GOVERMENT POLYTECHNIC, SAMBALPUR

ELECTRICAL ENGINEERING DEPARTMENT

LECTURE NOTES ON ENVIRONMENTAL STUDIES

(TH5)

3rd Semester

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Th5. ENVIRONMENTAL STUDIES

(Common to all Branches)

Name of the Course: Diploma in Electrical Engineering			
Course code:		Semester	3rd
Total Period:	60	Examination :	3 hrs
Theory periods:	4P / week	Internal Assessment:	20
Maximum marks:	100	End Semester Examination ::	80

A. RATIONALE:

Due to various aspects of human developments including the demand of different kinds of technological innovations, most people have been forgetting that, the Environment in which they are living is to be maintained under various living standards for the preservation of better health. The degradation of environment due to industrial growth is very much alarming due to environmental pollution beyond permissible limits in respect of air, water industrial waste, noise etc. Therefore, the subject of Environmental Studies to be learnt by every student in order to take care of the environmental aspect in each and every activity in the best possible manner.

B. OBJECTIVE:

After completion of study of environmental studies, the student will be able to:

1. Gather adequate knowledge of different pollutants, their sources and shall be aware of solid waste management systems and hazardous waste and their effects.
2. Develop awareness towards preservation of environment.

C. Topic wise distribution of periods:

Sl. No.	Topics	Period
1	The Multidisciplinary nature of environmental studies	04
2	Natural Resources	10
3	Systems	08
4	Biodiversity and it's Conservation	08
5	Environmental Pollution	12
6	Social issues and the Environment	10
7	Human population and the environment	08
	Total:	**60**

D. COURSE CONTENTS

1. The Multidisciplinary nature of environmental studies:

1.1 Definition, scope and importance.

1.2 Need for public awareness.

2. Natural Resources:

Renewable and non renewable resources:

2.1 Natural resources and associated problems.

- 2.1.1. Forest resources: Use and over-exploitation, deforestation, case studies, Timber extraction mining, dams and their effects on forests and tribal people.
- 2.1.2. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dam's benefits and problems.
- 2.1.3. Mineral Resources: Use and exploitation, environmental effects of extracting and using mineral resources.
- 2.1.4. Food Resources: World food problems, changes caused by agriculture and over grazing, effects of modern agriculture, fertilizers- pesticides problems, water logging, salinity, .
- 2.1.5. Energy Resources: Growing energy need, renewable and non-renewable energy sources, use of alternate energy sources, case studies.
- 2.1.6. Land Resources: Land as a resource, land degradation, man induces landslides, soil erosion, and desertification.

2.2 Role of individual in conservation of natural resources.

2.3 Equitable use of resources for sustainable life styles.

3. **Systems:**

3.1. Concept of an eco system.
3.2. Structure and function of an eco system.
3.3. Producers, consumers, decomposers.
3.4. Energy flow in the eco systems.
3.5. Ecological succession.
3.6. Food chains, food webs and ecological pyramids.
3.7. Introduction, types, characteristic features, structure and function of the following eco system:
3.8. Forest ecosystem:
3.9. Aquatic eco systems (ponds, streams, lakes, rivers, oceans,

estuaries).

4. **Biodiversity and it's Conservation:**

4.1. Introduction-Definition: genetics, species and ecosystem diversity.
4.2. Biogeographically classification of India.
4.3. Value of biodiversity: consumptive use, productive use, social ethical, aesthetic and optin values.
4.4. Biodiversity at global, national and local level.
4.5. Threats to biodiversity: Habitats loss, poaching of wild life, man wildlife conflicts.

5. **Environmental Pollution:**

5.1. Definition Causes, effects and control measures of:

5.1.1 Air pollution.
5.1.2 Water pollution.
5.1.3 Soil pollution
5.1.4 Marine pollution
5.1.5 Noise pollution.
5.1.6 Thermal pollution
5.1.7 Nuclear hazards.

5.2. Solid waste Management: Causes, effects and control measures of urban and industrial wastes.
5.3. Role of an individual in prevention of pollution.
5.4. Disaster management: Floods, earth quake, cyclone and landslides.

6. **Social issues and the Environment:**

6.1. Form unsustainable to sustainable development.
6.2. Urban problems related to energy.
6.3. Water conservation, rain water harvesting, water shed management.
6.4. Resettlement and rehabilitation of people; its problems and concern.
6.5. Environmental ethics: issue and possible solutions.
6.6. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies.
6.7. Air (prevention and control of pollution) Act.
6.8. Water (prevention and control of pollution) Act.
6.9. Public awareness.

7. **Human population and the environment:**

7.1. Population growth and variation among nations.
7.2. Population explosion- family welfare program.
7.3. Environment and humanhealth.
7.4. Human rights.
7.5. Value education

7.6. Role of information technology in environment and human health.

Syllabus coverage up to Internal assessment

Chapters: 1, 2 and 3.

Learning Resources:			
Sl.No	**Title of the Book**	**Name of Authors**	**Name of Publisher**
1.	Textbook of Environmental studies	Erach Bharucha	#UGC
2.	Fundamental concepts in Environmental Studies	D.D. Mishra	S.Chand & Co-Ltd
3.	Text book of Environmental Studies	K.Raghavan Nambiar	SCITECH Publication Pvt. Ltd.
4.	Environmental Engineering	V.M.Domkundwar	Dhanpat Rai & Co

Unit - 1 Multidisciplinary nature of environmental Studies :-

Definition :- Environment is derived from the french word 'environner' which means to 'encircle or surround'

Its common definition is :-

Environment is the sum of all social economical, biological, physical or chemical factors which constitute the surroundings of man/living organism. who is both creater and moulder of the environment".

→ environmat is the surrounding space or condition in which organism or group of organism live.

→ environment consist of both biotic (living) and abiotic (non-living) substances.

→ environment is not static or constant, rather it is changing always.

→ Environmental study is a science dealing with details, about nature, behaviour, characteristics of environment.

→ Environmental study is multidisciplinary in nature because it covers all subjects like physics, chemistry, engineering, medical study, social science etc.

Scope and importance :-

Environment consists of all living and non-living things which surround us. There fore basic components of the environment are :-

1. The atmosphere or the air
2. The hydrosphere or the water
3. The lithosphere or the soil and rocks.
4. The biosphere

The scope of environmat is very vast and non-living being can escape out ~~of~~ it it as ~~all~~ all living organism take birth from within it and dies in it.

Environmental study plays very vital and important role in our day to day life and growth. It helps in resource planning and material mangement which yields better productivity and thus plays important role in overall growth of the nation.

