

SYLLABUS FOR V SEMESTER
III B.Sc. ANALYTICAL CHEMISTRY(HONOURS)
ENVIRONMENTAL CHEMISTRY

UNIT-I Introduction

Concept of Environmental chemistry - Scope and importance of environment in now a days – Nomenclature of environmental chemistry – Segments of environment - Natural resources – Renewable Resources – Solar and biomass energy and Non-renewable resources – Thermal power and atomic energy – Reactions of atmospheric oxygen and Hydrological cycle.

UNIT-II Air Pollution

Definition – Sources of air pollution – Classification of air pollution – Acid rain – Photochemical smog – Green house effect – Formation and depletion of ozone – Bhopal gas disaster – Controlling methods of air pollution.

UNIT-III Water pollution

Unique physical and chemical properties of water – water quality and criteria for finding of water quality – Dissolved oxygen – BOD, COD, Suspended solids, total dissolved solids, alkalinity – Hardness of water – Methods to convert temporary hard water into soft water – Methods to convert permanent hard water into soft water – eutrophication and its effects – principal wastage treatment – Industrial waste water treatment.

UNIT-IV Chemical Toxicology

Toxic chemicals in the environment – effects of toxic chemicals – cyanide and its toxic effects – pesticides and its biochemical effects – toxicity of lead, mercury, arsenic and cadmium.

UNIT-V Ecosystem and biodiversity

Ecosystem: Concepts – structure – Functions and types of ecosystem – Abiotic and biotic components – Energy flow and Energy dynamics of ecosystem – Food chains – Food web – Tropic levels – Biogeochemical cycles (carbon, nitrogen and phosphorus) Biodiversity: Definition – level and types of biodiversity – concept - significance – magnitude and distribution of biodiversity – trends - biogeographical classification of India – biodiversity at national, global and regional level.

Unit-1
Introduction

Concept of Environment

The term environment refers to our surrounding which includes physical, biological and sociocultural aspects. The non living things like air, water, land, etc. Come under physical aspects and plants and trees comes under biological aspects and the man-made aspect like culture, religion, customs, etc.. Environmental condition determines our health also.

Concept of Environment Education

According to UNESCO in 1975, environment education can be defined as, Education that concerns about the total environment and its associated problems and commitment to work individually and collectively toward the solution of current problems

Importance of Environment Education Environment helps to full fill all our demands Human activities have resulted into natural calamities, degradation, pollution and many other problems. Environment education plays a significant role to control these problems and maintain the balance of the environment.

The importance of environment education are:

1. Develops the concept of wise use of natural resources: Many people do not have the concept that their activities interfere the status of the environment.. They do not even know the hazards of their malpractices. They do not try to replace the lack by the means of a forestation and other regeneration programmes. Environment education teaches people about wise use of natural resources.
2. Encourage for the creation of healthy environment: Healthy environment refers to the environment which is free from the dust, germ and other elements that cause many hazardous diseases. Environment education provides knowledge about various things such as personal hygiene, environmental sanitation and other topic related to healthy environment which prompts us to create a healthy environment.
3. Cultivates awareness about environmental: Environmental degradation has been a great threat to the existence of all flora, fauna and human beings. Environment education gives knowledge about environmental pollution, create awareness.
4. Helps to provide integrated knowledge: Environment education incorporates the elements that are related with health and population education. It helps to control the rapidly growing population, to keep the surrounding clean and to give emphasis on personal hygiene.

The status of soil, water and other elements determines the biodiversity because different animals and plants have special adaptability cyclic relationship. Environment helps to fulfil all our demands Human activities have resulted into natural calamities, environmental degradation, environmental pollution and many other problems. Environment education gives knowledge about environmental pollution, create awareness.

