meeting

8. Use energy efficient lighting and other equipment's
9. Keep ACs at 26 °C
10. Buy garments, shoes or accessories made in Eco friendly manufacturing system
11. If it's cotton garment, then look for organic cotton tag
12. Look for garments made from recycled raw material
13. Order/Take what as much as you eat
14. Try to avoid wasting food items
15. Donate the extra food to avoid food waste
16. Save water
17. Understand the expiry date of food stuff and manage it accordingly
18. Try to create compost piles (can be used in kitchen gardening, roof gardening)
19. Avoid food packings to reduce plastic pollution
20. By buying items with less packaging, one can reduce plastic pollution
21. Buy items with recycled packaging material
22. Don't use plastic cups
23. Reuse items and take reusable bags on shopping
24. Eat local items (avoids traveling – saves environment)
25. Buy locally to reduce your carbon footprint and greenhouse gases emission reduction
26. Grow your own garden and use plant based items or you can switch organic food
27. Whenever you buy anything keep environment in your mind
28. Bring your own bag for shopping
29. Use non-toxic cleaning agent (eco friendly)
30. Take care of tree / plant more trees

Q4 Write is the role of women in the protection of the environment?

Ans.: **Role of Women-** as 50% population of the earth-

Women have a vital role in environmental management and development. Their full participation is therefore essential to achieve sustainable development. Advancing gender equality may be one of the best ways of saving the environment, and countering the dangers of overcrowding and other adversities associated with population pressure. The voice of women is critically important for the world's future not just for women's future. Women have unique concerns, values, and perceptions in terms of-

- **As mother- The first teacher**
- **As teacher, mentor or guide**
- **As professionals as environmental consultants, environmental manager, environmental lawyer etc**
- **As an activist**

Detailed Answers

Unit 1

Q1 Define atmosphere. How the temperature varies in vertical layers of atmosphere? State significant activities taking place in different layers of atmosphere.

OR

On the basis of temperature profile explain the structure of atmosphere with neat sketch.

Ans.: **Atmosphere:** *Atmosphere is the protective thick gaseous mantle, surrounding the earth which sustains life on earth and saves it from unfriendly environment of outer space.*

Characteristic features of the atmosphere are as follows-

The earth's atmosphere is an envelope of gases extending up to 2000 feet above the ground. The gases include nitrogen, oxygen, argon, carbon dioxide, traces of carbon monoxide, oxides of nitrogen, sulfur and hydrocarbon, and very little amount of water vapour. The concentration of these gases decreases with an increase in altitude. The bulk of these gases are present within the atmospheric band that stretches up to 5 km above the earth.

1. It is mobile, elastic, compressible and expandable as made up of gases.
2. The atmosphere protects the earth's biosphere by absorbing a major portion of electromagnetic radiation and most of the cosmic rays. The atmosphere also absorbs infrared radiation and thereby maintains the temperature of the earth at life-sustaining levels. It also helps nature in maintaining its balance through different biochemical cycles, namely the oxygen cycle, nitrogen cycle, carbon cycle, and hydrological cycle.

Structure of Atmosphere along with Temperature profile of Atmosphere and Related Phenomenon:

The earth's atmosphere is broadly divided into five regions:

Troposphere: The lower portion of the atmosphere is called troposphere. It contains 70 per cent of the atmosphere's mass. The density of the troposphere decreases with altitude. The upper boundary of the layer, known as the tropopause, ranges in height from 10 km near the poles up to 17 km above the equator. The air near ground is heated by the radiation from the earth, but the temperature decreases uniformly with altitude until at the tropopause where the temp is -55°C – 60°C . This is the region in which most of the living things exist and also the air which we breathe. The area is required to be pollution free, but presently it's the most polluted. One of the most recent changes in the troposphere is the phenomenon of acid rain.

Stratosphere: Above the troposphere, the layer is known as the stratosphere. It extends from the tropopause to about 50 km. While the temperature may be -60°C at the tropopause, the top of the stratosphere is much warmer and may be near freezing. Very little water vapour is found here. From an altitude of 20 to 50 kms temperature increases with an increase in altitude, reached up to 0°C due to absorption of ultraviolet radiation by ozone. Ozone is formed here i.e. why this layer is also known as the ozone layer or ozonosphere. Ozone concentration is created between about 20–40Km (8-10ppm). The ozone molecule, present in the layer, absorbs the Sun's ultraviolet radiation and decomposes into oxygen molecules and an oxygen atom. When these particles combine, energy is released as heat radiation. The stratosphere shields life on earth from the injurious effects of the Sun's ultraviolet rays. The stratopause separates the stratosphere from the mesosphere.

Mesosphere: In the mesosphere the height reaches upto 80 to 85 km. Temperature keeps dropping with height with the mesopause is the coldest place on Earth and has an average temperature around -85°C . The mesopause separates the mesosphere from the thermosphere. Most meteorites burn and disintegrate here, as they experiencing friction.

Thermosphere: In thermosphere which extends upto 500- 700 km, the temperature again rises to very high value approaches about 1200°C – 2000°C . Hence, atmospheric gases such as oxygen and nitric oxide split into atoms, which absorb solar radiation in the far ultraviolet region and then undergo ionization. That is why this layer is also called ionosphere. This layer is important for the operation of satellites.

Exosphere: The uppermost layer of the atmosphere is called the exosphere. This extends up to a height of about 1600 km and gives way to interplanetary space. In this region atoms & molecules have sufficient velocity to escape from earth's gravitation.

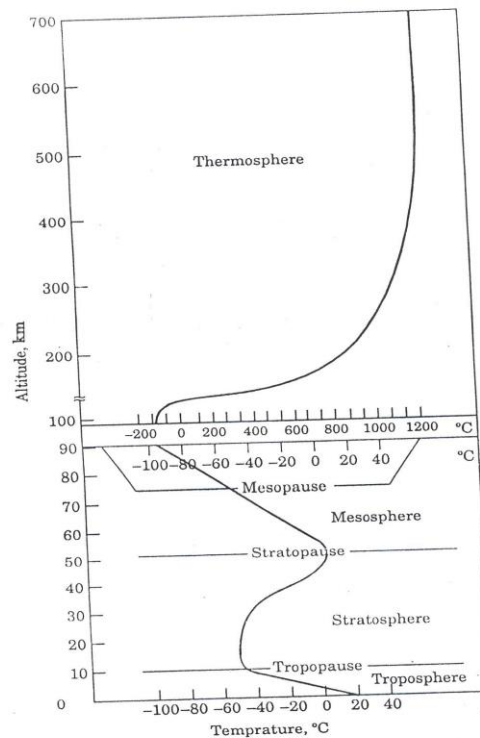


Fig. 1.1. : Temperature profile of the atmosphere (From Miller)

Q2 Discuss the components of environmental in detail.

Ans.: There are four components or components of environment which are conceptual spheres.

- Atmosphere
- Lithosphere
- Hydrosphere
- Biosphere

Every sphere has a two way linkage to every other sphere including itself. The two-way linkage signifies that matter flow from one sphere (compartment) to other in both the directions.

Atmosphere-

- The atmosphere is blanket of gasses and suspended liquid and solids that entirely envelops the earth.
- Composed of various gasses and water vapor.
- The four major gasses N_2 (98.084%), O_2 (20.94%), Ar (.93%) & CO_2 (.0314%) accounts for more than 99% of the total atmospheric mass.
- On the other hand total of all the trace gasses like neon, helium, eH_4 , H_2 , CO , O_3 etc. do not exceed .02%.
- Water vapour is also present in the lower atmosphere in very small quality (.01–5%) but its importance is great.

Hydrosphere

- The hydrosphere is the water domain as more than two third (70.8) of earth's surface is covered with water in the form of oceans, seas, strained glaciers, rivers.
- Of this (70.8%), approximately 97% of water is contained in the ocean and seas where the high salt content does not permit its use for human consumption.
- About 2% the water resources are locked in glacier's fresh water.
- Remaining 1% is available as fresh water in surface water resources (rivers, lakes, ponds, streams etc.) & in groundwater resources.

Lithosphere

- The lithosphere is outer crust of earth.
- Consists of three layers – crust, mantle & core
- Outermost solid zone of the earth is known as crust. It is about 8 – 40km above the mantle and covered with soil.
- Directly below the crust is mantle extends about 2900 – 3000km constitute largest volume of earth's interior.
- The core central fluid having a diameter of about 2500kms from the center. It is composed of nickel and iron.
- The lithosphere includes different varieties of fuel masses, and land farms with different types of ecosystems.

Biosphere

- The term biosphere was first coined by the Austrian geologist “Edward Huxley” in 1875.
- It includes the lower atmosphere, the hydrosphere and the upper lithosphere.
- The biosphere indicates the domain of living organisms and their interaction with the environment.
- Under natural circumstances, plants and animals influence each other life directly or indirectly.

Q3 What is ecosystem? Explain aspects of ecosystem.

OR

Explain the following:

i) Ecosystem and its components.

ii) Functions of ecosystem.

Ans.: **Ecosystem Components** – The term ecosystem was proposed by A.G. Tansley in 1935.

An Ecosystem is defined as “the system resulting from the integration of all living and non-living factors of the environment.” An ecosystem is the smallest unit of the Biosphere. It is composed of two major components-

- Abiotic Component [refers to non-living components]
- Biotic Component [refers to living components]


Ecosystem Structure – The structure of an ecosystem depends upon the following characteristic.

- The quantity of non-living components and their distribution.
- The quantity distribution, life-history and biomass of living organisms.
- Conditions for the existence of living organisms such as light, temperature, humidity etc.


- **Abiotic Components** – It includes all the non-living components. Composed of Chemical / Edaphic and climatic factors. The inorganic substances influence the quality of nutrient cycles. The organic substance remains present in biomass.

Examples: Air, Water, soil, Humidity, Temperature, Rainfall, Minerals present in the soil

- **Biotic Components** – It includes all the living components. Composed of Producers, consumers & decomposers.

 **Producers** – These are known as Autotrophs or self-nourishing organisms. Which derives energy from sun to convert inorganic substances into organic substances. Autotrophs are divided into-

- **Photo autotrophs** – These are producers who fix energy from the sun and store it in complex organic compounds. They also contain the green pigment chlorophyll.
Example: green plants, Algae.
- **Chemoautotrophs** – They are bacteria that oxidized or reduced inorganic substances and produce complex organic compounds.
Example: Sulphur bacteria, blue-green algae.

 **Consumers**- These are known as heterotrophic components. Organisms get their energy and nutrients from producers directly or indirectly. Examples: Deer, rabbit, cattle; fox, wolf, dog, Lizard, Lion etc. Depending on food habits, they may be classified into-

- Primary consumers [Herbivores]
- Secondary Consumers [Carnivores]
- Tertiary Consumers [Omnivores]

🌱 **Decomposers**– These are known as Micro – consumers or Micro – heterotrophs or saprotrophs. These organisms namely feed on dead decaying matter and convert complex organic substances into simpler substances. - The organisms are also called reducers, scavengers and detritivores. Examples – Fungi, parasites, Earthworms, soil- insects, ants, termites.

Ecosystem Functions – The functioning of abiotic and biotic components of ecosystems are interrelated to each other. The functions of the ecosystem can be studied in the following forms-

- ✓ Food-chains & Food-web
- ✓ Energy flow
- ✓ Mineral Nutrient cycles.

The functions of the Ecosystem can also be summarized as-

1. It allows the flow of biological energy i.e. controls the rate of production and respiration of the community.
2. It controls the rate of the nutrient cycle i.e. production and consumption of minerals.
3. It allows the circulation of chemical elements from the environment to organisms and organisms to the environment, so, it controls nutrient fulfillment.
4. Conversion of elements into organic forms.
5. Ecosystem Productivity.
6. Stability to Ecosystem.

Q4 Write about the Energy flow in Ecosystem.

Ans. **Energy flow in Ecosystem**- The functioning of ecosystem depends on the flow of energy matter. Energy enters in to the ecosystem from the solar radiations and is converted in to chemical form by the producers. From there the energy passes from one trophic level to the next through food. Energy flow in the ecosystem is governed by laws of thermodynamics-

- A) Energy can neither be created nor destroyed but can be transferred.
- B) Every transformation or transfer of energy is accompanied by its dispersion.

There are two aspects with respect to energy flow in ecosystem.

- a) There is in directional flow of energy in the ecosystem ie from producers through herbivores to carnivores, the energy cannot be transferred in the reverse direction, ie energy that is captured by producers (autotrophs) does not revert back to solar input or the energy which passes to the herbivores does not back to the autotrophs.
- b) Producers capture only a small fraction of solar energy (1–15%) of total radiation the bulk of unutilized energy is dispersed as heat. Energy actually used by the herbivore trophic level is only small fraction of energy captured at the producer level. Which is the approximate 10% of gross primary production of the producer. In this way, again only a small fraction i.e. about 10% of herbivore productivity is used to support carnivore productivity. Similarly, a very small portion of assimilated energy at the carnivore level is used to support the next trophic level. This happens due to with increasing trophic levels the respiration cost also increases sharply. On average, producers consume about 20% their gross productivity in respiration. The herbivores consume about 30% assimilated energy in respiration and it rises up to 60% assimilated energy. Thus, there is a tremendous loss of energy in successive higher trophic levels. As result, the residual energy is decreases to such an extent that no further trophic level can be supported.

Q5 Explain the concept of sustainable development? What are its components and objectives? **OR**

What do you understand by sustainable development? What are its components?