The importance of environment and environmental ~~the~~ studies can be better understood from the table which shows how the different ~~dis~~ disiplines of environmental study adresses the major problem/issues faced by human race:-

Major issues to be addressed in ~~Environmental~~ environmental studies.	Major thrust areas / Contributions made by disciplines of –
Biodiversity . Conservation	← Microbiology and biotechnology.
Resource recovery, Waste disposal and treatment	←
Air, Water, Soil, noise pollution.	← Atmospheric, ocean and space science.
Environmental ethics and awareness.	← Ethics, behavioural science and literature
global climate change and water scarcity	←
	← Meteorology and telecommunication
Computer simulation and analysis	← Computer science and information technology.
Population, explosion, urbanisation	← Social Science
Land use, human resource and Sustainable development	← Physics, chemistry, geology, geography ~~management science~~
energy ~~crisis~~ and crisis and non-conventional sources.	← Management science and environmental law
	← Mathematics
Globalisation and world trade	← Engineering
Global environmental problems.	← Medical science.
Modelling and management of resources	← Ecophysiology and Ecotoxicology
	← Ecology / environmental biology
Power Generations, Dams and technosphere	← Life science / bioscience / Biology
Diseases, drug, abuse and Acids, Toxic chemicals, pesticides. and Radioactivity	
Resource depletion deforestation	
Specific problems of various habitats (eg:- Problems of aquaculture)	
Perturbations of biogeochemical cycles	

Some major problems and issues and disciplines which provide input to solving these problems in environmental science

Need of Public awareness :-

- During Industrial revolution in 19th and early 20th century, ~~there~~ there has been immense impact of man on his environment.
- Huge industrial installations, faster mode of transport, sprawling of large ~~cities~~ crowded cities and skyscrappers, deforestation and decrease in volume of agricultural land and green fields of ~~vegetables~~ vegetation, wide spread use of insecticides, pesticides and fertilizers and chemicals - imbalanced the ecosystem and caused ~~irreparable~~ irreparable loss to the environment.

In this direction, United Nations organisation (UNO) has organised several conferences in different parts of the world (Stockholm – 1972, Vienna – 1985, Montreal – 1987, and Brazil – 1992) to workout the action plan from time to time to fight against the menace of environmental pollution.

— In 1992 'Earth Summit' was held in Rio-De-Jenerio on environment and development to attract the attention of general public.

— In 2002 another World summit on sustainable development was held at Johanesburg to discuss the environmental issues and aware the public to save the environment.

— Every year on June 5th world environmental day is being celeberated world wide under the guidance of UNO to protect the environment, ecosystem and wild life and aware the general public on issues and remedial majors to be taken for environmental protection.

— In our country by the virtue of 42nd ammendment act of our Constitution, the environment protection act is introduced in the year 1976.

— World wide in every country govt has introduced a ministry on environment and ecology to work in this regard.

— At last it can be said that awareness is the first step towards environmental protection.

—x—

Assignment :- (1)

① Define environment? [2]

ans:- It is the sum of all social economical, biological, physical or chemical factors which constitute the surrounding of men / living organism, who is both creator and moulder of this environment.

② Define environmental study? [2]

ans:- Environmental Studies is a multidisciplinary academic field which systematically studies human interaction with the environment. It connects principles discipline to address complex contemporary environmental issues.

③ What are biotic and abiotic substances? [2]

ans:- Biotic Substances :- These can be described as any living component that affects another organism or shapes the ecosystem. This includes both animals that consume other organism, and the organism that are being consumed.

Abiotic Substances :- These are non-living components that impact an ecosystem. These are a part of the ecosystem and can impact the associated living thing. eg: wind, water, light, fire

Q4 Discuss briefly on the scope of environmental studies. [5]

ans:- Environmental studies has multiple disciplines and multilevel scope. The study is important and necessary not only for children but for everyone. The scopes are summerized as follows.

(i) The study creates awareness among the people to know about renewable and non-renewable resources.

(ii) It provides the knowledge about ecological system and cause and effect relationships.

(iii) It provides necessary information about biodiversity richness.

(iv) The study enables one to understand the cause and consequences due to natural and man induced disasters and pollutions and measures to minimize effects.

(v) The study emposes the problems of over-population, health, hygine etc. and the role of science and technology in eliminating the evils from the society.

Q5 What is the importance of environment and environmental study?

ans:- Importance of environment:- It plays an important role in the healthy living of all living beings. It matters because it is the only home that every living beings have, and it provides air, food and other needs. Humanity's entire life support system depends on the well-being of all the environmental factors. It plays important role in regulating air and climate. It is the key of life on the earth. The only planet in our solar system that supports for existence of life is the earth due to the presence of environment.

Importance of environmental study:-

Environmental Study is based upon a comprehensive view of various environmental system. It aims to makes the citizens competent to do scientific work and to find out practical solution to current environmental problem. The citizens acquire the ability to analyze the environmental parameters like the aquatic, terrestrial and atmospheric system and their interaction with the biosphere.

Q6 What are the major disciplines of environmental study?

ans:- The major disciplines of environmental study are as follows.

Biology:- Environmental biology focuses on the relationship among plants, animals and their surrounding, including the responses to environmental stimuli.

Geology:- It is the study of the interaction between humans and their geological environment; rocks, water, air, soil, life. Humans are impacted by earth processes, and by their activities have an impact on earth.

Physics :- Environmental physical is defined as the branch of physics concerned with the measurement and analysis of interactions between organisms and environment.

Chemistry :- Environmental chemistry deals with the study of the origin, transparent, reactions, effects and fates of chemical species in the environment.

Q7 Give some reasons for which public should be aware of the environment?

ans:- The public should be aware of the environment because :-

(i) The natural resources endowment in the earth is limited.
(ii) World population is increasing at an alarming rate.
(iii) The pollution and degraded environment seriously affect the health of all living beings.
(iv) The natural resources are over exploited
(v) Education and training is needed to save the diversity.

Q8 Write briefly about the study environment in your class in your College?

ans:- In any class there are rules to maintain cleanliness to prevent pollution, in any school or college, the study - plant trees so that it helps in increasing green cover, and help improve the oxygen cycle and prevent air pollution and soil erosion.

Q9 Write briefly about the social environment in your home?

ans:- In every home the environment developed by family members as contrasted b with the natural environment :- It includes culture that the culture that individual was educated or lives in and the persons we interact with in a particular area with in the house premises is called social environment in home.

Q10 Do you feel that you have to do a lot for your environment? Comment ?

ans:- yes I feel that I have to do a lot for our environment because the many peoples are in the country are illiterate and they are not aware about the consequences of distorting the balance of the environment. And there are people who are well well educated but they are not interested in maintaining the balance of the environment because it needs control over the ~~fuel~~ petroleum which causes pollution because petroleum is used in daily life and made our life easy. So they are not trying to control their habits which distort the balance of the environment.