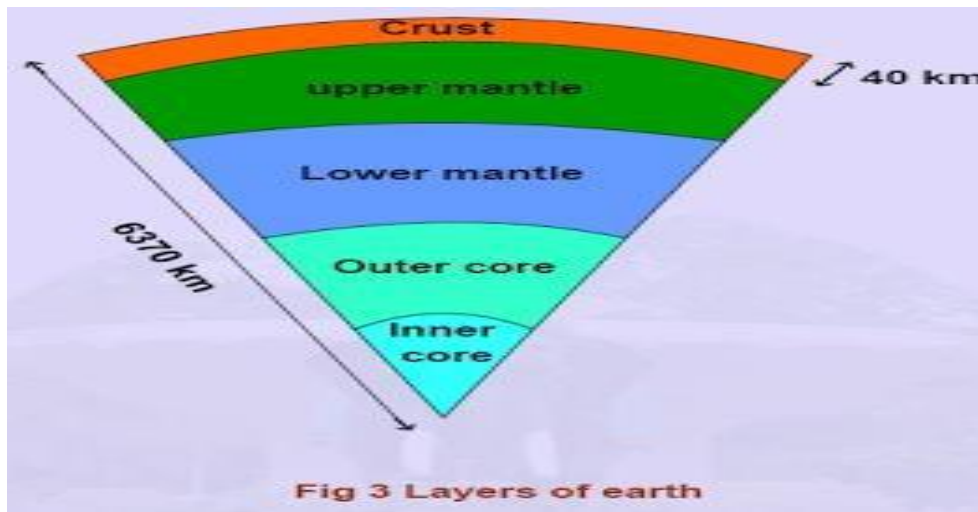
Segments of Environment

Environment is divided in following segments:

1. Lithosphere
2. Hydrosphere
3. Atmosphere

4. Biosphere

(1) Lithosphere: The lithosphere consists of upper mantle and the crust. The crust is the earth's outer skin that is accessible to human. The crust consists of rocks and soil of which the latter is the important part of lithosphere.



The solid component of earth is known as lithosphere. Lithosphere means the mantle of rocks constituting the earth's crust. Soil plays an important role as it provides food for man and animals.

Muddy bottoms of ponds, ravines or glacial deposits, porous rock surface, bottoms of lakes peat etc., all are thus soil. A typical productive soil contains approximately 95 per cent inorganic matter and 5 per cent organic matter. Organic matter in the soil provides food for microorganism. This matter includes amino sugars, organic sulphur, organic phosphate, and polysaccharides. In some soils, manganese oxide and titanium oxide are also available.

(2) Hydrosphere: This includes all the surface and ground water resources such as oceans, seas, rivers, streams, lakes, reservoirs, glaciers, polar ice caps, ground water and water locked in rock and crevices and minerals laying deep below the earth's crust.

1. Earth is called blue planet because 80 per cent of its surface is covered by water (97 per cent of the earth's water resources is locked up in the oceans and seas, 2.4 per cent is trapped in giant glaciers and polar ice caps.) Only 1% of the total water supply is available as fresh water in the form of rivers, lakes, streams and ground water for human consumption and other uses.

2. Water is universal solvent.

3. Water is also the main medium by which chemical constituents are transported from one part of an ecosystem to others.

4. Water has high specific heat, latent heat and relatively high freezing point.

5. Surface water contains a lot of organic matter and mineral nutrients, which feed large bacteria population and algae.

(3) Atmosphere: The gaseous envelope surrounding the earth is composed of an entire mass of air containing N_2 , O_2 , H_2O , CO_2 and inert gases is known as atmosphere.

1. The atmosphere is a reservoir of several elements essential to life and serves many purposes and functions.

2. The atmosphere is mobile, elastic, compressible and expansible.
3. It absorbs most of the harmful radiations.
4. It maintains the heat balance of the earth.
5. Different cycles those are present in the atmosphere in the form of water cycle, carbon, oxygen, nitrogen cycle etc. related to the movement of matter been an organism and its environment.
6. Atmosphere can be divided into several layers on the basic of temperature variations. They are troposphere, stratosphere, mesosphere and thermosphere.