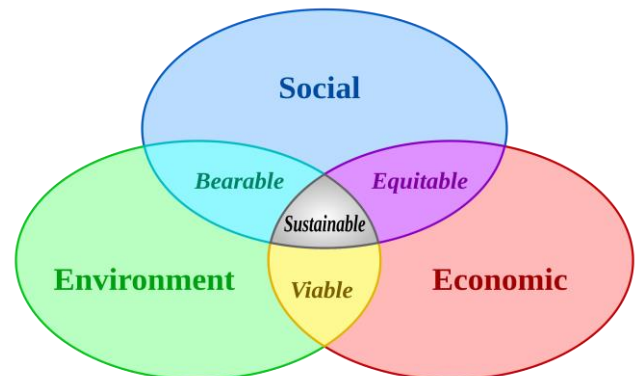
Ans.: **Sustainable development**- Earlier the concern was only towards the economic and social development. Then, the resources were plenty. But due to exponential growth of population and human activities, there is an increasing demand for the resources and they have become depleted. These consequences of unsustainable development have reached their extremities, forcing the activities to change for sustainable development.

Sustainable development was first brought in to common use by the world commission (a group of people appointed by united nations) on environment and development, chaired by Norwegian P.M. G.W. Brundthland – “Brundtland commission.” The commission made sustainable development theme of its final report “our common future” published in 1987.

The commission defined the term as a form of development of progress that **“meeting the needs of the present without compromising the ability of future generations to meat out own needs.”**

Or

Sustainable development defined as the **successful management of resources for development and to satisfy the human needs maintaining and conserving the resources.**



In order to achieve a sustainable life a balanced and equitable distribution of natural resources is necessary. Pillars of Sustainable development or necessary conditions for achieving sustainable development are-

- 1. Social Equity**– There should be an equilibrium condition in the society between-
 - (i) same nation and generation (intra generation equity)
 - (ii) different generations (inter –generations equity).
 We should hand – over, a safe healthy and resourceful environment to our future generation.
- 2. Economical Equity**– Technology should solve the problem of developing countries like by –
 - a) Producing drought varieties for uncertain climates.
 - b) Developing vaccines for infectious diseases.
 - c) Clean fuel for domestic and industrial use.
 ➤ Technological development should support the economic growth of poor countries and help in narrowing wealth gap and lead to sustainability.
- 3. Ecological Security**– Any developmental project should save biodiversity, decreased rote of erosion, increase forest cover and help in maintaining ecological equity.

Objectives or Parameters of sustainable development

- ❖ Should protect biodiversity.
- ❖ Should prevent soil erosion.
- ❖ Slow down the population growth.
- ❖ Increase forest cover (Afforestation)
- ❖ Simulate poverty.
- ❖ It can be achieved by restricting human activities.
- ❖ Technological development should be input effective and not input utilising.
- ❖ The rate of consumption should not surpass the rate of salvation.
- ❖ For renewable resources, the rate of consumption should not surpass the rate of production of renewable substitutes.
- ❖ All types of pollution should be minimized.
- ❖ It can be achieved by sensible use of natural resources.

Measures of sustainable development

- ✓ Implementing effective planning for population growth.
- ✓ Using efficient technological devices.
- ✓ Reducing demand for natural resources.
- ✓ Following 4’R’s approach (Refuse, Reduce, Reuse, Recycle)

Problems and obstacles on the path of sustainable development

- Disagreements between stakeholders- In a society there are many stakeholders such as men, women, children, youth, NGOs, workers, trade unions etc. Each of these stakeholders the different priorities, hence it is extremely difficult for all to agree upon a common goal of sustainable development.
- Consumption and lifestyle – Level of consumption and lifestyle of different people of the area are different. Developing countries aspire to achieve a more comfortable living standard should be counter – balanced by ecological footprints of developed countries.

Q6 What are the negative impacts of agricultural activity on environment?

OR

Discuss the effects of modern agricultural methods.

Ans. Maintaining a consistent food production for the growing populations using available limited natural resources (land, water) was an immense challenge encountered by agriculture sector. To resolve this issue, intensified agricultural practices were adopted. Simply 'modern agriculture' is an approach based on high input- high output procedures such as practicing intense tillage, use of abundant irrigation water, use of inorganic fertilizers, genetic manipulation of plants and chemical control of pest and diseases to combat the global demand of food and fuel. It is also termed as intensive farming, modern farming or intensive agriculture.

- Requires large amounts of energy input to produce, transport and apply chemical fertilizers/pesticides,
- **Eutrophication**- Eutrophication is the process in which a water body becomes overly enriched with nutrients, leading to plentiful growth of simple plant life. The excessive growth (or bloom) of algae and plankton in a water body are indicators of this process. Agricultural activities in the field as well as the utilization of fertilizers promotes the accumulation of many nutrients in the soil. If these nutrients reach their maximum concentration level, and the soil or ground is unable to assimilate them, then these nutrients are transported by means of rain into the rivers as well as groundwater which flow into seas or lakes. Use of fertilizers can alter the biology of rivers and lakes.
- Pesticides generally kill useful insects as well as those destroy crops.
- The chemicals used may leave the field as run off eventually ending up in rivers and lakes or may drain into groundwater aquifers.
- **Biomagnification**- Use of pesticides have numerous negative health effects in workers who apply them, people that live nearby the area of application or downstream/downwind from it, and consumers who eat the pesticides which remain on their food. Biomagnification can be defined as the rise or increase in the contaminated substances caused by the intoxicating environment. The contaminants might be heavy metals such as mercury, arsenic, and pesticides such as polychlorinated biphenyls and DDT. These substances are taken up by the organisms through the food they consume. When the organisms in the higher food chain feed on the organisms in the lower food chain containing these toxins, these toxins get accumulated in the higher organisms.
- **Waterlogging**- When the water is liberally applied to the fields, the excessive water percolates deeply inside the grounds where it meets the water table. Due to this activity, the water table at that location arises.
- Limits or destroys the natural habitat of most wild creatures, and leads to soil erosion.
- Is often not sustainable if not properly managed-may result in desertification, or poisonous and eroded land that nothing else will grow there.

Unit 2

Q1 What are waterborne and water induced diseases?

Ans.: **Water Borne and Water Induced Diseases**- Any disease that can spread through contaminated water. The contamination can involve bacterial, viral or protozoan organisms. Some examples of waterborne diseases include cholera (bacteria), dysentery (bacteria or amoeba), cryptosporidiosis (protozoa), hepatitis A (virus) and giardia (protozoa). Infection can result not only from drinking the water but also from swimming in the water where it can enter the body in other ways such as through broken

skin. Many poorer countries have limited uncontaminated water supplies so waterborne disease is a huge health issue worldwide.

Category	Comments
<i>Water-borne diseases</i>	Caused by the ingestion of water contaminated by human or animal faeces or urine containing pathogenic bacteria or viruses; includes cholera, typhoid, amoebic and bacillary dysentery and other diarrhoeal diseases.
<i>Water-washed diseases</i>	Caused by poor personal hygiene; includes scabies, trachoma and flea-, lice-, and tick-borne diseases, which are also water-washed.
<i>Water-based diseases</i>	Caused by parasites found in intermediate organisms living in water; includes dracunculiasis, schistosomiasis and some other helminths.
<i>Water-related diseases</i>	Transmitted by insect vectors which breed in water; includes dengue, filariasis, malaria, onchocerciasis, trypanosomiasis and yellow fever.

Q2 Classify the energy resources. Explain any one form of energy.

Ans.: **Energy Resources-** Energy Resources can be classified in many ways, such as –

1. On the basis of their availability –

a) Primary Energy Resource – These are obtained directly from the environment.

Example:

- i) Fossil fuels (Coal, oil, Natural gas)
- ii) Nuclear fuels (uranium, Plutonium)
- iii) Hydro energy
- iv) Solar Energy, wind energy
- v) Ocean energy, Biomass energy
- vi) Wind energy, Hydrogen energy
- vii) Geothermal energy.

b) Secondary energy Resource – These do not exist in nature, they are derived from primary energy resource. Example:

- i) Petrol diesel, Kerosene oil.
- ii) Compressed natural gas (CNG) / Liquid Petroleum Gas (LPG)
- iii) Electrical energy based on coal, diesel.

II. On the basis of older & Newer in Use –

a) Conventional Energy Resource – These are also known as Non-Renewable Energy Resource.

The resources which cannot be replenished in a shorter duration of time as their supply is limited in the environment.

Example: Coal, Mineral Oil, Natural gas, Nuclear Power.

b) Non-Conventional Energy Resource – These are known as Renewable energy Resource.

These resources can be replenished in shorter duration of time as they have unlimited quantity in the environment.

Example: Solar energy, wind energy, Hydro energy, Biomass, firewood, petro plants etc.

Solar Energy – Solar energy is an inexhaustible form of energy. Solar energy in the form of radiations reaches the earth surface, absorbed by the plants or biosphere and utilized by the organisms. It is utilized by converting it into different forms as.

1. Thermal conversion (Direct heating)
2. Photo conversion. (In direct heating)

Application –

1. Solar cells (PV Cells)
2. Solar Heating

3. Solar cooker
4. Solar space conditioning
5. Solar drying
6. Solar Furnace
7. Solar greenhouse

Advantages –

1. Solar equipment's do not create pollution.
2. Occupies less space on floor, as there is no need of strong verses.
3. Noiseless operations.
4. Cheaper initial cost and no need of containers to store the fuel.

Disadvantages –

1. Solar equipment's fail to work in nights or during rain.
2. All sorts of foods cannot be cooked in solar cooker.
3. Initial cost and installation is expensive.

Q3 What are the alternative energy resources? Write the merits and demerits of solar energy.

Ans.: **Alternative Energy Resource** - Alternative energy Resources comprises of both conventional & non-conventional energy resources. At various places, these resources are used to create environmentally clean energy resources. For examples –

1. LPG (Liquid Petroleum Gas)
2. CNG (Compressed Natural Gas)
3. Alcohols
4. Hydrogen
5. Methane
6. Fuel cells of various kinds.

Liquefied Petroleum Gas is a gaseous hydrocarbon at room temperature and atmospheric pressure. Principle component of LPG are –

1. Propane
2. Butane
3. Butane
4. Propene
5. Propane & butane

Alcohols – All oxygenated compounds as ketones, ethers, alcohols & nitroparaffins. Two main kinds of alcohols are –

1. Methanol (Methyl alcohols)
2. Ethanol (ethyl alcohol)

Both are well suited as fuels for spark ignition engines.

1. Methanol or Ethanol separately for SI engines.
2. Aqueous alcohol mix with water, in SI engines.
3. Methanol & Ethanol mixed with diesel in CI engines.

Fuel Cell – It is an electrochemical energy source. That can be used as replacement to lead acid battery for auto-vehicles.

Application of Solar Energy –

- Solar cells (PV Cells)
- Solar Heating
- Solar cooker
- Solar space conditioning
- Solar drying
- Solar Furnace
- Solar greenhouse

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Disadvantages –

- Solar equipment's fail to work in nights or during rain.
- All sorts of foods cannot be cooked in solar cooker.
- Initial cost and installation is expensive.

Q4 Explain some applications of solar energy in modern days.

Ans.: **Solar Energy** – Solar energy is an inexhaustible form of energy. Solar energy in the form of radiations reaches the earth surface, absorbed by the plants or biosphere and utilized by the organisms. It is also utilized by converting it into different forms as.

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Application –

- ⇒ Solar cells (PV Cells)
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Disadvantages –

- Solar equipment's fail to work in nights or during rain.
- All sorts of foods cannot be cooked in solar cooker.
- Initial cost and installation is expensive.

Q5 With the help of neat and labeled sketch explain various steps carried out in Nitrogen cycle.

Ans.: **Nitrogen Cycle**- It is a biogeochemical process, in which nitrogen is converted into different forms. It is a continuous process of passing nitrogen from the atmosphere to the soil and later to the organisms and then back into the atmosphere. The nitrogen process involves several processes like nitrogen fixation, nitrification, denitrification, decay, and putrefaction.

Stages of Nitrogen Cycle- The different stages of the nitrogen cycles are – Nitrogen fixation, Nitrification, Assimilation, Ammonification, and Denitrification, these are discussed in detail below.

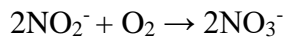
Nitrogen Fixation- This is the initial step of the nitrogen cycle, in this process atmospheric nitrogen which is in inert form is converted into ammonia usable form. The nitrogen fixation is entirely completed by symbiotic bacteria which are known as Diazotrophs. Azotobacter and Rhizobium also have a major role in this process, as these bacteria consist of a nitrogenase enzyme that has the capability to combine gaseous nitrogen with hydrogen to form ammonia. Nitrogen fixation can occur through atmospheric fixation which involves lightening or industrial fixation by manufacturing ammonia under high temperature and pressure conditions. Nitrogen can also be fixed by man-made processes, primarily industrial processes that create ammonia and nitrogen-rich fertilizers.

Types of Nitrogen Fixation:

1. **Atmospheric Fixation:** It is a natural phenomenon where the energy of lightning breaks the nitrogen into nitrogen oxides and is then used by plants.
2. **Industrial Nitrogen Fixation:** This is a man-made alternative that helps in nitrogen fixation by the use of ammonia, it is produced by the direct combination of nitrogen and hydrogen.
3. **Biological Nitrogen Fixation:** As the nitrogen is not directly usable from the air to plants and animals. Some of the bacteria such as *Rhizobium* and blue-green algae transform the unusable form of nitrogen into other compounds that are more readily usable.

Nitrification- In the process of bacteria nitrification, ammonia is converted into nitrate with the presence of bacteria in the soil, nitrites are formed by the oxidation of ammonia with the help of *Nitrosomonas* bacteria species. further, the produced nitrites are converted into nitrates with the help of *Nitrobacter* bacteria, this conversion is very important as ammonia gas is very toxic for plants.