Unit -2 Natural resources :-

Things or materials of the nature, that can be put to some use by human beings for their growth, development, comfort and other necessities are called as natural resources.

Natural resources

↓

Exhaustible — Non-exhaustible

↓

Renewable — Non Renewable

- Natural resources can be broadly classified into two types - exhaustible and non-exhaustible.
- Exhaustible resources are those which, can be exhausted though continued use or misuse. examples are soil, groundwater, forest, animals, natural gas minerals etc.
- Exhaustible resources can be again divided into two categories, renewable, and non-renewable
- Renewable resources are those which can be renewed like soil, grassland water, forest, animals
- Non-renewable resources are those which can never be renewed resources are those which can never be renewed eg:- fossil fuel; metals, minerals
- Non-exhaustible resources are those which can never be exhausted. eg:- Air, sunlight, etc

1. Forest Resources :- Forest resource is the most important gift of nature consisting trees, vines and grasslands is becoming natural habitat of wild animals, birds, insects, reptiles and many sort of living organism
- Depending upon temperature of the region (from -ve or 0C upto maximum i.e are wise from polar region to equatorial region) forest can be divided into — Alpine forest (in cold to severe cold lands)
  - Temperate and Subtropical forests (near to tropical region)
  - Tropical forest (around tropical line).
  - Mangroves (in coastal areas and water lands)
- In our country moving from great Himalayas on the northern end upto Cape Comorin southern part - all the above types of forest are seen as the temperature varies from -ve or zero degree centigrade to 35° to 45°C and upto 50 - 55°C at desert.
- India is one of the 12, megadiver city countries, commanding 7%. of the world's biodiversity and supporting 16%. of the major forest types

Use and over exploitation :- India has large and diverse forest resource. Its forest type varies from tropical rainforest in the north east to desert and thorne forest in Gujrat and Rajasthan, mangroove forest in West Bengal, Odisha, and other coastal areas, dry alpine - forest in the western Himalayas. The most common forest types are:-

- Tropical moist deciduous forest
- Tropical dry deciduous forest
- Tropical evergreen forests.

Use:- → We used forest products like fruit, root, leaf, vines and mostly earning livelyhood.
→ Forest houses wildlife, animals, insects, macro and micro organisms
→ Most of the medicines are prepared from plant products.
→ Wood, timber, bamboo, cane are used for house and household for furniture etc.
→ Trees inhales, carbon-dioxide and exhales oxygen which are very much essential for animals.
→ Roots of trees held on the soil, and so prevents soil erosion.
→ Trees also control weather and eliminate by controlling rain and wind speed.

Over exploitation:-
- Dishonest business people exploit and over exploit, forest resources like cutting trees for wood and timber
- Primitive people living in forests use by cutting trees for fuel wood.
- Burning prematures young trees to produce charcoal.
- House hold things and furniture production leads to over exploitation
- Some times for establishing large industries and for building houses and generations agricultural lands we destroy forests.

Deforestation:- It is the loss or continual degradation of forest habitat due to either natural or human related causes

→ deforestation can be defined in two ways.

In a broad sense (according to United Nations Research Institute for Social Development. UNRISD). Deforestation is not only conversion to non-forest land but also degradation that reduces forest quality - the density and structure of trees, the ecological services supplied, the biomass of plant and animals, the species diversity and genetic diversity.

- Narrow sense of definition (according to United Nations food and agriculture organization UNFAO) is - removal of forest cover to an extent that allows for alternate land use.

Causes of deforestation:- 1) Present Cause

- Human related causes of deforestation are agriculture and livestock grazing
- Urban sprawl.
- Mining and petroleum extraction
- Demand for farmlands and fuel wood.
- Slash and burn activity in tropical forests

2) Pre historic Cause:

Thousands years ago, in prehistoric age (mesolithic period), human beings are burning forests to convert it into agricultural land with in nowadays also prevailing.

3) Pre-industrial history :-
In pre-industrial revolution time, when commerce was only in water ways. ports and for that human-dwelling crowded in river-basins by destroying forests.
- Sometimes soil erosion in high lands deposited large volume of silt in down stream river beds and so widening the flood plain of the river which causes shifting of human habitat to next higher land and causing heavy deforestation.

(3) Industrial pressure :- Massive use of charcoal and other forest products in large scale industries leads to deforestation.

Environmental effects of deforestation :-

1. Atmospheric pollution :- Deforestation cause green house effect as trees/plants remove carbon from atmosphere during photosynthesis.
2. Wild life :- Forests protect wild life and deforestation causes threat to their natural habitat and causes extinction.
- Trees and plants also affect the hydrological cycle as the roots, steams of trees produces macropores and increases water retaining capacity of soil.
3. Soil erosion :- Trees and plants hold up the soil by its roots (steams and its levels/branches reduces the velocity of water drops of heavy rains with may erode surface soil. By deforestation, heavy rain causes floods which in the main cause of soil erosion.
4. Land slides :- As tree roots binds soil together, its removal by deforestation on steep slopes with shallows soil increases the risk of land slides.

Controlling Deforestation :-

1. Farming :- Modern developed and planned method of farming of food crops in deforested forest land and cyclic agriculture may control deforestation by avoiding complete cleaning of trees required to produce agriculture land.
2. Forest management :- It is a versatile method of stopping or slowing deforestation
- Putting plants seeds on regular basis to germinate and sprout naturally, clearing very old damaged trees systematically, preserving forest land and natural biomass making policy and plan and executing it efficiently, all comes under forest mangement which reduces deforestation.
3. Afforestation :- In developed countries, rules have been formed to plant 3-5 plants well before, in place of a tree to cut or uprooted.
- forest land owners, industrialists and govt. at large are taking proper forest mangement to create new forest slowly but steadily to preserve the ecosystem.

Some Case studies :-

1) In Brazil :- In Brazil, the rate of deforestation in apparently driven by commodity prices. Recent development of a new variety of Soyabean has lead to displacement of beef ranches and slash and burn farmers which in turn move further into the forest.

2) Indonesia :- The large natural forest strips have been cleared by multinational pulp companies and now it is being replaced by huge plantations.

3) USA :- Before 1850, large forest areas are cleared for wood and converting to agriculture land. From 1850 to 1930, the agricultural land is again converted to forest land as mechanised farming needs less land and using machines in place of cattle for farming, reduces the need of grazing land, so the remaining land slowly become forest.