(4) Biosphere: The biosphere refers to the realm of living organisms and their interactions with the environment (VIZ: atmosphere, hydrosphere and lithosphere)

1. The biosphere is very large and complex and is divided into smaller units called ecosystems.
2. Plants, animals and microorganisms which live in a definite zone along with physical factors such as soil, water and air constitute an ecosystem.
3. Within each ecosystems there are dynamic inter relationships between living forms and their physical environment
4. The biosphere is the part of the earth in which life exists.
5. Biosphere is biological envelope that surrounds the globe, containing and able to support.

Natural resources. Resources obtained from nature, i.e. from the earth are called natural resources. These resources occur naturally, and humans cannot make them.

Classification of Resources Natural resources are valuable to us. The broadest classification of resources is done on the basis of their replenishing ability. Let us take a look, at these two classifications

- Renewable resources
- Non Renewable resources

• Renewable resources

. Renewable resources are those resources that can be replenished or renewed naturally over time. Air, water, wind, solar energy etc are all renewable resources.

1). Solar energy

Sun is a big source of energy. The energy that we get from the Sun is called solar energy. All the natural phenomenon like the flowing of wind, water cycle, photosynthesis etc are possible only due to solar energy.

2. Hydro-Energy All living organisms need water to live. Humans need water for many purposes such as drinking, cleaning, cooking and for growing crops. Water flowing into the river or water stored in a dam is sources of hydro energy. The Simple method to use hydro energy is to convert it into electrical energy.

3. Wind energy The energy from this wind is used for grinding grain, pumping water and to produce electricity. In India, many windmills have been set up in different places such as Tamil Nadu, Maharashtra, Rajasthan, Kerala, West Bengal and Gujarat.

4. Biogas Biogas is a type of fuel which is a mixture of gases such as methane, carbon dioxide, hydrogen etc

5. Wood Wood is an ancient and traditional source of energy. It is mainly a mixture of many carbohydrate compounds. Wood is used to cook food. It leads to deforestation and pollutes air also

6. Hydrogen It is a good source of energy because it does not create pollution and produce maximum energy on burning.

7. Alcohol Alcohol has many commercial and medical purposes. It can use for producing energy. It can be obtained while making sugar from sugarcane..

8. Air All living things need air to breathe. Therefore, air is an important natural resource.

• **Non Renewable resources**

Non-renewable resources are those natural resources that are available in limited quantity. These resources cannot be renewed or replenished in short duration. Therefore they are also known as exhaustible resources. Examples- coal, natural gas, petroleum etc.

1). Fossil fuel Fossil fuels like coal and petroleum are non-renewable resources. They are found deep inside the earth and are made by natural processes over many centuries. Their quantity is limited and they take thousands of years to get renewed. Example of fossil fuels is coal, petroleum, natural gas etc.

- **Coal:** It is also known as black diamond. Coal is used as a fuel, to generate electricity, and in factories and steam engines.
- **Natural gas:** Natural gas is used as a fuel called Compressed Natural Gas or CNG. Natural gases are a good alternative to petrol and diesel and it is used as Compressed Natural Gas.
- **Petroleum:** Petroleum is also known as mineral oil or crude oil. This liquid mineral is refined to make fuels such as petrol, diesel, cooking gas and kerosene. It is found deep inside the Earth or under the sea floor..

2). Nuclear energy In the classification of resources, nuclear energy is classified as non-renewable. The fuel used for nuclear energy is generally uranium, which is in a limited supply. So we classify it as non-renewable. Production of electricity from nuclear energy does not release carbon dioxide.

Atomic energy Atomic energy is energy obtained from the atom. Every atom has particles of energy in it. Energy holds the parts of an atom together. So in atomic energy the core of an atom is the source of the energy, and this energy is released when the atom is split.