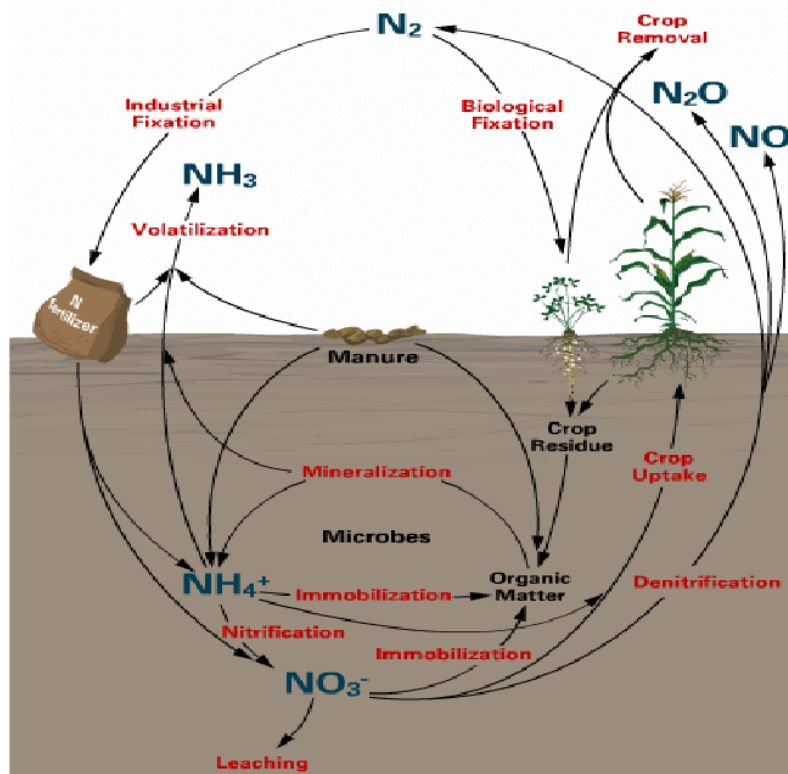
The process of bacteria nitrification involves the following reaction:



Assimilation- Some of the primary producers like plants take nitrogen compounds directly from the soil, with the help of their roots. which are available in the form of ammonia, nitrite ions, nitrate ions, or ammonia ions, and they are used in the formation of the plant proteins, in this way they enter the food web when the primary consumer eat the plants.

Ammonification- The nitrogen which is present in the organic matter is released back into the soil, the plants and animals die. some of the decomposers like bacteria and fungi (present in the soil), convert the organism matter back into ammonium. The ammonia produced in this process of decomposition is further used for other biological processes.

Denitrification- Denitrification is the process by which nitrogen compounds make their way back into the atmosphere by converting nitrate into gaseous nitrogen. This process is the final stage of the nitrogen cycle, which occurs in the absence of oxygen. This process is carried out by the denitrifying bacteria, some of them are *Clostridium* and *Pseudomonas*, which will process nitrate to gain oxygen and give out free nitrogen gas as a byproduct.



Q6 How can we get energy from hydrogen as fuel cell?
OR

Why hydrogen is considered as an alternate future source of energy.

Ans.: Hydrogen is the simplest and most abundant element on earth—it consists of only one proton and one electron. Hydrogen can store and deliver usable energy, but it doesn't typically exist by itself in nature and must be produced from compounds that contain it.

Energy Carrier- Hydrogen is an energy carrier, not an energy source and can deliver or store a tremendous amount of energy. Hydrogen can be used in fuel cells to generate electricity, or power and heat. Today, hydrogen is most commonly used in petroleum refining and fertilizer production, while transportation and utilities are emerging markets.

Sources of Energy- Hydrogen can be produced from diverse, domestic resources. There are many ways to produce hydrogen using sunlight, including photobiological, photoelectrochemical, photovoltaic-driven electrolysis, and solar thermochemical processes-

- Most hydrogen can also be produced through steam methane reforming, a high-temperature process in which steam reacts with a hydrocarbon fuel to produce hydrogen.
- Another common hydrogen production method takes water, and separates the molecule H₂O into oxygen and hydrogen through a process called electrolysis. Electrolysis takes place in an electrolyzer, which functions much like a fuel cell in reverse—instead of using the energy of a hydrogen molecule, like a fuel cell does, an electrolyzer produces hydrogen from water molecules.
- Biological processes can also produce hydrogen through biological reactions using microbes such as bacteria and microalgae. In these, microbes consume plant material and produce hydrogen gas.

Uses for Hydrogen

Hydrogen is a clean fuel that, when consumed in a fuel cell, produces only water, electricity, and heat. Hydrogen and fuel cells can play an important role in our national energy strategy, with the potential for use in a broad range of applications, across virtually all sectors—transportation, commercial, industrial, residential, and portable. Hydrogen and fuel cells can provide energy for use in diverse applications, including distributed or combined-heat-and-power; backup power; systems for storing and enabling renewable energy; portable power; auxiliary power for trucks, aircraft, rail, and ships; specialty vehicles such as forklifts; and passenger and freight vehicles including cars, trucks, and buses.

Due to their high efficiency and zero-or near zero-emissions operation, hydrogen and fuel cells have the potential to reduce greenhouse gas emission in many applications.

The greatest challenge for hydrogen production, particularly from renewable resources, is providing hydrogen at lower cost. For transportation fuel cells, hydrogen must be cost-competitive with conventional fuels and technologies on a per-mile basis. To reduce overall hydrogen cost, research is focused on improving the efficiency and lifetime of hydrogen production technologies as well as reducing the cost of capital equipment, operations, and maintenance.

Q7 Write a note on biomass energy?

Ans.: Biomass is organic, meaning it is made of material that comes from living organisms, such as plants and animals. The most common biomass materials used for energy are plants, wood, and waste. Biomass contains energy first derived from the sun: Plants absorb the sun's energy through photosynthesis, and convert carbon dioxide and water into nutrients (carbohydrates). The energy from these organisms can be transformed into usable energy through direct and indirect means. Biomass can be burned to create heat (direct), converted into electricity (direct), or processed into biofuel (indirect).

Thermal Conversion

Biomass can be burned by thermal conversion and used for energy. Thermal conversion involves heating the biomass feedstock in order to burn, dehydrate, or stabilize it. The most familiar biomass feedstocks for thermal conversion are raw materials such as municipal solid waste (MSW) and scraps from paper or lumber mills. Different types of energy are created through direct firing, co-firing, pyrolysis, gasification, and anaerobic decomposition.

Anaerobic Decomposition

Anaerobic decomposition is the process where microorganisms, usually bacteria, break down material in the absence of oxygen. Anaerobic decomposition is an important process in landfills, where biomass is crushed and compressed, creating an anaerobic (or oxygen-poor) environment. In an anaerobic environment,

biomass decays and produces methane, which is a valuable energy source. This methane can replace fossil fuels. In addition to landfills, anaerobic decomposition can also be implemented on ranches and livestock farms. Manure and other animal waste can be converted to sustainably meet the energy needs of the farm.

Q8 India is a megadiversity nation. Classify forest types of India.

Ans.: Among the biodiversity countries of the world India holds 13th place. It has 10 biogeography zones that includes Himalaya, desert, semi-arid and Western ghats etc. The large species richness and abundance are due to immense variety of climatic and altitudinal condition in country. These vary from the humid tropical Western Ghats to the hot desert of Rajasthan, from cold desert of Ladakh and the icy mountain of Himalayas to the warm coast of peninsular India and these includes ecosystem diversity is highest in the world, which represents forest ecosystems, grassland ecosystems, wetland ecosystems, coastal and marine ecosystems and the desert ecosystems. The country constitutes only 2.4% of the world's land area, but having 11% of flora and 6.5% of fauna of the world.

From the rainforest of Kerala in the south to the Alpine Pastures of Ladakh in the north there are wide ranges of forests that one can find in India. The soil type, climate, elevation, and topography are some of the major elements that define the type of forest. They are classified based on nature and composition. Moreover, it also depends upon the climate type in which they grow and their relationship with the surrounding environment.

Different Types of Forest in India

There are various types of forest in India namely coniferous forest, broadleaved forest, evergreen forest, wet evergreen forest, deciduous forest, and mangrove forest. Almost 24.56% of the geographical area of the country is under forest cover.

Coniferous Forest

The coniferous forests can be found in the Himalayan Mountain Range. The temperature in this region is low and it also snows during some parts of the year. The vegetation is composed of tall, stately trees having needle-like leaves that jut out from downward sloping branches. Such an arrangement of leaves helps the snow to fall off easily. These trees belong to the family Gymnospermae. So, they don't bear fruits; they bear woody cones instead. Some of the commonly known conifers are cedar, cypress, fir, juniper, etc.

Broadleaved Forests

The Broadleaved Forests can be categorized into- evergreen forest, deciduous forest, mangrove forest, and thorn forest. These forms of forest have trees with large broad leaves of different shapes.

Evergreen Forest

The evergreen forests can be found in the Western Ghats, Northeastern Himalayas, and in the Andaman and Nicobar Islands. The trees in this type of forest stay green throughout the year because in these regions monsoon lasts for a long time. The trees of evergreen forests are tall, straight, and have green crowns that almost form a canopy. Some examples are Jamun, Betel Nut Palm, Mango, Jackfruit, and Hollock.

There are semi-evergreen forests too in some pockets of the Western Ghats, Northeastern Himalayas, and Andaman and Nicobar Island. This type of forest is highly dense and has a wide variety of trees.

Deciduous Forests

Deciduous forests are found in regions that receive a moderate amount of rainfall. Here one can find teak trees. The trees in the deciduous forests shed their leaves during dry seasons, mostly in winter.

The thorn forests are found in the semi-arid regions of the country. The trees in this type of forest are sparsely distributed and are enclosed by open grasslands. These types of plants are known as Xerophytes. This means they can conserve water. These trees have a different form of leaves. Some have thick, waxy leaves that help in regulating the water loss at the time of transpiration. They have a long fibrous root that can reach water at greater depths. The thorns that are present on the plant prevent water loss and keep them safe from herbivores.

Mangrove Forest

The mangrove forests in India are found in the river deltas and along the coast. The trees in this forest grow in a mixture of freshwater and saline water. The low-lying areas where these trees grow become submerged under the water during high tide. To facilitate breathing in clayey soil, nature has equipped mangrove plants with breathing roots. Some common mangrove plants are sundari, goran, gewa, etc. The Sundarbans is the largest mangrove forest in India and the world. It is located in the Ganges delta of West Bengal and Bangladesh.

The forests in India are rich sources of timber, medical plants, honey and other natural resources. They also serve as the natural habitat of numerous animals and birds. Unfortunately, India's population explosion has reduced the forest cover to a great extent. But it is the responsibility of the government as well as common people to save the forests for the sake of a greener tomorrow.

Q9 What is meant by soil erosion. Briefly tell about causes and effects of soil erosion.

Ans.: **Soil Erosion-** Soil erosion is the process of wearing away of the surface layer, or topsoil, by the transportation of the surface particles under the mechanical actions of agents like wind, river, or even glaciers. Soil erosion is a continuous process that occurs either slowly or at an alarming rate. It results in a continuous loss of topsoil, ecological degradation, soil collapse, etc.

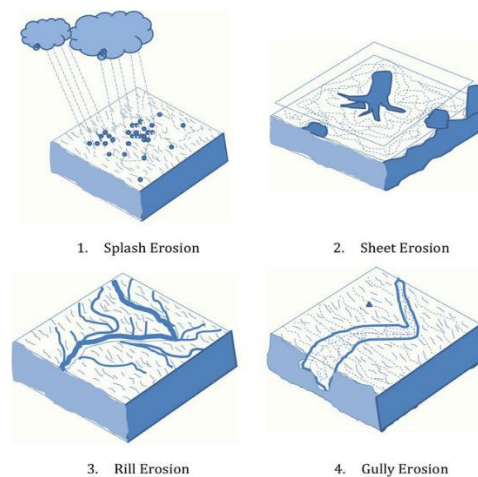
Cause of Soil Erosion- Following are the important causes of soil erosion:

Rainfall and Flooding-

Higher intensity of rainstorms is the main cause of soil erosion. Four types of soil erosion are caused by rainfall:

- Rill erosion
- Gully erosion
- Sheet erosion
- Splash erosion

The raindrops disperse the soil, which is then washed away into the nearby streams and rivers. Regions with very heavy and frequent rainfall face a large amount of soil loss. The flowing water during floods also erodes a lot of soil by creating potholes, rock-cut basins, etc.



Agriculture- The farming practices are the major cause of soil erosion. The agricultural activities disturb the ground. The trees are cleared and the land is ploughed to sow new seeds. Since most of the crops are grown during the spring season, the land lies fallow during winters. Most of the soil is eroded during winters. Also, the tyres of tractors make grooves on the land, making a natural pathway for water. Fine soil particles are eroded by wind.

Grazing- The grazing animals feed on the grasses and remove the vegetation from the land. Their hooves churn up the soil. They also pull-out plants by their roots. This loosens the soil and makes it more prone to erosion.

Logging and Mining- A large number of trees are cut down to carry out the logging process. Trees hold the soil firmly. The canopy of the trees protects the soil from heavy rainfall. The leaf litter that protects the soil from erosion, is also lost during logging.

Mining activities also disturb the land and leave the soil more prone to erosion.

Construction

The construction of roads and buildings exposes the soil to erosion. The forests and grasslands are cleared for construction purposes, which exposes the soil making it vulnerable to erosion.