- Again nowadays, due to urban sprawl forest lands are converted to urban amenities (houses, road, park, hospitals, schools etc).

Timber extraction :-

- It is a profitable business and can create large employment..
- Extracting timber by cutting trees and producing logs which are used by plywood industries and furniture industries, paper mills etc.
- In the world quality timbers are available in tropical dense rain forest of indonesia and malaysia. malaysia. So in these countries a large employment opportunity was in the field of timber extraction.
- This led to large scale deforestation.
- As timber demand could not be fulfilled its cost increased and Govt. also banned its export to other countries.
- Still because of large deforestation and very slow aforestation, timber industries could not sustain and unemployment increased.
- In indonesia, reforestation efforts have been taken up by using mainly Acacia mangium with the view to the future establishment of pulp and paper mills
- In 1991, the international Tropical Timber organisation (ITTO) issued a document that how a sustainable tropical timber production could be achieved.

Mining :- It is the extraction of valuable minerals or other geological materials from earth, usually from ore, vein, or seam

eg:- Bauxite, coal, iron, diamonds, gold, nickel, phosphate limestone, Uranium etc.

- Mining also include extraction of petroleum, natural gas and even water.

Steps of mining process :-

1. Prospecting to locate ore
2. Exploration to defining the extent and value of ore where it was located.
3. Conduct resource estimate to mathematically estimate the extent and grade of deposit.
4. Conduct mine planning to evaluate the economically recoverable portion of the deposit.
5. Conduct a feasibility study to evaluate the total Project and decide whether to workout or walkout.
   - This includes A to Z analysis ie initial exploration all the way through to reclamation
6. Development to create access to an ore body.
7. Exploitation to extract ore on a large scale.
8. Reclamation to make land where a mine had been suitable for future use

Environmental effects of mining and Mitigation process

- Soil erosion, - formation of sinkholes, - loss of biodiversity, contamination of ground water by chemical from the mining process and products.

Mitigation process :-

→ Mining companies are required to follow strict environmental and reclabilitation codes ensuring the area mine is returned to close to its original state or an even better environmental state than before ~~mining~~ mining.

- The two most adverse effects of mining are loss of ~~biodivirsi~~ biodiversity and contamination of water
- Water contamination may include acid-mine drainage (AMD)
- The five principal technologies used to control water flow at mine sites are :- (a) diversion system (b) containment ponds (c) groundwater pumping system (d) surface drainage system (e) surface barriers.

DAM :- Dam is a structure (may be earthen, concrete or rcc) built across a stream or river or an estuary to retain water. By building a dam, a reservoir is made to store surface water.

Benefits of large dams :-

1. Water for drinking and industrial use :-
Dams store water collected during the season it is surplus and use it in the lean time for drinking as well as the industrial use. available

2. Irrigation :- All crops need water for survival and yeild. Food crops get their water requirement from irrigation system in which the stored water of dams and reservoirs are lead to the coalfields by canals.

3. Flood control :- Floods in rivers in rainy season create have with life and property of people. Dams plays important role in controlling flood by storing the excess rain water in its catchment area and releasing water downstream in a controlled manner.

- The water conserved by means of dams and reservoirs at the time of floods can be utilised for meeting irrigation and drinking water requirements and hydroelectric power generation.

4. Hydro electric power generation :-

- Hydropower is a cheap, clean and renewable source of energy.
- In dams with large water resistors turbines are set in power channels, so that water turns the turbines and generate large amount of electrical energy.
- Dams thus acts as multipurpose hydro electric projects which provide energy in adition to supplying drinking water and controlling floods.

(5) Inland navigation :-
Because of dams, large amount of water is spared for use throughout the year. It creates a waterway in which inland navigation can be made.

(6) Recreation / sports activities :-
Dams produce reservoirs and lakes in which water sports activities can take place. It also provides a mean for recreation and amusement in the form of boating, swimming, rowing etc.

Effects of dams :- Effects of high level multipurpose dams can be as follows 1) Re settlement and rehabilitation issues :-

As natural water flows of a river is checked by constructing a dam in rainy season it will merge a large nearby basin area of the river under water. The people living in the submerged area are required to be settled in nearby high lands and their cultivated lands / cattles etc are to be provided by govt.

2) Environment and forest issues :-

A large area will remain submerged. the forest habitat will be destroyed which will affect the environment, hence sufficient remedial majors are to be taken well before the construction of dams.

3) Sedimentary issues :-

Water Stream of the river will carry large amount of rocks, sands and other waste materials which will be deposited in the reservoir bed for years together. This sediments will ~~cross~~ create problems for the dam as well as for the water taken out of the reservoir and also it will ~~red~~ reduce the catchment capacity of the reservoir so regularly sediments are to be taken out and and reservoir bed is to be changed.

4) Socio economic issues :-

As dams will merge the habitat and also taken out their livelyhood, it will create social economic problem, which is required to be settled in a planned and humanitarian way.

5) Safety aspects :-

Safety of the people living in upper and lower side of the dam is a major concern.

- If the dam is allowed to store more water in its reservoir it will submerge large area in the upper part and at the same time will be a threat to its own stability.
- If more water is allowed to release then also it may create flood and water logging situation down stream. Hence safety of the dam as well as people living both upper and down sides of the dam is a major concern and to be handled carefully.

(6) Water Resources :-

- Water is an important resource because its availibility greatly influences the health of the people and overall development of the area.
- About 70% of world's surface is covered with water It is about 1386 million km^3.
- 97.3% of total water available is saline (salty) and only 2.7% is fresh water.
- Most part of the fresh water is in frozen ~~form~~ form in polar regions and deep aquifiers which are not available for use.
- Fresh water used by human being, is available in two sources (i) Surface water and (ii) ground water.

- Water is made available by rainfall and also by melting of glaciers.
- India receives avg. annual precipitation of 4000 km³ out of which 700 km³ is immediately lost to atmosphere, 2150 km³ soaks into the ground and 1150 km³ flows as surface runoff.
- There are 24 river basins in India " with total water resource of 1953 km³. Out of which 62% (1202 km³) lie in Ganga — basins Brahmaputra basin and remaining 38% (751 km³) lies in rest 23 basins.

Surface water :- Use and over exploitation :-

- There are 20 river basins of which 12 are major basins having drainage area of 20000 km²
- The avg rainfall runoff estimated to be 1952.87 BCM.
- The storage built up in various river basins through major and medium irrigation projects is about 173.73 BCM.
- The major and medium irrigation projects under construction and identified would account for 75.42 and 132.3 BCM respectively taking the total to 381.4 BCM.
- If minor irrigation structures are included the total storage goes upto 420 BCM.
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- The avg annual usable water resources through conventional schemes of all the 20 river basins taking into account the uneven nature of distribution of water resources and the topographic constraints is estimated to be 690.3 BCM which is about 35% of the total surface water resource.
- Surface water is sometimes over exploited by some of the states in the inter-state rivers in the upstream by making barrages and check dams, while down stream areas faces scarcity.
- Similarly upper stream areas sometimes releases large water through its dams causing flood in downstream area.