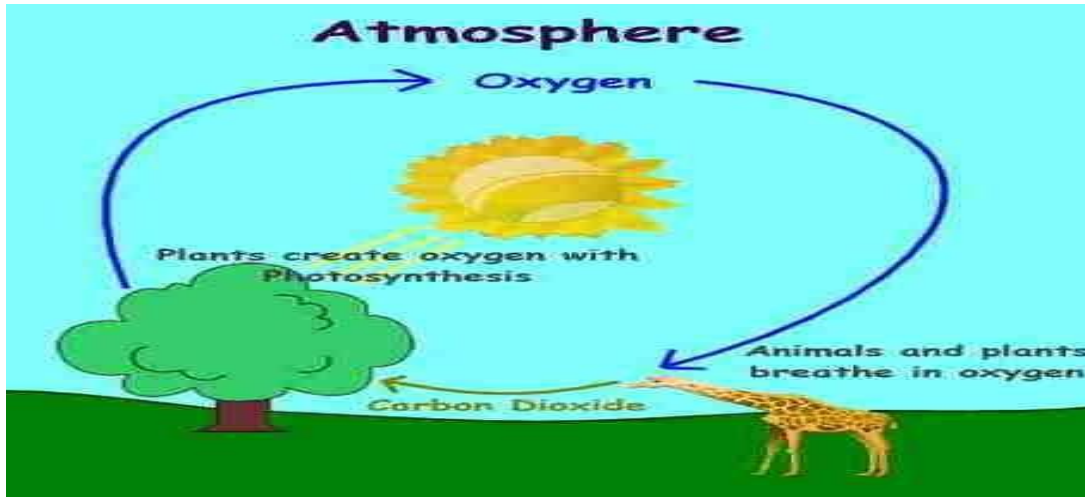
There are actually two ways of obtaining energy with atoms. One is called "fusion" and one is called "fission." When fusion takes place, two atoms are made to form one single atom. The fusion of atoms results in the release of a tremendous amount of energy in the form of heat. Most of the energy given off from the sun comes from fusion .This is one form of atomic energy.

Another form of atomic energy comes from the fission process. Fission happens when one atom splits into two. This is done by bombarding or hitting atoms with atomic particles such as neutrons (one of the particles that make up the atom).

An atom doesn't split every time it is bombarded by neutrons. In fact, most atoms cannot be made to split. But uranium and plutonium atoms will split under proper conditions.

oxygen cycle The oxygen cycle is a biogeochemical cycle that describes the movement of oxygen within the earth's three main reservoirs which are the atmosphere (air), the hydrosphere (water), and the lithosphere (land).

Oxygen is constantly used and generated by different processes on Earth and all these processes together make up the oxygen cycle.



1. Processes that generate oxygen: the oxygen is produced by plants via photosynthesis. Plants are the main creator of oxygen in the atmosphere. some oxygen is produced when sunlight reacts with water vapour in the atmosphere.

2. Processes that uses oxygen: 1. all organisms use oxygen for respiratory.

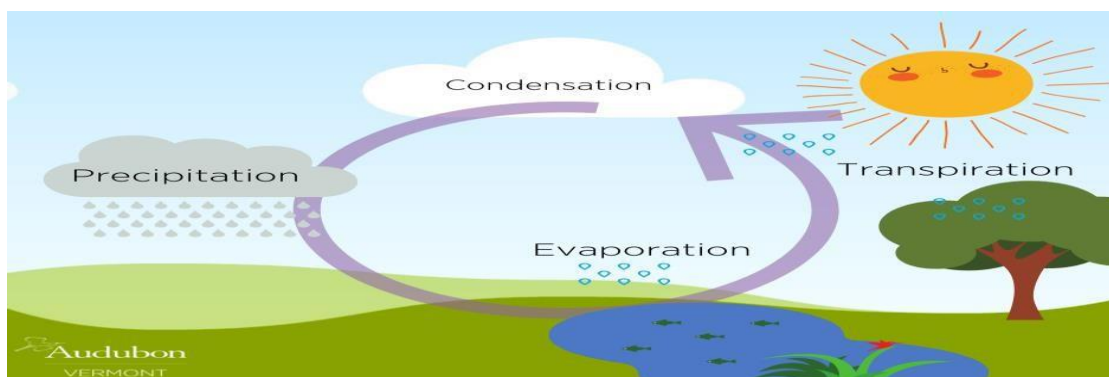
2. when plants and animals die, they decompose.