Rivers and Streams

The flowing rivers and streams carry away the soil particles leading to a V-shaped erosion activity.

Heavy Winds

During dry weather or in semi-arid regions, the minute soil particles are carried away by the wind to faraway lands. This degrades the soil and results in desertification.

Effects of Soil Erosion- The major effects of soil erosion include:

- Loss of Arable Land
- Clogging of Waterways
- Air Pollution
- Desertification
- Destruction of Infrastructure

Soil Erosion Prevention- Soil erosion is a serious environmental issue. Steps should be taken to curb this problem. Following are some of the methods of soil erosion prevention:

1. Plant trees on barren lands to limit erosion of soil.
2. Add mulch and rocks to prevent the plants and grass underneath to prevent soil erosion.
3. Mulch matting can be used to reduce erosion on slopes.
4. Put a series of fiber logs to prevent any water or soil from washing away.
5. A wall at the base of the slope can help in preventing the soil from eroding.
6. Every household should have a proper drainage system so that water flows down into proper water collecting systems.

Unit 3

Q1 What do you understand by the term pollution and pollutants? Classify all the categories of pollutants with examples.

Ans.: **Pollution** – Pollution is an undesirable change in the physical, chemical or biological characteristics of our air, land and water (basic amenities) causing harmful effect on our life or that of other desirable species.

Pollutants – “The substance which causes pollution is known as pollutants”. “Anything or any substance if present in undesirable concentration and in the wrong place at the wrong time is a pollutant”

Classification of pollutants

A) On the basis of their forms, they exist in the environment after their release –

1. Primary Pollutants –
 - Those substances emitted directly from an identifiable source.
 - These substances exist as such after being added released in to the environment.
 - Examples are- SO_x and NO_x etc.
2. Secondary pollutants –
 - These are substances, derived from primary pollutants by chemical reactions.
 - For example – primary pollutants such as hydrocarbons & NO_x , particularly in the environment react in presence of sun light to form a nitrous compound like peroxyacetyl nitrate (PAN) as the secondary pollutants & photochemical smog.

B) On the basis of decomposition nature –

1. Non-biodegradable pollutants –
 - Are those pollutants that can not be degraded itself or by artificial means.
 - Ex- radioactive materials, heavy metals and some plastics.

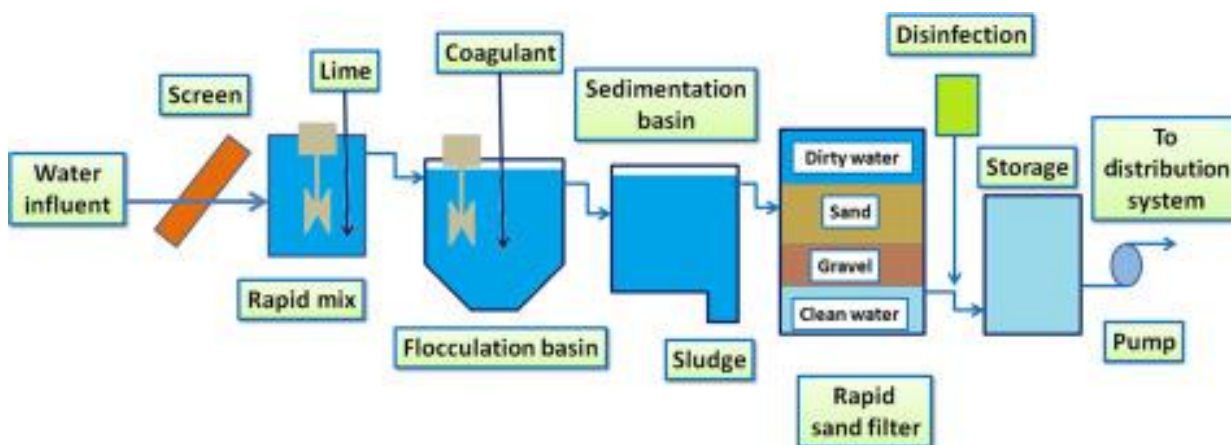
- They do not only accumulate but are often biologically magnified.
 - They must be controlled or prevented from reaching the environment.
2. Degradable pollutants –
- Are those that can be decomposed, removed or consumed or reduced to acceptable levels either by natural or artificial means.
 - Such as human sewage, animal & crop wastes.
- C) On the basis of nature, the pollutants are of three types-
- Physical pollutants – Heat, Noise, Radioactive elements.
 - Chemical Pollutants – Oxides of carbon (CO_x), SO_x , NO_x halogen gasses etc.
 - Biological pollutants – Microorganisms such as bacteria, virus and fungi, pollen-grains.
- D) On the basis of their source of origin –
1. Point source pollutants –
 - When the emission or origin source is point.
 - Such as – emissions from stock.
 2. Line source pollutants –
 - When the emission source is in the form of line or curve.
 - Such as – transportation means, road rollers etc.
 3. Area source pollutants –
 - When the emission or origin source is an area.
 - Such as – crushing, grinding, blasting in mines etc.

Q2 Discuss the various steps used in water effluent treatment plants with suitable diagrams and examples.

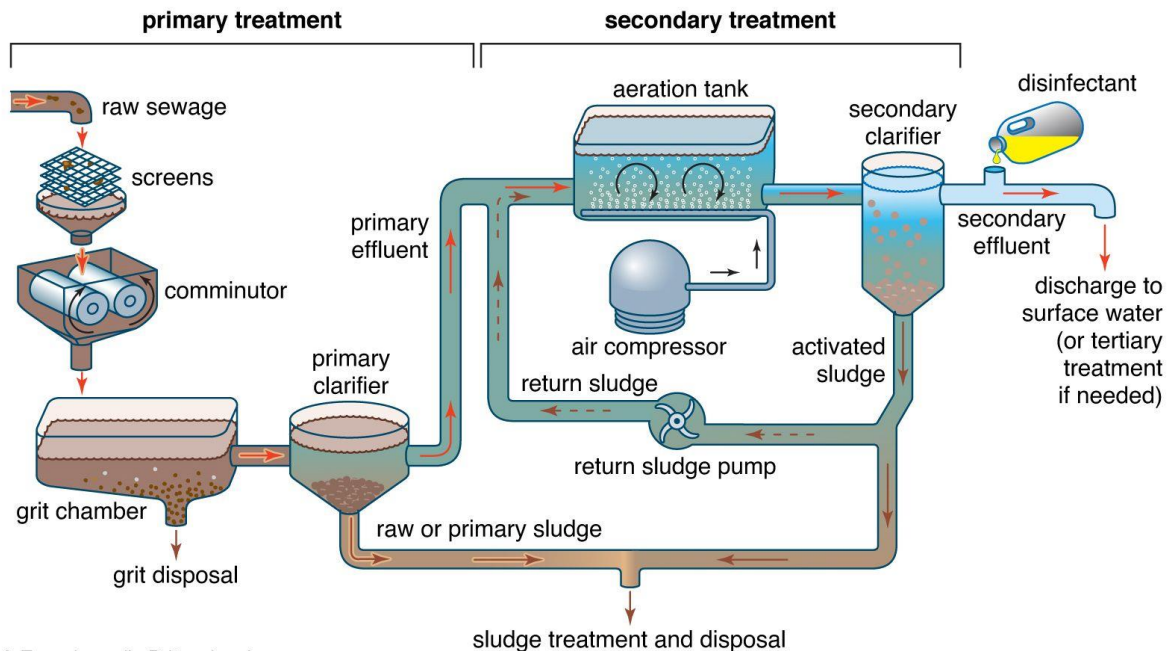
Ans. **Water Treatment**– Preliminary (Manual and Simple)- Elimination of debris and coarse wastes, Primary (Chemical and Mechanical)- Elimination of inorganic and suspended organic wastes, and Secondary (Biological) - Elimination of dissolved organic wastes.

Primary Treatment

Primary treatment removes material that will either float or readily settle out by gravity. It includes the physical processes of screening, comminution, grit removal and sedimentation.



Chemical Treatment



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Screens are made of long, closely spaced, narrow metal bars. They block floating debris such as wood, rags and other bulky objects that could clog pipes or pumps. In modern plants the screens are cleaned mechanically and the material is promptly disposed of by burial on the plant grounds. A comminutor may be used to grind and shred debris that passes through the screens. The shredded material is removed later by sedimentation or flotation processes.

Grit chambers are long narrow tanks that are designed to slow down the flow so that solids such as sand, coffee grounds and eggshells will settle out of the water. Grit causes excessive wear and tear on pumps and other plant equipment.

Suspended solids that pass-through screens and grit chambers are removed from the sewage in sedimentation tanks. These tanks also called primary clarifiers, provide about two hours of detention time for gravity settling to take place. As the sewage flows through them slowly, the solids gradually sink to the bottom. The settled solids—known as raw or primary sludge—are moved along the tank bottom by mechanical scrapers. Sludge is collected in a hopper, where it is pumped out for removal. Mechanical surface-skimming devices remove grease and other floating materials.

Chemical Treatment Methods

Some of the commonly used chemical methods in wastewater treatment are-

- 1. Coagulation/flocculation, 2. Sedimentation, 3. Disinfection*

Secondary Treatment

Secondary treatment removes the soluble organic matter that escapes primary treatment. It also removes more of the suspended solids. Removal is usually accomplished by biological processes in which microbes consume the organic impurities as food, converting them into carbon dioxide, water, and energy for their own growth and reproduction. The sewage treatment plant provides a suitable environment, albeit of steel and concrete, for this natural biological process. Removal of soluble organic matter at the treatment plant helps to protect the dissolved oxygen balance of a receiving stream, river, or lake.

There are three basic biological treatment methods: the trickling filter, the activated sludge process, and the oxidation pond. A fourth, less common method is the rotating biological contractor.

-Trickling filter

A trickling filter is simply a tank filled with a deep bed of stones. Settled sewage is sprayed continuously over the top of the stones and trickles to the bottom, where it is collected for further treatment. As the wastewater trickles down, bacteria gather and multiply on the stones. The steady flow of sewage over these growths allows the microbes to absorb the dissolved organics, thus lowering the biochemical oxygen demand (BOD) of the sewage. Air circulating upward through the spaces among the stones provides sufficient oxygen for the metabolic processes.

Settling tanks, called secondary clarifiers, follow the trickling filters. These clarifiers remove microbes that are washed off the rocks by the flow of wastewater. Two or more trickling filters may be connected in series, and sewage can be recirculated in order to increase treatment efficiencies.

-Activated sludge

The activated sludge treatment system consists of an aeration tank followed by a secondary clarifier. Settled sewage, mixed with fresh sludge that is recirculated from the secondary clarifier, is introduced into the aeration tank. Compressed air is then injected into the mixture through porous diffusers located at the bottom of the tank. As it bubbles to the surface, the diffused air provides oxygen and a rapid mixing action. Air can also be added by the churning action of mechanical propeller-like mixers located at the tank surface.

Under such oxygenated conditions, microorganisms thrive, forming an active, healthy suspension of biological solids—mostly bacteria—called activated sludge. About six hours of detention is provided in the aeration tank. This gives the microbes enough time to absorb dissolved organics from the sewage, reducing the BOD.

The mixture then flows from the aeration tank into the secondary clarifier, where activated sludge settles out by gravity. Clear water is skimmed from the surface of the clarifier, disinfected, and discharged as secondary effluent. The sludge is pumped out from a hopper at the bottom of the tank.

-Oxidation pond

Oxidation ponds, also called lagoons or stabilization ponds, are large, shallow ponds designed to treat wastewater through the interaction of sunlight, bacteria, and algae. Algae grow using energy from the sun and carbon dioxide and inorganic compounds released by bacteria in water. During the process of photosynthesis, the algae release oxygen needed by aerobic bacteria. Mechanical aerators are sometimes installed to supply yet more oxygen, thereby reducing the required size of the pond. Sludge deposits in the pond must eventually be removed by dredging. Algae remaining in the pond effluent can be removed by filtration or by a combination of chemical treatment and settling.

Tertiary Treatment

When the intended receiving water is very vulnerable to the effects of pollution, secondary effluent may be treated further by several tertiary processes.

Q3 What is air pollution? What are its effects on human health?

OR

Describe in brief air pollutants and its effects on the environment.

OR

Explain four major air pollutants and their effects.

Ans.: Air Pollution – Air Pollution refers to substances that on local and regional scales directly harm animals. Plants & people and their property.