Ground Water :- Use and over exploitation :-

- According to central ground water board (CGWB) report 1993, total replenishable ground water resources is about 431.32 BCM and utilizable ground water resources as 395.6 BCM of which 325.6 BCM is available for irrigation and rest for domestic and industrial use.
- The gross available and utilisable water resources of the country are therefore 2334.5 BCM and 1086 BCM respectively. Per capita available and utilisable water resources (according to 1991 population) are 2830 m³ and 1288 m³/capital/per year respectively.
- The above data varies widely from basin to basin and with increase in population availability of water resource reduces.
- According to standard definition of water availability, if it falls below 1000 m³/capita/per year, it will hamper health and economic condition and thus alarms to take up immediate remedial measures.
- Less than 500 m³/capita per year causes constraints to life.
- According to CGWB an amount of 10091 km³ of static ground water can be additionaly exploited
- Large scale over exploitation of static water by mining may cause heavy damage to properties of land, soil. may trigger seismic activities.

Hydrological cycle (water cycle) :-

The Natural Research Council defines hydrological cycle as the pathway of water as it moves in its various phases through the atmosphere to the earth, over, and through the lands, to the ocean, and back to the atmosphere. This is shown in the fig -I.2.-3

- Water cycle has no begining or end and a single water molecule may assume various states while mixing with varibus chemical compounds in the pathway
- Water cycle is solar driven, water evaporates from earth's surface into the atmosphere and is returned back as rain or snow
- Another part of this precipitation evaporates back into the atmosphere
- Another part flows into streams, rivers, lakes, commencing its journey back to sea.
- Still another part percolates into the soil and becomes soil moisture or ground water.
- Plants extract soil moisture into their tissues and release it into the atmosphere in the process of transpiration.
- Much of ground water makes its way to flow of surface water and thus back to sea.
- The hydrological cycle can also be viewed on global scale. This is shown in fig. 2.2.5. The role of human in water cycle can be explained through the below block diagram. fig (a) is the classical view point and fig (b) is the modern view point

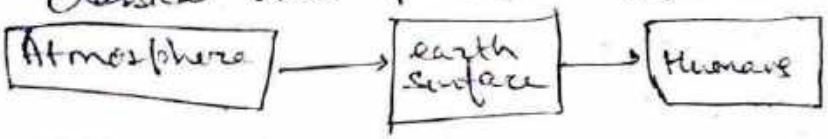


fig (a)

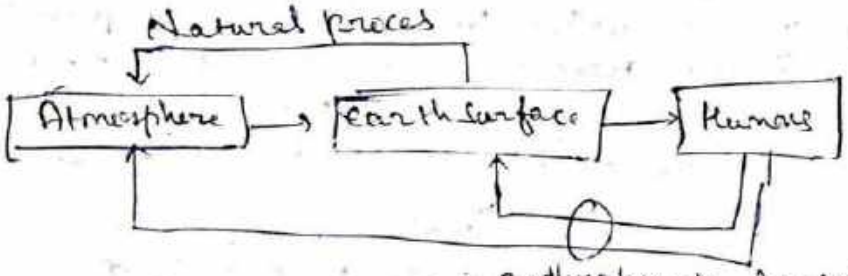


fig (b)

Floods :- Flood is a hazardous environmental condition (a natural calamity) by excess down pour so that surface water flow swells and rushed over agricultural land, road also to human dwellings.

- If water flows with high currents as a cause of overflow or breaking of of dams then it may take away the homes, livestocks and even human beings and cause heavy loss to life and property.
- Floods come in rainy season not only in plane and coastal areas but also in hilly and high lands. If heavy rain falls continuously for longer time
- To control flood, Dams, Anicuts, river embankments are made to let the excess water flows to seas.

- Sometimes it is required to shift human beings and domestic animals to high and safe places to get rid of flood.
- If riverbeds are not cleared/cleaned from the sands, silt and other sedimentary deposits regularly, then their catchment capacity decreases then excess water form heavy rainfalls causes floods.

Drought :- Drought is another natural calamity caused by deficient rainfall
- According to Indian meteorological department, the area, where natural rainfall is less than 75% of the normal is said to be affected by drought. If is less than 50% it is severe drought.
- In our country nature and gravity of drought is studied with help of palmer drought index. various parameters for obtaining palmer drought index are annual rainfall, evapo-transpiration and soil moisture.
- The computations on Palmer drought index shows that on an average drought is experienced on 20% - 25% of the days in each of months of kharif season over large areas of the country.
- Drought situation is completely natural and so cannot be predicted and avoided but to some extent can be prevented.
- One of the major step in drought prevention is afforestation planting more and more trees and not living a single patch of land without vegetation will lead to ecological balance to create rain and retain soil moisture.

Conflicts over water :-
- Day to day, for almost all socio-economic activities, demand for water is increases Demand increases with degree of scarcity.
- For use of surface water from rivers, there is always a conflict between people of down stream and people of upstream.
- In case the river is inter-state, the conflict starts on use of water between the states. eg:- Dispute among odisha and chhattisgarh to use the water of Mahanadi.
- For inter-nation rivers like ganga, Brahmaputra and Sindhu (Indus) there is conflict among nations likes India-Bangladesh and India-pakistan.
- Also there is conflict among people living in urban areas and surrounding sub-urban and urban water demands are concentrated in space, therefore pose serious problems at local levels. water demand in megacities are growing faster and requires to be over-exploited putting serious shortage problems for surrounding rural people
- There is conflict between urban dwellers in the cities and farmers having their cultivated land upstream.
- Its polluted waste waters pose harmful hygienic conditions for people as well as for cultivation - Conflicts are already there between States of Delhi and haryana also between states of tamilnadu and andhra Pradesh.

E) Mineral Resources :-
Natural resources which are extracted from mines are called mineral resources. Minerals are chemically bonded substances located in the earth underneath and are non-renewable resources so called as stock. minerals are of 3 types

1. **Metallic minerals :-** These are minerals present in a compound form called ores from which the metals are extracted through various phase wise process. ores also called alloys, because it contains the metal in compound form along with important various types of alloys are.

a) **Ferrous alloys**:- Ferrous alloys are those from which most commonly and widely used metal 'iron' is extracted. eg:- hymenite, magnetite, hematite.

b) **Non-ferrous alloys**:- These are alloys from which non-ferrous metals like Onitmony, arsenic, copper, zirconium, Cerium, Lithium are extracted.

c) **The mineral/alloys** in which very less amount of metals are found and so its extraction is costly eg:- Gold, silver, platinium, Iridium.