3. This process uses oxygen and releases carbon dioxide.

The process of oxidation uses oxygen causing metals to rust. The process by which fire is generated also uses oxygen and releases carbon dioxide. The oxygen cycle takes place

1. Photosynthesis
2. Respiration
3. Repeat

(hydrological cycle) water cycle The water cycle, also known as the hydrological cycle or the H₂O cycle, describes the continuous movement of water on, above and below the surface of the Earth. The water moves from one reservoir to another, such as from river to ocean, or from the ocean to the atmosphere, by the physical processes of evaporation, condensation, precipitation, infiltration, runoff, and subsurface flow., the water goes through different phases: liquid, solid, and gas.



The water cycle involves the exchange of energy, which leads to temperature changes. For instance, when water evaporates, it takes up energy from its surroundings and cools the environment. When it condenses, it releases energy and warms the environment. These heat exchanges influence climate.

The evaporative phase of the cycle purifies water which then replenishes the land with freshwater. The flow of liquid water and ice transports minerals across the globe. The water cycle is also essential for the maintenance of most life and ecosystems on the planet.

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2. Air pollution

Air pollution Air pollution can be defined as the presence of toxic chemicals or compounds (including those of biological origin) in the air, at levels that pose a health risk. Air pollution means the presence of chemicals or compounds in the air which are usually not present and which lower the quality of the air or cause detrimental changes to the quality of life (such as the damaging of the ozone layer or causing global warming).

2. Sources of Air Pollution: These sources can be classified into two major categories which are: Anthropogenic sources (human activity) : mostly related to burning different kinds of fuel:

- i. "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.
- ii. "Mobile Sources" include motor vehicles, marine vessels, aircraft and the effect of sound etc.
- iii. Chemicals, dust and controlled burn practices in agriculture and forestry management.
- iv. Fumes from paint, hair spray, varnish, aerosol sprays and other solvents.
- v. Waste deposition in landfills, which generate methane. Methane is not toxic; however, it is highly flammable and may form explosive mixtures with air.

Natural sources:

- i). Dust from natural sources, usually large areas of land with little or no vegetation.
- ii). Methane, emitted by the digestion of food by animals, for example cattle.
- iii. Radon gas from radioactive decay within the Earth's crust. Radon is a colourless, odourless, naturally occurring, radioactive noble gas that is formed from the decay of radium. It is considered to be a health hazard
- iv. Smoke and carbon monoxide from wildfires.
- v. Volcanic activity, which produce sulphur, chlorine, and ash particulate

3. Types of Air Pollutants: An air pollutant is known as a substance in the air that can cause harm to humans and the environment. Pollutants can be classified as either primary or secondary. Usually, primary pollutants are substances directly emitted from a process, such as ash from a volcanic eruption, the carbon monoxide gas from a motor vehicle exhaust or sulphur dioxide released from factories. Secondary pollutants are not emitted directly. Rather, they form in the air when primary pollutants react or interact.

Major primary pollutants produced by human activity include:

- i). Sulphur oxides (SO₂):** SO₂ is produced by volcanoes and in various industrial processes. Since coal and petroleum often contain sulphur compounds, their combustion generates sulphur dioxide. Further oxidation of SO₂, usually in the presence of a catalyst such as NO₂, forms H₂SO₄, and thus acid rain.
- ii). Nitrogen oxides (NO₂):** Especially nitrogen dioxide are emitted from high temperature combustion. Nitrogen dioxide is the chemical compound with the formula NO₂. It is responsible for photochemical smog, acid rain etc.