Sources of Air Pollution- Different sources of air pollution or pollutants are as follows:

1. Carbon Compounds – These are mainly CO & CO_2 .
 - CO_2 is released by the complete combustion of fossil – fuels.
 - CO is released by automobile exhausts.
 - Carbon oxides are primary air pollutants.
 - CO affects human health by combining with Hb (Hemoglobin), blocks the oxygen carrier & suffocates to death.
 - Also increases respiratory problems.
 - CO_2 acts as greenhouse gases, and can cause global warming.
2. Nitrogen Oxides – These consists of mixed oxides, nitric oxide and nitrogen dioxide (NO & NO_2).
 - $N_2 + O_2 \rightarrow 2NO$
 - $2NO + O_2 \rightarrow 2NO_2$
 - These reactions occur in automobile engines.
 - In the air, it is converted into nitric acid.
 - $NO_2 + O_3 \rightarrow NO_3 + O_2$
 - $NO_3 + NO_2 \rightarrow N_2O_5$ (Nitrogen Pentoxide)
 - $N_2O_5 + H_2O \rightarrow 2HNO_3$ (Nitric acid)
 - Nitrogen oxides affect the respiratory system, and irritate the eye, nose & throat.
 - NO_2 causes leaf fall (abscission) & suppressed the growth of plants resulting in reduced yield of the crop – plants.
3. Hydrocarbons & Photochemical smog –
 - CH_4 (Methane) is generated or released from – (i) decomposition

$$2[CH_2O] \xrightarrow{\text{bacteria}} \underset{\text{Carbon}}{CO_2 \uparrow} + \underset{\text{Methane}}{CH_4 \uparrow}$$
 - PAN (Proxy acetyl nitrate) irritates the eyes, as it is present in the automobile smoke.
 - It also affects the lungs and damages the leafy vegetables (discoloration occurs).
4. Sulphur dioxide, SO_2 → These include SO_2 , H_2S & H_2SO_4 , are released by fossil – fuels (coal). Release from – (1) Thermal Power Plants.
(2) Industrial Units.
 - $S + O_2 \rightarrow SO_2$ (sulfur dioxide)
 - $2SO_2 + O_2 \rightarrow 2SO_3$ (sulfur trioxide)
 - $SO_2 + O_3 \rightarrow SO_3 + O_2$
 - $SO_3 + H_2O \rightarrow H_2SO_4$ (Sulfuric Acid)
 - Sulfuric Acid is formed on aerosol drop late. (Smoke, fog, mist)
 - It causes Acid – Rain, Photochemical smog.
 - SO_2 causes, bronchitis, pneumonia & other respiratory troubles.
 - In plants, SO_2 causes chlorosis, damages buildings, materials.
 - Paints are discolored by SO_2 , H_2S particles.

Q4 What are the main pollutants released from automobile pollution. Discuss important devices to eliminate solid particulate matter from air emission.

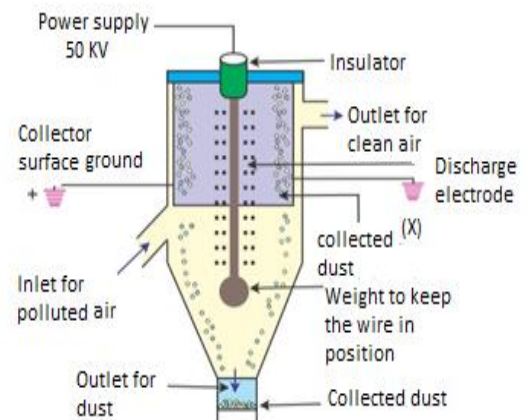
Ans.: The largest part of most combustion gas is nitrogen dioxide, water vapor and carbon dioxide and a relatively small part of carbon monoxide. When fuel burns in automobile exhausts hydrocarbons release gases by complete burning like carbon dioxide or incomplete burning of fuel like carbon monoxide. Large amount of nitrogen dioxide is released around 60-70%, while carbon dioxide is around 14-12% and water vapor around 10%.

Control through Devices

The following items are used as pollution control devices to destroy contaminants or remove them from an exhaust stream before it is emitted into the atmosphere-

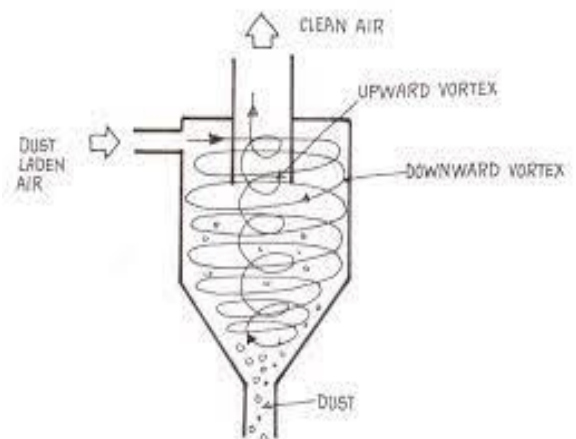
✚ Electrostatic Precipitators:

Electrostatic precipitators are very economical devices that take away about ninety nine percent of particulate present within the industrial and thermal power exhausts. They include charged plates are square measure connected to the bottom. The electrode wires are supplied with high voltage current that turn out a corona that releases electrons. These electrons attach to the dirt particles giving them a negative charge. The aggregation particles are grounded and attract the charged dirt particles. The speed of air between the plates should be low enough to permit the dirt to fall.



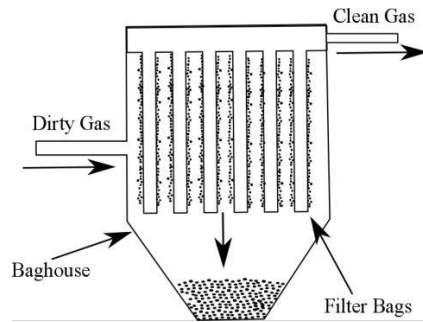
✚ Cyclone Separators:

Cyclonic separation is a method of removing particulates from an air, gas or liquid stream, without the use of filters, through vortex separation. When removing particulate matter from liquid, a hydrocyclone is used; while from gas, a gas cyclone is used. Rotational effects and gravity are used to separate mixtures of solids and fluids.



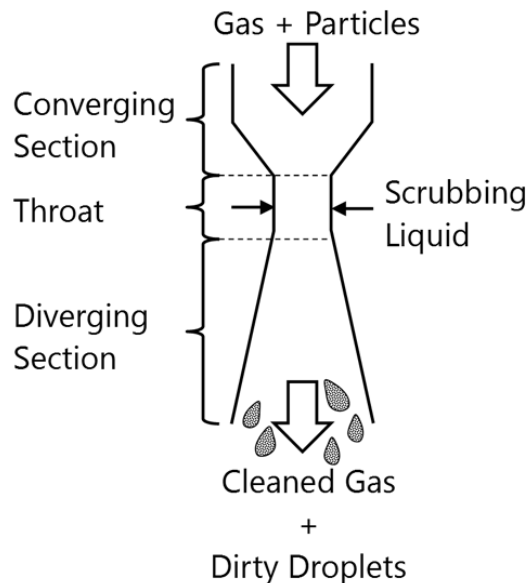
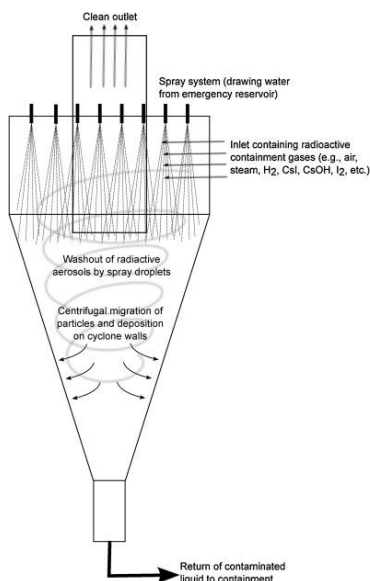
Baghouses:

Designed to handle heavy dust loads, a dust collector consists of a blower, dust filter, a filter-cleaning system, and a dust receptacle or dust removal system (distinguished from air cleaners which utilize disposable filters to remove the dust).



Particulate Scrubbers:

A wet scrubber is a form of pollution control technology. The term describes a variety of devices that use pollutants from a furnace flue gas or from other gas streams. In a wet scrubber, the polluted gas stream is brought into contact with the scrubbing liquid, by spraying it with the liquid, by forcing it through a pool of liquid, or by some other contact method, so as to remove the pollutants. Ex- Spray Tower or Wet Scrubber, Ejector venturi scrubber



Q5 Define soil pollution. What are its sources and effects?

Ans.: **Land / Soil Pollution-** Land pollution (soil) is the degradation of earth's surfaces or topmost layer of soil. Often caused by human activities and misuse of land resources.

“Any change in the physical, chemical & biological properties of soil due to natural or man-made activities is known as soil pollution.

Studies have known that 15% of the total land area in the world is degraded to varying degrees. About 55% of this area has been degraded by water erosion. 28% by wind erosion. 12% by chemical factors (water – logging – solemnization). And the main cause of this degradation is over organizing deforestation & agricultural activities.

Causes/Sources of soil – pollution.

1. **Natural sources** –natural sources are landslides, earthquakes, landslides, hurricanes & floods.
 - Such natural disasters cause serve damage to the compotation of soil.

2. **Man – Made sources**

Industrial Wastes –

- Contain different kind of toxic flammable and non – bio degrade substances that may persist in the soil for a long time and destroy the composition of soil.
- Such as Hg (Mercury), Zinc (Zn), Iron (Fe) and ed etc.

- Fly ash (powder material to un burnt material besides huge heap of solid waste.

Mining –

- Mining activities leave behind heap of mining wastes containing several toxic substances.

Agricultural wastes –

- Non judicious use of chemical fertilizers, pesticides, insecticides and fumigants remain in the soil for long period of without degradation causes soil pollution.

Domestic Wastes –

- Kitchen and food wastes, paper etc are biodegradable but glass, plastic materials, metal cans etc are non-biodegradable, In proper disposal of hazardous domestic wastes such as batteries, paints, medicines, glass bulbs spray cans etc contribute greatly to soil pollution.

Radioactive waste –

- Radioactive substances from nuclear power plants are released in to the soil.
- Radioactive wastes contains several Radio nuclear such as Sr (Strontium – 90), Iodine 190, Cesium 137 and isotopes of iron which are more injurious.
- Sr.-90 gets deposited in the bones and tissues & instead of calcium.
- Nuclear reactor produces Ruthenium – 106, Barium -140 Lanthanum – 140, cesium -144 along with primary nuclides.
- Sr-90 and Cs-137.

Biological agents –

- Soil gets large quantities of human and animal excreta which constitute the major part of land pollution.
- In addition to these excreta faulty sanitation, municipal garbage, waste water and wrong methods of agricultural practices also induce heavy soil pollution. Pathogens excreted by human and animals such as entire bacteria and parasite worms contaminated the soil.

Effects of soil pollution

A) Effects of Industrial wastes

- Metallic contaminants such as Hg, Pb, Zn, As, Cd & Cu etc. destroy bacteria and beneficial microorganisms in the soil.
- Industrial effluents when discharged through sewage. System will poison the biological purification mechanism of sewage treatment.

B) Effects of Modern Agro – practices

- Excessive use of *N* – Fertilizer makes plant less resistant to diseases.
- Organochlorine pesticides like DDT are highly toxic, persistent and bio accumulative. Almost all food commodities in India are contaminated with pesticide residues.
- Excessive use of NPK fertilizers in land the soil deficient in macronutrient such as *Zn, CO, Fe, Ne, Mn* etc

C) Effects of Radioactive pollutants

- Radioactive elements (wastes) remains active in soil for thousands of years and enter the food chain causes a number of adverse health effects such as cancer deformities in bones etc. in human beings. Radiation also affects the soil and soil fertility.

D) Effects of Biological pollutants –

- Pathogenic soil bacteria cause cholera, typhoid, bacillary dysentery, paratyphoid fever.
- Pathogenic soil bacteria like salmonella typhosa causes infections of intestinal tract.

E) Effects of domestic wastes –

- Non-biodegradable domestic waste are retained in the soil for a long time and slowly poison the soil and damage its fertility.

Control of soil pollution

- Industrial wastes and effluents must be treated before being disposed to reduce toxicity of the elements present in them.
- Waste disposal system should be planned.
- Garbage from urban areas should be segregated into biodegradable and non-biodegradable waste products.
- Biodegradable wastes can be used for production of manures and biogas.

- Non-biodegradable wastes such as glass, metal and plastics can be recycled & reused.
- The use of chemical fertilizers and pesticides should be minimized as far as possible.
- Solid waste (organic) can be used for electricity generation. A number of small-scale electricity plants are running in our country.
Such as – Central mechanical engineering and Research Institute at Durgapur. The plant has capacity to use about 500 kg garbage per hectare producing 5 kw electricity.
- Planting trees must be encouraged as they utilize many of the pollutants during photosynthesis, and reduce the severity of soil pollution.
- Disposal of radioactive waste should be prohibited as it is impossible to completely cleanse the soil of Radioactive elements.

Q6 Discuss in brief causes and impacts of noise pollution?

Ans.: **Noise Pollution**

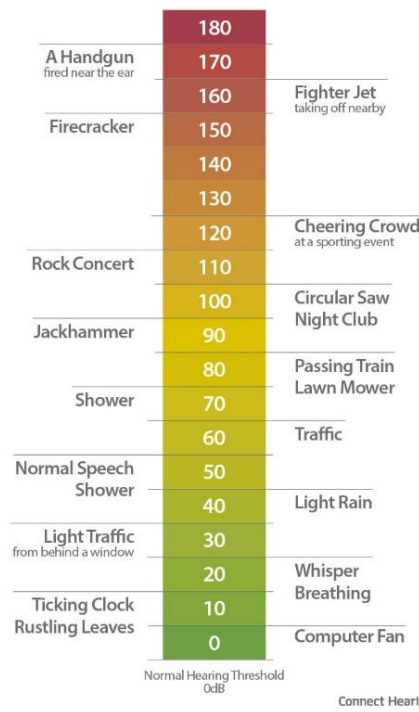
The word noise is derived from the latin word nausea which refers to a loud sound. A loud, unwanted or unpleasant sound that causes discomfort is known as noise. The release of unwanted sound in to the atmosphere is known as Noise pollution.

“Noise is the wrong sound, in the wrong place at the wrong time.”

Decibel Scale- The unit by of which noise intensity is measured is called decibel (dB).

The decibel is a logarithmic ratio between two values – a measured and a reference value. On a decibel scale, one decibel equals one-tenth (deci-) of one bel.

| Decibel Table of Ambient Noises



How Does the Decibel Scale Work?