2) **Non-metallic Minerals**:- These are minerals from which non-metallic substances are extracted. Eg:- Graphite, dolomite, quartz, kaoline, fireclay, feldspar, limestone, Boron etc. Stones like phylite, cyanite, limestone, ruby sapphire Emerald etc are also non metallic minerals.

3) **Mineral fuels**:- These are minerals which are used as fuel to burn to provide energy eg: coal, natural gas, fossil fuel, petroleum, etc.

Mineral Resources of India:-

- India is fairly rich in mineral resources and has sufficient quantities of Iron, aluminium, titanium, copper, lead, zinc etc.
- India has world's largest deposit of coal.
- Next to Russia, India has the largest supply of manganese.
- Chromite deposits are found in Bihar, odisha, A.P, Karnataka, Bauxite deposits are in odisha, AP, Kashmir, Tamilnadu and Kerala.
- Ramagiri filled in AP, Kollar and Hutti in Karnataka have gold mines.
- The panna diamond belt is the only diamond producing belt in India which covers districts of Panna, Chhatarpur, and Satna in MP, some parts of Banda in UP.
- Fuel oil deposits are found in Assam, Tripura, Manipur, WB, Punjab, Himachal, Kutch, and andamans.
- In India also valuable minerals like Uranium and some varieties of rare earth ~~metals~~ are available.

Use and exploitation:-

- Minerals are used as the basic and most important raw material of industry.
- More use means more extraction and more industrial productivity leads to socio-economic development of the nation.
- Some of the minerals are exported to other countries and thus we earn foreign country.
- Some minerals are also imported from foreign countries.
- Increasing demand ~~on~~ minerals leads to over exploitation.
- Minerals being non-renewable in nature can be exhausted if not used in a controlled manner
- More mining activities also affect the environment and pose a threat to biodiversity.

Environmental effects of extracting and using mineral resources:-

- Land degradation due to lowering of surface at some point and creation of large mainds ~~of~~ at some other place.
- Deforestation in mining area causing soil erosion.
- Loss of top and subsoil.
- Ground water table is severely affected.
- Due to increased discharge of rainwater passing through the terrains, drainage system in the lower plane land get destroyed.
- Frequency of land slide increases.
- Agricultural lands are affected by silt and fine materials mined but not recovered..

- Causes disturbance to floral and faunal population.
- The heavy earth moving machines and blasts during mining causes damage to nearby building roads etc and causes release of poisonous gases to the atmosphere.
- Surrounding environment of the mining site get polluted severely.
- Deforestation due to mining causes natural calamities like, flood, drought due to decrease in rainfall and also cause climatic changes.

Food Resources :-

Food is the most important factor for life. Population increases day by day whereas food production and its means are decreasing which creates food problem.

World food problem :-

→ Before 21st century increase in population was rapid and food production was less due to use of old technology etc.
→ In 1991, International food policy Research Institute (IFPRI) reported the increase in food consumption by 2020.
→ In world food summit at Rome, in the year 1996 - 3 basic points were discussed (a) Reduce world hunger (b) Agricultural supply and demand (c) Population growth.
→ In 2001, Summit of IFPRI at Bonn, Germany, the agenda discussion was on - "Goals, Solutions and actions necessary to end hunger".
→ All these shows that world is facing severe food problem due to population increase and less food production.
→ Different approaches undertaken to solve the problem are
1) expansion of irrigated agriculture 2) increase in food production in rainfed areas. 3) Public acceptance of genetically modified crops. 4) 2nd green revolution with hi-tech application (unlike that of 1960 and 70).
→ The world authoritative body, consultative group on International agricultural Research (CGIAR) warns that - The world is entering the 21st century on the brink of a new food crisis that is as dangerous but far more complicated than the threats it faced in the 1960s.

Changes caused by agriculture and overgrazing :-

- Upto 18th century agriculture was based upon primitive cultivation methods and without use of manures, fertilizers and pesticides.
- In 18th century modern agricultural and techniques were adopted with breeding of improved crop varieties.
- By 1840 irrigation in very large scale helped agriculture to take growth production increased providing sufficient food.
- By 1860 chemical fertilizers are produced in factories and helped in yielding of food crops.
- Now a days almost all agriculture work is being done by machines. Tractors, power tillers, harvesters, threshers etc are some agricultural equipments.
- Sufficient food production by agricultural changed the world economic scenario

Overgrazing :-

- Grazing management is the foundation of grassland based livestock production since it affects both animal and plants health and productivity.
- Overgrazing reduces plant leaf areas so that sunlight interaction reduces which affects the plant growth.
- Plants becomes weakened and root length reduces producing weakened posture ~~and stalk~~ seed.

- Overgrazed soils allows weed seeds to germinate and grow. If the weeds are unstable or poisonous then it will harm the animal and human being.
- Overgrazing also increases soil erosion, reduces organic content of the soil and reducing its fertility.
- Overgrazing can be prevented by providing forage supplement to the herd.
- Another method is to plant warm season perenial grasses such as switch grass.

Effects of Modern agriculture :-

Modern agriculture started in around 1960s by adapting advanced technological innovations like - development of hybrid strains and other genetic improvements increase in the use of pesticides and fertilizers use of advance agricultural equipments etc.. Still it has severe environmental effects :-

1. Damage to soil :- Mechanical deep ploughing causes soil to be loose and prone to be eroded. Short time high yielding crops produces more erosion than long term crops. Erosion also affects fertility of soil as it takes away most of the organic matter, plant nutrients and fine soil particles.

2) Fertilizers and pesticides :- By applying fertilizers, agricultural production increases but at the same time some damage also caused to the environment.

- The three major nutrients present in fertilizers are nitrogen, phosphorus and potassium
- Nitrogen can easily lost to underground as it is soluble in nitrate form and its leaching can elevate its concentration in ground water to unacceptable level for drinking.
- phosphate does not leach rapidly but it can be carried with eroded soil to surface water bodies, which may cause excessive growth of aquatic plants.
- Move away of potassium with eroded soil may not cause any health problem ~~human~~ to human. Like fertilizers used for high production, pesticides are used for crop protection. Use of pesticides also have some adverse effects on the environment.
- Pesticides does not kill only the pest of concern but also some bacterial pest and insects and other organisms. Once the effect of the pesticide ~~wear~~ wears off, the pest species is likely to recover more rapidly than its predators, because of differences in the available food supply. Previously in important species may also become significant crops pests when their natural predator are killed by pesticides application.
- Increasing pesticides have increased resistance power of pests. The pests survived from the pesticide application breed to produce more tolerant pest population
- After World war-II the most used pesticides like DDT and other chlorinated hydrocarbons which are highly persistant are banned because it is not destroyed and remains present in micro-level for years together and enters and accumulated in animal cells tissues.