The lowest (quietest) sound on a decibel scale, which is considered near-complete silence, is 0 dB. Regarding the units of 10 as mentioned above, a sound 10 times greater in intensity will be measured as 10 dB; a sound 100 times more intense than 0 dB will be measured as 20 dB; a sound 1,000 times greater in intensity than near silence will be measured as 30 dB, and so on.

- 40 dB and up: Learning and concentration become challenging
- 60 dB and up: Long-term exposure may result in hearing damage
- 65 dB and up: Higher risk of cardiovascular diseases in case of long-term exposure
- 85 dB and up: Loud work places can do permanent damage over the years
- 120 dB and up: Hearing damage possible even in case of short-term exposure

In the past few years, the noise level has increased due to various human activities. The noise level are much higher than the prescribed level. The main causes of noise pollution are-

Causes/Sources of Noise-pollution

Natural Phenomena-

- Very few natural phenomena cause noise pollution.
- These include violent volcanic eruptions, thunder, fierce storm etc.
- These are rare occurrences and it is not humanly possible to control.

Noise from Industrial plants-

- Various Industries such as textile mills, printing press, engineering units, stone crushers etc. use a lot of complier machinery for a variety of processes such as crushing of different materials, grinding, drilling blasting etc.
- These machines cause a lot of noise creating noise pollution.

Noise from Transportation

- The increasing number of automobiles plying on the road in cities contributes greatly.
- Due to blaring of music – system and constant of honking by drivers, commuting on busy roads has become a harrowing experience.
- Apart from motor – vehicles, trains, ships and aircrafts. also generate air-splitting noise.
- People living close to railway stations, shopping ports and airports are constantly subjected to high-intensity noise.

Noise from Entertainment

- Electronic devices such as radio, television, music system also produce a considerable amount of noise.
- Brushing crackers and playing loud music during social gatherings and festivals lead to a lot of noise pollution.

Noise from Domestic appliances

- The excessive use of domestic, appliances such as mixers, washing machines, telephones etc. that were invented for the convenience of human beings leads to the generation of a lot of noise.

Q7 What is solid waste? What are the various processes involved in solid waste management.

Ans. Solid waste means any garbage or refuse, sludge from a wastewater treatment plant, water supply treatment plant, or air pollution control facility and other discarded material, resulting from industrial, commercial, mining, and agricultural operations, and from community activities. Nearly everything we do leaves behind some kind of waste.

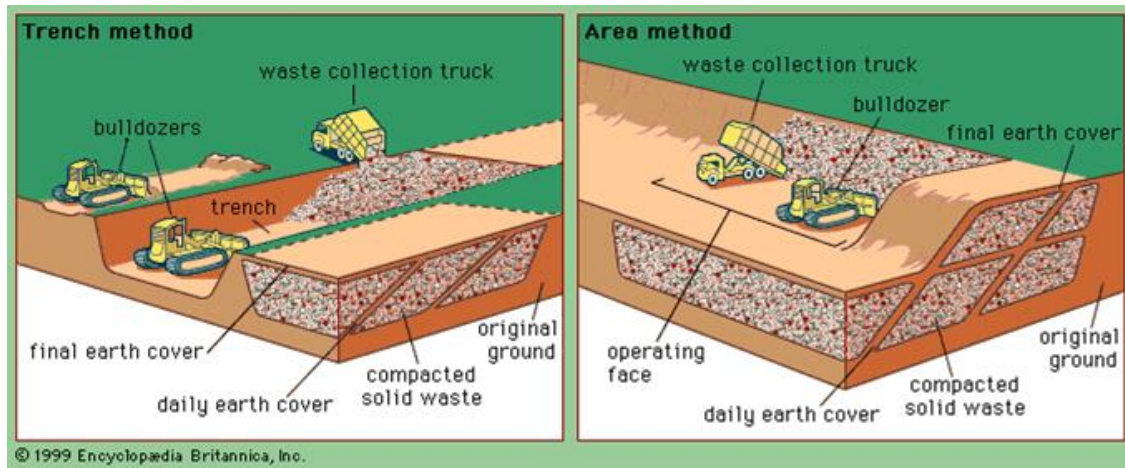
Waste Management- *Waste management is the “generation, prevention, characterization, monitoring, treatment, handling, reuse and residual disposition of solid wastes”. There are various types of solid waste including municipal (residential, institutional, commercial), agricultural, and special (health care, household hazardous wastes, sewage sludge).*

Methods of Waste Disposal

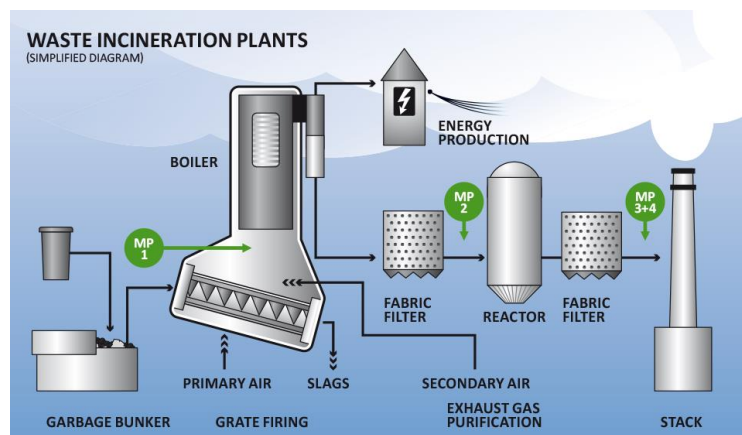
Solid Waste Open Dumping/Burning

Solid waste open dumping / burning is not the perfect method in the present scenario.

Landfills- The Landfill is the most popularly used method of waste disposal used today. This process of waste disposal focuses attention on burying the waste in the land. Landfills are found in all areas. Solid wastes sanitary landfills process is simple, clean and effective. In this procedure, layers are compressed with some mechanical equipment and covered with earth, levelled, and compacted. A deep trench of 3 to 5 m is excavated and micro-organisms act on the organic matter and degrade them. In this procedure, refuse depth is generally limited to 2m. Facultative bacteria hydrolyze complex organic matter into simpler water-soluble organics.

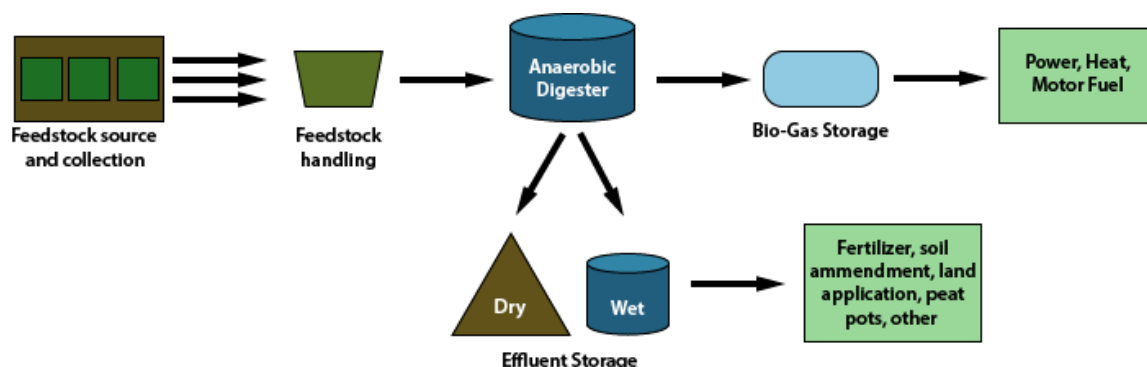


Incineration/Combustion- Incineration or combustion is a type disposal method in which municipal solid wastes are burned at high temperatures so as to convert them into residue and gaseous products. The biggest advantage of this type of method is that it can reduce the volume of solid waste to 20 to 30 percent of the original volume, decreases the space they take up and reduce the stress on landfills. This process is also known as thermal treatment where solid waste materials are converted by Incinerators into heat, gas, steam and ash.



Composting

Composting is a easy and natural bio-degradation process that takes organic wastes i.e. remains of plants and garden and kitchen waste and turns into nutrient rich food for your plants. Composting, normally used for organic farming, occurs by allowing organic materials to sit in one place for months until microbes decompose it. It is popular in developing countries. Composting is one of the best methods of waste disposal as it can turn unsafe organic products into safe compost, that can be used as a base for fertilizers. On the other side, it is slow process and takes lot of space.



Two methods have been used in this process:

1. Open Window Composting
2. Mechanical Composting

Salvaging (Recovery and Recycling)

Resource recovery is the process of taking useful discarded items for a specific next use. These discarded items are then processed to extract or recover materials and resources or convert them to energy in the form of useable heat, electricity or fuel. Recycling is the process of converting waste products into new products to prevent energy usage and consumption of fresh raw materials. Materials such as metal, paper, glass, rags, certain types of plastic and so on can be salvaged, recycled, and reused

Plasma Gasification

During the treatment solid waste by plasma gasification, the waste's molecular bonds are broken down as result of the intense heat in the vessels and the elemental components. This form of waste disposal provides renewable energy and an assortment of other fantastic benefits.

Avoidance/Waste Minimization

The easier method of waste management is to reduce creation of waste materials thereby reducing the amount of waste going to landfills. Waste reduction can be done through recycling old materials like jar, bags, repairing broken items instead of buying new one, avoiding use of disposable products like plastic bags, reusing second hand items, and buying items that uses less designing.

Waste Disposal in Deep Sea

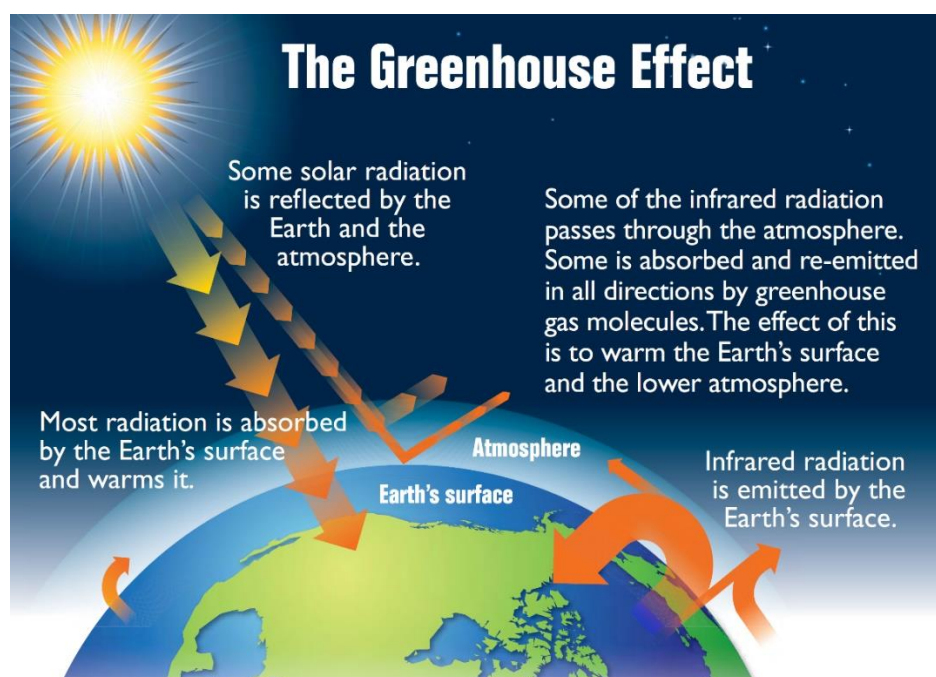
Not advisable, until alternative methods are possible, as sea itself is a natural resource.

Unit 4

Q1 What are greenhouse gases and the greenhouse effect? Explain the global warming phenomenon.
OR

What are greenhouse gases? Name and discuss their contribution to global warming. What can be their effects on the environment?

Ans.: **Greenhouse effect and global warming** – Human activities over a long period of time have resulted in a dangerous phenomenon called the enhanced greenhouse effect. It is used to indicate a heat-trapping process caused by greenhouse gases such as CO_2 and water-vapour. The greenhouse effect is the warming of earth.



The atmosphere allows a large percentage of the rays of visible light from the sun to reach the earth surface and heat it. A part of this energy is reradiated by the earth's surface in the form of long – wave infrared radiation, much of which is absorbed by molecules of CO_2 & water vapour in the atmosphere and which is

reflected to the surface of the earth as heat. The trapping of this infrared radiation causes the earth's surface and lower atmosphere layer to warm to a higher temperature.

Note – This natural trapping of heat or green house effect has made the earth habitable, without it, the earth would have been a cold, lifeless planet. This effect helps to maintain the heat temperature of the earth 15°C . and in the absence of the greenhouse effect the earth's temperature would have been -180°C .

Thus, the greenhouse effect is a blessing and not a curse but only when GHGs are present in the atmosphere at an optimal level. The increment in the concentration of these gases over a long time rises the average temperature of the earth as a whole, which is called global warming.

Greenhouse gases- “Greenhouse gases are the gases that absorb the infrared radiations and create a greenhouse effect. For eg. carbon dioxide and chlorofluorocarbons.” By their percentage contribution to the greenhouse effect on Earth the four major gases are as follows:

water vapour 36–70%, carbon dioxide 9–26%, methane 4–9%, ozone 3–7%

The major contributors to greenhouse gases are factories, automobiles, deforestation, burning of fossil fuel etc. The increased number of factories and automobiles increases the amount of these gases in the atmosphere. The enhanced greenhouse gases never let the radiation escape from the earth and increase the surface temperature of the earth. This then leads to global warming.

Causes of enhanced Greenhouse Effect- The major causes of the greenhouse effect are-

Burning of Fossil Fuels

Fossil fuels are an important part of our lives. They are widely used in transportation and to produce electricity. Burning of fossil fuels releases carbon dioxide. With the increase in population, the utilization of fossil fuels has increased. This has led to an increase in the release of greenhouse gases in the atmosphere.

Deforestation

Plants and trees take in carbon dioxide and release oxygen. Due to the cutting of trees, there is a considerable increase in greenhouse gases which increases the earth's temperature.

Farming

Nitrous oxide used in fertilizers is one of the contributors to the greenhouse effect in the atmosphere.

Industrial Waste and Landfills

Industries and factories produce harmful gases which are released in the atmosphere. Landfills also release carbon dioxide and methane that adds to the greenhouse gases.

Environmental effects of enhanced Greenhouse Effect

- **Global Warming-** The gradual increase in temperature due to the greenhouse effect caused by pollutants, CFCs and carbon dioxide is called global warming. This phenomenon has disturbed the climatic pattern of the earth.
- More extreme weather, causing hotter and drier summers and colder winters
- Melting of polar ice and oceanic expansion. This results in flooding of coastal areas, swamps, wetlands and river deltas.
- Increase in the number and severity of tropical storms and cyclones - Flooding and erosion of agricultural plots. This damage crops and soils and decreases harvest.
- Major shifts in ecosystems and decreasing biodiversity
- Evaporation of water supplies causes drinking water scarcity.
- Saltwater penetration of groundwater zones.
- More contagious diseases because the environment is more positive for pathogens and some dangerous insects, such as the malaria mosquito.

Remedies- The following is a list of steps to reduce greenhouse gas emissions:

- ✓ Apply 4'R'Refuse, Reduce, Reuse, Recycle
- ✓ Use Less Heat and Air Conditioning
- ✓ Replace Your Light Bulbs
- ✓ Drive Less and Drive Smart
- ✓ Buy Energy-Efficient Products

- ✓ Use Less Hot Water
- ✓ Use the "Off" Switch
- ✓ Plant Trees- Afforestation

Q2 What are acid rains? Discuss its phenomena with examples.

OR

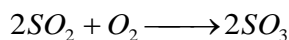
What are acid rains? Discuss their causes, consequences and control measures.

Ans.: **Acid Rain**

The term acid rain was first used by Robert Angus Smith in 1872. It refers to the presence of excessive acids in rainwater. Smith defined acid rain as 'a condition of the environment in which natural precipitation becomes acidic, after reacting chemically with pollutants in the air.

Causes of Acid Rain –

- Acidification of the environment is a phenomenon caused by human activities.
- Acid deposition is a more precise term for Acid rain.
- It (Acid deposition) may be either wet or dry.
- Wet forms of deposition are – Rain, snow, dew, fog, frost and mist.
- Dry deposition – setting of dust particles containing sulfates and nitrates on earth.
- Wet deposition is a more common occurrence.
- Major causes of acid rain include the burning of fossil fuel and use of nuclear weapons, which cause the emission of a large amount of sulfur dioxide (SO_2) and Nitrogen dioxide (NO_2).
- Sulphur dioxide (SO_2) oxidized in the atmosphere,



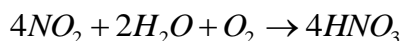
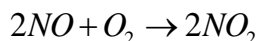
Which then reacts with rainwater to form Sulfuric acid.

Frost – Deposit of white ice crystals formed on surfaces when the temp falls below freezing temperature.

Mist – a cloud of tiny water drops.



- Similarly, the oxides of nitrogen react in the air to produce Nitric acid (HNO_3)



- Both these acids are very strong and when present in the atmosphere dissolve in water droplets to fall on earth as acid rain.
- Acid rain is measured using a scale called pH scale.
- Pure water has a pH of 7.0.
- Normal rain is slightly acidic because carbon dioxide dissolves into it and hence it has pH the more acidic it is.

Effects of Acid rain – Acid rain causes acidification of lakes and streams. It increases the acidity of soil reducing agricultural productivity. Some of the adverse effects describe below-

- **Effects of on aquatic ecosystem –**

Acid rain leads to a significant reduction in the population of aquatic organisms. Such as fishes, accompanied by a decrease in the variety of species in food chains.

Nearly 1,500 lakes of Sweden have become fishless. These fishless lakes are now called fish graveyards.

- **Effect on Terrestrial Ecosystem –**

It has severe effects on terrestrial vegetation, such as reduced photosynthesis, slower growth, and increased sensitivity to drought and disease.

Retards growth of plants such as peas, beans, radish, potatoes, spinach and carrots.

Effects on buildings –

Acid rain causes extensive damage to building structural materials such as marble, limestone, state mortar etc. as they can easily be dissolved by acid rain.

The attack on marble is known as stone leprosy.

Acid rain is causing damage to many famous buildings and monuments across the world.

- Eg– (i) Taj Mahal in Agra
(ii) British Parliament building also suffered due to Acid rain.
(iii) In Europe and Greece many famous buildings, monuments and art treasures have deteriorated at an alarming rate.

Solutions of Acid rain –

- Less use of fossil fuel in industries and transport
- Afforestation
- Reduction in SO₂ and NO₂ by using pollution control equipment such as Scrubbers
- Liming of lakes and soils

Q3 How ozone layer formed and depleted in nature? Explain the role of agents in depletion with photochemical reactions.

OR

How the ozone layer formed and depleted in nature, explain with photochemical reactions. Discuss the effects of ozone depletion.

Ans.: **Oxygen – Ozone cycle-** Three forms of oxygen (allotropes) are involved in ozone-oxygen cycles.

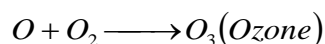
- Oxygen atom or atomic oxygen O.
- Oxygen molecules – O₂ or diatomic oxygen.
- Ozone gas – O₃

O₃ is formed in stratosphere when O₂ molecules photo dissociate after absorbing on UV light (Photon), whose wavelength is shorter than 240nm. (Nano – billionth of a unit)

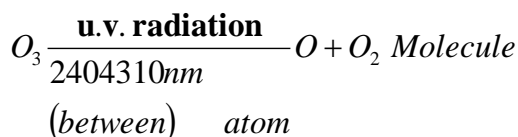


(shorter than) Oxygen atom

This atomic oxygen then combines with another O₂ molecule to produce O₃ molecules.



Ozone (O₃) molecule absorbs UV light between 200-310nm and splits in to 'O' atom and O₂ molecule.

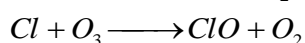
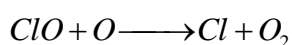
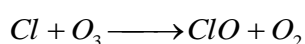
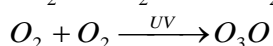
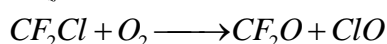
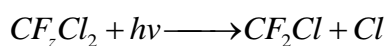


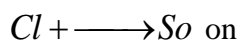
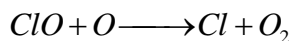
This oxygen atom then joins up with another O₂ molecule and O₃ (ozone) is formed. (regenerate)

Note – this is a continuous process that terminates when an oxygen atom recombines with O₃ molecule instead of O₂ molecule to form 2O₂ molecule.

Ozone layer depletion (process) or mechanism – The overall amount of O₃ in stratosphere is determined by balance between photochemical production and recombination. O₃ (ozone) can be destroyed by a group of manufactured chemicals, containing chlorine and/or bromine, called "ozone-depleting substances" (ODS). The main ODS are chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), carbon tetrachloride, methyl chloroform, and Halons (brominated fluorocarbons).

Each atom of chlorine dissociated from ODS reacts with molecules of oxygen, converting ozone into oxygen.





A single Cl atom would keep on destroying O_3 for up to two years.

Depletion of ozone layer (Ozone – hole) over Antarctic region

- Ozone hole was first noticed by area search group from British, Antarctic survey scientist Joseph Farman, Brian Gardiner and Jonathan Shanklin.
- Satellite measurement showing massive depletion of ozone (40% loss in the spring time) around the south pole.
- The polar regions are more prone to ozone depletion because of the formation of polar vortex (a huge air mass, trapped for a long time due to blowing of wind in a circular pattern at polar region), which collects dust particles, CFC 's and other components.
- Polar regions get a much larger variations in sunlight than anywhere else. And during 3 months of winter spend most of time in dark without solar radiation and temp reach close around $-80^\circ C$ cause cloud formation are known as Polar Stratospheric clouds.
- These Polar stratospheric clouds are composed of the ice crystals.
- The CFC 's brought from lower levels/regions get attached to the tiny ice crystals.
- When the sun rises after a long night (Antarctica spring) light triggers a massive demolition of ozone by ClO .
- The vast demolition of ozone at that level in the stratosphere makes the ozone layer very thin.
- This is called “ozone hole”.
“The ozone hole is defined geographically as the area wherein the total ozone amount is less than 120 Dobson units.”

Montreal Protocol

- The Montreal protocol on substances that deplete the ozone layer is a landmark international agreement that was designed to reduce the production and consumption of ozone-depleting compounds (CFC 's) carbon tetrachloride, methyl chloroform etc.
- This protocol was signed on 16 September 1987 and came in to force on 1 January 1989.
- In 1995 the United Nations named 16 September as the international day for the protection of the ozone layer.

Global Climate change

- ✚ Weather is defined as a condition of the atmosphere at a particular place and time.
- ✚ Characterized by parameter such as temp. and wind.
- ✚ Climate refers to the long-term pattern of weather conditions of a given area.
- ✚ Change is a fundamental characteristic of nature or environment.
- ✚ Climate change refers to the variation in Earth's global climate or in regional climates over time.
- ✚ From ice age of past to the industrial age of the present the climate of earth has been changing.
- ✚ These changes can be caused by earth's internal processes, by external forces such as variation in sunlight intensity or by human activities.

Q4 Define Urban Sprawling. State its positive and negative impacts on environment.

OR

What are the major impacts of Urbanization?

Ans.: **URBANIZATION**- Urbanization is the expansion of a city or metropolitan area where the population in urban localities or area increases over time.

“Urban expansion is a global phenomenon. Urbanization is the physical growth of urban areas.”

Causes of Urbanization

- Urbanization takes place when people migrate from rural areas to the cities in search of jobs and better living conditions.
- Urbanization is directly linked with economic development.

- 30% of Indian population live in urban areas and expected to reach 50% by 2015.
- It has positive impact on employment and production economics as business which generate jobs and capital are usually located in urban areas.
- Cities are known to be places where money and wealth are centralized.
- Living in cities permits individuals and families to take advantages of the opportunities.
- Cities known as engines of economic growth as cities contributed about 60% of the National Income.

Impact of Urbanization

- The present evils of the urbanization are the consequences of poor policies and bad managements.
- About 20-30% live in slums and about 30% of urban population have no access to safe – water 60% of urban deaths are taken place from water borne diseases.
- Due to overpopulation the water – table displays a visible decreasing trend.
- Cities become 2 to 10⁰ F (1 to 6⁶ C) warmer than surrounding landscape.
- Air pollutants are 4 to 5 times higher than the permissible level in most of the cities due to heavy traffic pollution and industries located in the cities.
- The safe disposal of municipal solid waste is not existing in most of the cities and towns in India.
- Only 20% sewage in class I cities and 2% in class 2 cities (town) is being treated.
- The unplanned urbanization resulted in unmanageable civic and social stresses.
- Further growth should be carefully planned to avoid social disruption and complete chaos.
- The policy markers at national, regional and local level should coordinate to control, urban growth at the level proportionate with the available resources like land, water food etc.

Unit 5

Q1 What is the role of NGO? Explain their importance in the prevention of environmental pollution. **OR**

What are the initiatives of Non-Governmental organization (NGO) in environment protection?

Ans.: A **non-governmental organization (NGO)** is the term commonly used for an organization that is neither a part of a government nor a conventional for-profit business. Usually set up by ordinary citizens, NGOs may be funded by governments, foundations, businesses, or private persons. Some avoid formal funding altogether and are run primarily by volunteers.

Types-

On the basis of location-

- Local NGOs
- National NGOs
- International NGOs

On the basis of Working-

- Operational
- Advisory

Role of NGO'S in Protection for the Environment in India - NGO activities include, but are not limited to, environmental, social, advocacy and human rights work. They can work to promote social or political change on a broad scale or very locally. NGOs play a critical part in developing society, improving communities, and promoting citizen participation. There are several national and international NGOs such as:-

1. Greenpeace.
2. WWF (World Wide fund for nature)
3. Conservation International (CI)
4. Pratham, AVSAR (National)
5. TERI (The energy and Resource Institute)
6. CSE (Centre for science and environment).

The Indian NGO's from past five decades have witnessed the difficult problems encountered in providing health care services to our poor people; spread the awareness to public protection of wildlife, forest, human right, Women and Children etc. Few important areas of their working are-

- Creating awareness among the public on current environmental issues and solutions.
- Facilitating the participation of various categories of stakeholders in the discussion on environmental issues.
- Conducting participatory rural appraisal.
- Being involved in the protection of human rights to have a clean environment.
- Protecting the natural resources and entrusting the equitable use of resources.
- Data generation on natural resources, time line history of villages.
- Analysis and monitoring of environmental quality.
- Transferring information through newsletters, brochures, articles, audio visuals, etc.
- Organizing seminars, lectures and group discussion for promotion of environmental awareness.
- Helping the villages' administrative officials in preparation, application and execution of projects on environmental protection.

Q2 Write about the urn, bell and pyramid shape of population pyramid.

Ans. **HUMAN POPULATION-** A group of individuals of the same species living in the same area is called a population. A population is composed of individuals belonging to different age groups at any given time. The individuals in a population can be divided into three age groups: pre-reproductive, reproductive and post-reproductive age groups.