Water logging :- It is a problem associated with excess irrigation in poorly drained soil. If the irrigated water remain stacked in the field having poorly drained soil, the excess water which could not penetrate to ground, thus affects the water table of the soil.

- By water logging, air spaces in the soil are filled so plant roots do not get oxygen and suffocated
- → Water logging also changes soil structure and effects its fertility.

- Water logging problem can be avoided by employing timely scientific methods of irrigation and also by cultivating ground covers in the crop field.

Salinity :- It is a condition of the soil which represents the presence of ionic concentrations of soluble salts in the root zone of the soil.
- It also represents the electrical conductivity nature of the soil as salt solutions are conductive in nature.
- ~~Deposition~~ Depending upon the conc: there are three types of saline soils.

(a) Saline Soils :- These types of soils have electrical conductivity more than 4 mmho/cm 4 Ω/cm. Exchangeble sodium percentage is less than 15 and PH is less than 8.5. The soluble salts mainly consists chlorides and sulphates of sodium, calcium, magnesium. These soils have white due to salt deposition.

(b) Non-Saline/Alkali Soil :- These types of soils do not contain large amount of soluble salts, so the conductivity is less than 4 mmho/cm. Exchangable sodium percentage is more than 15 and PH is more than 8.5. These types of soil looks black.

(c) Saline-Alkali soil :- These types of soil is both saline and alkali. These have appreciable amount of soluble salt and so the electrical conductivity is more than 4 mmho/cm. The exchangeble sodium percentage is greater than 15. The PH is likely to be less than 8.5.

Effects of Salinity or alkalinity or both :-

1. Causing low yield of crops or crop failure in extreme cases.
2. Limiting the choice of crop, because some crops are sensitive to salinity, or alkalinity or both.
3. Rendering low quality fodder, because fodder grown in alkaline soil contain high amount of molybdenum and low amount of zinc, causing malnutrinal problem and decrease among life stock.
4. Creating difficulties in construction of roads and buildings.
5. Causing excessive runoff during flood resulting in damage to adjoining crops.

Causes of Salinity :-
- In arid and semi arid areas salts form during weathering of soil.
- Excessive irrigation of the ~~soil~~ uplands containing salts produces accumulation of salts in the valleys.
- If saline water is used for irrigation then salinity of the soil will increase.
- Obstruction of natural drainage, siltation in natural drainage may increase salinity.
- In coastal areas in place of seawater induces salinity in the soil.
- When sodium ions predominate in the soil solution and carbonates are present alkali soils are formed.

Reclamation :- It is the process of getting rid of the effects of salinity and alkalinity in the soil and getback the natural original state
- If the problem is only of the salinity, the salts need to be leached below the root zone and not allowed to come up. This can be achieved by providing sub-surface drain arrangements.
- Reclamation of alkali soils can be achieved by adding some soil ammendment (like gypsum) containing soluble calcium salts.

Energy Resources :- From biochemical reactions of the cell inside the body of all living organism and vegetation energy is needed. This is a vital resource and primary need of all.

Growing energy needs :-

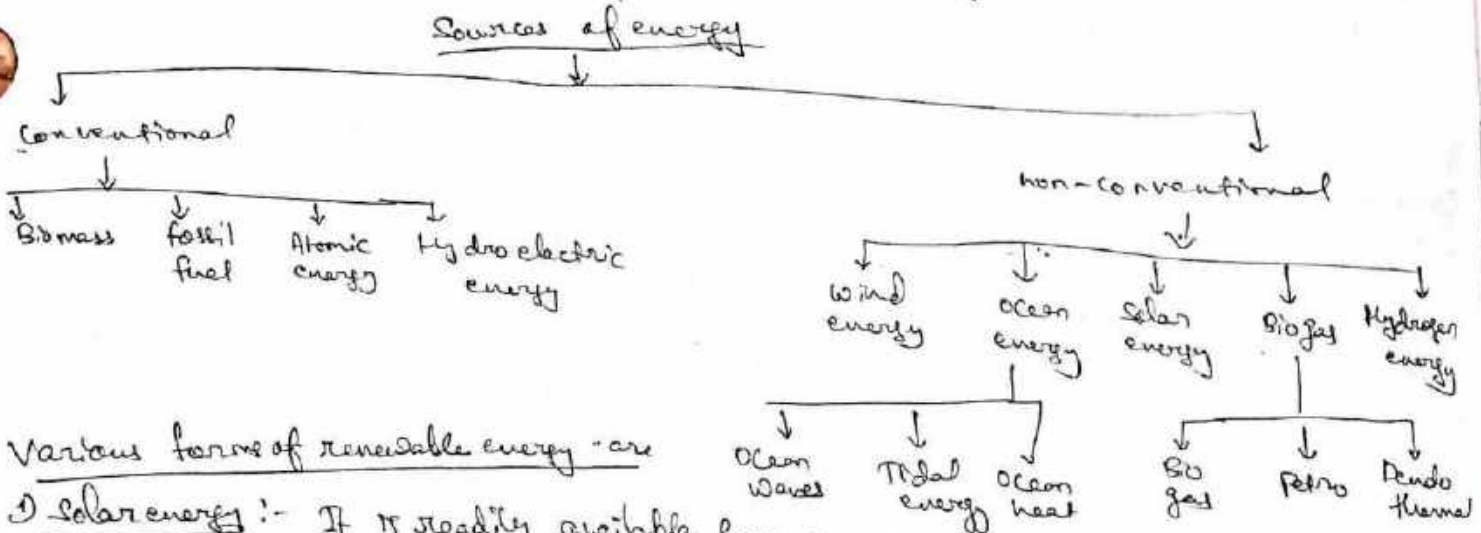
- India has very fast growing developing economy and the growth has been accompained by a steady increase in energy consumption.
- As economy grows, energy intensity rises following corresponding increase in energy consumption.
- The linkage between energy and economic factors manifested in energy elasticity and energy intensity are related to :-
  (i) Demographic changes including a relative faster growth in urban areas, higher per capita GDP and per capita gross saving.
  (ii) Efficient enduse devices
  (iii) Technological improvements in conversion equipments.
  (iv) Inter-fuel substitution with more efficient alternatives.