The graphical representation of the age composition of a specific population is called the age pyramid. The age pyramid is obtained when the percentage of individuals of a given age or age group is plotted for the population.

The base of the pyramid consists of individuals of the pre-reproductive age group, the individuals in the reproductive age group are present in the middle and the post-reproductive individuals are placed at the top of the pyramid.

The shape of the age pyramid gives us an idea about the growth status of the population. It is used by demographers to study human populations.

For the human population, the age pyramids generally also include the age distribution of males and females (sex) and thus is also referred to as the age-sex pyramid. The shape of the pyramid reflects whether the population is growing, stable or declining.

Age pyramids can be of the following shapes:

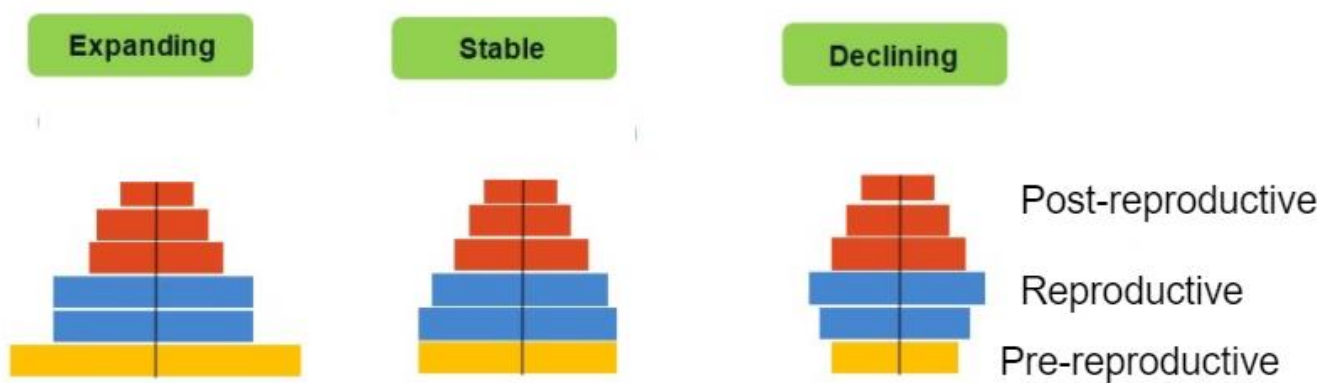


Figure: Representation of age pyramids for human population

- Triangular shaped age pyramids are formed when the individuals in the pre-reproductive and reproductive age group are high and very less number of individuals are present in the post-reproductive age group. Such a population is predicted to grow or expand.
- Bell-shaped age pyramids are formed when the pre-reproductive and reproductive individuals are almost in equal numbers or percentages and the post-reproductive individuals are relatively fewer. Such a population is predicted to remain stable.
- Urn shaped age pyramids display low numbers or percentages of pre-reproductive individuals, maximum number of individuals in the reproductive age group and a few number of individuals in the post-reproductive age group. Such a population is said to decline.

Age pyramids are used by demographers to study the human populations in order to predict the growth status of a population in the future. Extinct organisms do not exist anymore and hence age pyramids cannot be constructed for the extinct organisms and rather there is no purpose of constructing the age pyramids for the extinct organisms.

Q3 Explain in detail the various acts relating to air, water and environment protection.

Ans.: POLLUTION RELATED ACTS-IN INDIA

Water (prevention and Control of pollution) Act 1974- Act defines water pollution as – Such contamination of water or such alteration of the physical, chemical, or biological properties of water or such discharge as is likely to cause a nuisance or render the water harmful or injurious to public health and safety or harmful for any other use, or to aquatic plants and other organisms or animal life.

The salient feature and provisions of the act are-

1. It provides for maintenance and restoration of quality of all types of surface and ground water.
2. It provides for establishment of central and state boards for pollution control.
3. It confers them power and duties to control pollution.
4. The act has provisions for funds, budgets. Accounts and audits of central and state pollution control boards.
5. The act makes provisions for various penalties for the defaulters and procedure for the same.

Air (prevention and Control of pollution) Act 1981-Provides prevention, control and abatement of air pollution. Defines air pollution as- presence of solid, liquid or gases (including noise) in atmosphere in such concentration as may be harmful to human beings or any other living being or property or environment.

1. Noise pollution was inserted in 1987.
2. Regulatory authorities are-
Central Pollution Control Board
State Pollution Control Board
3. Powers, duties, funds, budgets, accounts, audits and penalties are same as in Water Act.
4. Section 20 of the act provides emission standards for automobiles.
5. According to section 19, in consultation of SCBs, state government may declare any area as – air pollution control area, completely restricting the entries of vehicles using other than approved fuel.
6. Provision for appeal is under section 31 of the act.

The Environment Protection Act, 1986- In 1980, the Deptt. of Environment was established in India. Later on it became the Ministry of Environment and Forests in 1985. EPA, 1986 came into force soon after the Bhopal Gas Tragedy.

IMPORTANT TERMINOLOGY....

“Environment” It includes water, air, and land and the interrelationship which exists among and between water, air and land and human beings, other living creatures, plants, microorganism and property. **“Environmental Pollutant”** means any solid, liquid or gaseous substance present in such concentration as may be, or tend to be injurious to environment.

“Environmental pollutant” means any solid, liquid or gaseous substances present in such concentration as may be or tend to be injurious to environment and human being. **“Hazardous Substance”** means any substance or preparation which, by reasons of its chemical or physico-chemical properties, is liable to cause harm to human beings or other living creatures. **“Handling”** In relation to any substance, it means the manufacturing, processing, treatment, packaging, storage, transportation, use, collection, destruction, conversion, offering for sale, etc

“Environmental pollution” means imbalance in environment. The materials or substances when after mixing in air, water or land alters their properties in such manner, that the very use of all or any of the air water and land by man and any other living organism becomes lethal and dangerous for health. **“Occupier”** It means a person who has control over the affairs of the factory or the premises, and includes, in relation to any substance, the person in possession of the substance.

“Hazardous substance” means any substance or preparation which, by reason of its chemical or physico-chemical properties or handling, is liable to cause harm to human beings, other living creatures, plant, micro-organism, property or the environment.

1. This act has given powers to central government to take steps to protect and improve environment while the state government coordinates the action. This act provides-
2. The standards of quality of air, water and soil for various areas and purposes.
3. The maximum permissible limit of concentration of pollutants including noise in different areas.
4. The protection and safeguards for handling hazardous substances.
5. The prohibition and restriction on location of industries and to carry on process and operation in different areas.
6. The prohibition and restriction hazardous substances in different areas.
7. The procedure and safeguards for prevention of accidents which may cause environmental pollution and provision for remedial measures for these accidents.

Under the act the SPCBs have to follow the guidelines-

1. The board has to advice industries for treating wastewater or gases with best technology available.
2. The industries have to be encouraged the recycling and reuse of wastes.
3. They have to encourage industries for recovery of biogas, energy or reusable material.
4. While permitting discharge of effluents in environment the SPCBs have to assess assimilative capacity of receiving body.
5. CPCB and SPCBs have to emphasize on implementation of clean and green technologies for industries.

According to an amendment in 1994, list of 29 types of projects is given which require clearance of environment impact assessment (EIA) from central government before establishing. Other industries require clearance from SPCBs. The act also make provision for audit, means checking whether a company is complying environmental laws and regulation or not.

Q4 Detail out powers and responsibilities of various boards involved in environmental protection.

Ans.: POWERS AND FUNCTIONS OF BOARDS

CENTRAL POLLUTION CONTROL BOARD (CPCB)- Subject to the provisions of the Acts, the main function of the Central Board shall be to promote cleanliness of streams and wells in different areas of the States. In particular and without prejudice to the generality of the foregoing function, the Central Board may perform all or any of the following functions, namely-

- (a) advise the Central Government on any matter concerning the prevention and control of water pollution;
- (b) co-ordinate the activities of the State Boards and resolve disputes among them;
- (c) provide technical assistance and guidance to the State Boards, carry out and sponsor investigations and research relating to problems of water pollution and prevention, control or abatement of water pollution;

- (d) plan and organize the training of persons engaged or to be engaged in programs for the prevention, control or abatement of water pollution on such terms and conditions as the Central Board may specify;
- (e) organize through mass media a comprehensive program regarding the prevention and control of water pollution;
- (f) collect, compile and publish technical and statistical data relating to water pollution and the measures devised for its effective prevention and control and prepare manuals, codes or guides relating to treatment and disposal of sewage and trade effluents and disseminate information connected therewith;
- (g) lay down, modify or annul, in consultation with the State Government concerned, the standards for a stream or well: Provided that different standards may be laid down for the same stream or well or for different streams or wells, having regard to the quality of water, flow characteristics of the stream or well and the nature of the use of the water in such stream or well or streams or wells;
- (h) plan and cause to be executed a nation-wide program for the prevention, control or abatement of water pollution;
- (i) perform such other functions as may be prescribed.

The Board may establish or recognize a laboratory or laboratories to enable the Board to perform its functions under this section efficiently, including the analysis of samples of water from any stream or well or of samples of any sewage or trade effluents.

STATE POLLUTION CONTROL BOARD (SPCB)- Subject to the provisions of the Acts, the functions of a State Board shall be -

- (a) to plan a comprehensive program for the prevention, control or abatement of pollution of streams and wells in the State and to secure the execution thereof;
- (b) to advise the State Government on any matter concerning the prevention, control or abatement of water pollution;
- (c) to collect and disseminate information relating to water pollution and the prevention, control or abatement thereof;
- (d) to encourage, conduct and participate in investigations and research relating to problems of water pollution and prevention, control or abatement of water pollution;
- (e) to collaborate with the Central Board in organizing the training of persons engaged or to be engaged in programs relating to prevention, control or abatement of water pollution and to organize mass education programs relating thereto;
- (f) to inspect sewage or trade effluents, works and plants for the treatment of sewage and trade effluents and to review plans, specifications or other data relating to plants set up for the treatment of water, works for the purification thereof and the system for the disposal of sewage or trade effluents or in connection with the grant of any consent as required by the Act;
- (g) lay down, modify or annul effluent standards for the sewage and trade effluents and for the quality of receiving waters (not being water in an inter-State stream) resulting from the discharge of effluents and to classify waters of the State;
- (h) to evolve economical and reliable methods of treatment of sewage and trade effluents, having regard to the peculiar conditions of soils, climate and water resources of different regions and more specially the prevailing flow characteristics of water in streams and wells which render it impossible to attain even the minimum degree of dilution;
- (i) to evolve methods of utilisation of sewage and suitable trade effluents in agriculture;
- (j) to evolve efficient methods of disposal of sewage and trade effluents on land, as are necessary on account of the predominant conditions of scant stream flows that do not provide for major part of the year the minimum degree of dilution;
- (k) to lay down standards of treatment of sewage and trade effluents to be discharged into any particular stream taking into account the minimum fair weather dilution available in that stream and the tolerance limits of pollution permissible in the water of the stream, after the discharge of such effluents;
- (l) to make, vary or revoke any order --
 - (i) for the prevention, control or abatement of discharge of waste into streams or wells;
 - (ii) requiring any person concerned to construct new systems for the disposal of sewage and trade effluents or to modify, alter or extend any such existing system or to adopt such remedial measures as are necessary to prevent control or abate water pollution;

(m) to lay down effluent standards to be complied with by persons while causing discharge of sewage or sullage or both and to lay down, modify or annul effluent standards for the sewage and trade effluents;

(n) to advise the State Government with respect to the location of any industry the carrying on of which is likely to pollute a stream or well;

(o) to perform such other functions as may be prescribed or as may, from time to time be entrusted to it by the Central Board or the State Government.

The Board may establish or recognize a laboratory or laboratories to enable the Board to perform its functions under this section efficiently, including the analysis of samples of water from any stream or well or of samples of any sewage or trade effluents.

Ques Discuss fluorosis in detail.

Ans.: Fluoride Problem

- Fluoride is an essential element required by our body in our daily diet or drinking water.
- The maximum tolerance level in the human body is 1.5 ppm (WHO Standards).
- The daily intake of (F) from food and drinking water is less than 1 ppm.
- The prolonged intake of water containing excess fluoride causes the disease known as fluorosis.
- In India, there are several places where fluorosis has been reported such as Andhra Pradesh, Orissa, Punjab, Haryana, Delhi etc.

Symptoms of Fluorosis – Fluoride does not concentrate in any tissue but only in the bones & teeth.

3. Dental Fluorosis -
 - i) Teeth discoloration
 - ii) Damage to enamel
 - iii) Mottling of teeth.
4. Skeletal Fluorosis -
 - i) Deformation of bones.
 - ii) Stiffening of bones, joints.
 - iii) Back pain
 - iv) Gastrointestinal effects & diarrhea.

Skeletal Fluorosis is also known as crippling disease due to the deformation of bones.

Solution of Fluorosis- Fluorosis is difficult to treat especially once permanent changes occur. Nutritional supplements containing vitamins C, D, antioxidants, and calcium are advised to reduce the deleterious effects of excessive fluoride. Surgical treatment may be necessary to treat bony deformities due to fluorosis and subsequent compression of nerves.

Nalgonda Technique- In the Nalgonda Technique two chemicals, alum (aluminium sulphate or kalium aluminium sulphate) and lime (calcium oxide) are added to and rapidly mixed with the fluoride contaminated water. Induced by a subsequent gentle stirring, “cotton wool”-like flocs develop (aluminium hydroxides) and are subject to removal by simple settling. The main contents of the fluoride is removed along with the flocs, probably due to a combination of sorption and ion exchange with some of the produced hydroxide groups.