As need for energy consumption rises very fast and conventional energy sources are going to be exhausted, thrust has been given for renewable sources of energy, like solar, wind, hydro, biomass, tidal, hydrogen etc.

Energy Sources :- Energy sources are of two types (a) Renewable and (b) Non-renewable sources.

(a) **Renewable or non-conventional or enhaustive energy sources :-**
These sources are continuously replenished by natural process.
eg :- solar energy, wind energy, bio-energy etc.

(b) **Non-renewable or conventional or exhaustive energy sources :-**
These energy sources cannot be renewed. Once it is enhausted means enhausted for all time. eg :- fuel, oil, petroleum, natural gas.



Various forms of renewable energy are

1) **Solar energy :-** It is readily available free source of energy coming from sun which is the base of all forms of energy and life.
- Solar energy can be utilised via two roots. - one is solar thermal way in which Sun-ray is utilised and converted into thermal energy used for cooking, heating, drying, timber seasoning, seasoning, distillation, cooling, refrigeration and cold storage use also for electricity generation and Cold storage.
- The 2nd way is solar electricity in which solar energy is converted to electrical energy through photo voltaic cells (PV) cells and is used for lighting homes and buildings, street lighting, running motors, pumps, electrical appliances etc.

- Most popularly used solar thermal energy device is a solar cooker. For a small family a box-type solar cooker is good enough and for voluminous cooking parabolic concentrating solar cookers are useful.

Photovoltaic cells :- 'Photo' means light and voltaic means voltage or electricity. Photovoltaic cells are semiconductor devices made off silicon material which can produce electricity when exposed to light. The amount of electricity depends upon the intensity of light.

- Individual cells are connected together to form a solar panel or module.
- Solar panels can also be grouped together (in series or parallel depending upon the requirements) to produce a solar array
- PV modules are rated by their peak watt power at solar noon in a clear day
- PV panels can be fixed or made stationary facing towards the sun or it may be maintained on a tracking system. The tracking mechanism is utilised to track the sun as it moves on the sky.

Solar water pumps :- It is the same electric pumps run by the electricity generated by a photovoltaic (PV) array. The pump can draw water from borewell, open well, stream, pond etc

Case study :- Punjab energy development agency (PEDA) has installed about 500 solar pumps for agricultural use under solar photovoltaic pumping programme of the ministry of non-conventional energy sources.

(ii) Wind energy :- It is another form of renewable energy in which the K.E of wind is converted to electrical energy by using rotor, gearbox and generator.

India ranks 5th in wind power generation in the world. With an avg windspeed of about 75 km/h and minimum speed of 15-20 km/h can produce an annual production of about 225 kW to 1000 kW.

Wind energy technology is utilised to convert K.E of wind into electrical energy by a wind turbine. Wind turbines are of two types:- (1) Vertical axis wind turbine and (2) Horizontal axis wind turbine, depending upon the axis of rotation with respect to ground.

(iii) Hydro energy :- Potential energy of falling water, captured and converted to mechanical energy by water wheels. India has the potential of producing small hydropower of about 10000 MW. It is a non-polluting power and does not involve very high cost or loss of environment and ecology. Hilly regions of India especially Himalayas belts are endowed with rich hydel resources and tremendous potential

(iv) Bio energy :- It is renewable energy resources derived from carbonaceous waste of various human and natural activities. It is derived from numerous sources, including the by products from the wood industry, agricultural crops, raw material from the forest, household waste etc. Biomas energy is mostly derived from biogas plants in which the input raw material are the waste products.

Hydrogen energy :- Hydrogen can be used as a clean fuel and energy in various applications.

Hydrogen contained in metal hydrides can be used in vehicles. The centre for hydrogen energy in Berarai Hindu university has synthesised metal hydride hydrides, graphite nano fibers, having very high storage capacity

Ocean energy :- It is the energy obtained from ocean. It can be of 3 types ⓐ Ocean wave ⓑ Ocean tide and ⓒ Ocean heat.

Ocean wave moving on the surface of the ocean body can be utilised to produced electrical and mechanical energy.

Ocean tide is the high waves produced near the shore. It has tremendous speed and power which can be utilised to produce mechanical and electrical energy.

Ocean heat :- At ocean bed and inside core of the ocean, temperature is very high which can be sensed by appropriate sensor and converted to useable form of energy. As ocean covers more than 70% of earth's surface and it considered to be world largest solar collector, it has very high energy potential which can be converted to usable forms.

(vii) Geothermal energy :- Human civilization lives between two great energy sources one is the sun in the sky and other is the hot rocks and fluids beneath the surface of the earth.

Earth's core is very very hot and so metals minerals rocks etc. are in semi-molten fluid state : All these produce geothermal energy and is contained in areas having volcanos hot springs, gysers and methane gas deposits.

In India northwestern Himalayas and the western coast are considered to be geothermal potential areas. The devices used to utilise geothermal energy are heat exchangers and steam turbines.

(viii) Chemical sources of energy :-

Fuel cells electrochemically produces direct current electricity (dc) through a reaction between hydrogen and oxygen. Such cells are electrochemical devices that convert ~~heat~~ chemical energy of a fuel directly and very efficiently, to electricity and heat. The most suitable fuel for such fuel cells is hydrogen and/or a mixture of compounds containing hydrogen. Commercial fuel cell are phosphoric acid fuel cell, polymer electrolyte membrane, fuel cell, solid oxide and molten carbone fuel cells.

(2) Conventional or Non-renewable energy sources :-

Fuel wood, coal, oil and natural gases are the conventional or non renewable energy sources.

(i) Coal :- India is the third largest producer of coal reserve in our country is estimated to be about 210 billion tons mostly it is in the eastern states of Bihar, WB and odisha. Central India including MP and Andhra pradesh also have sizeable coal reserves.

(ii) Lignite :- It is a mineral used to produce electricity. Lignite reserve in our country is estimated to be 29.72 billion tons. Eighty percent of it is located in Tamil Nadu (Neyveli area) and rest areas spread over, Gujrat, Rajasthan, Kerala and Tamil Nadu.

(iii) Petroleum and Natural gas :- Relatively, The bulk of oil and natural gas reserves are located in offshore areas where exploration, drilling and production are expensive, leading to much higher cost of domestic crude oil and natural gas as compared to imported oil and gas. Exploration of hydrocarbon also limited to onland and shallow water offshore areas.
Under New exploration licensing policy (NELP) of Govt. of India, vast areas have been identified under deep water for exploration, but it requires specialized technologies and large scale investments.

(iv) Nuclear Power :- Nuclear power programme in India is based upon natural Uranium and indegenous thorium reserves.
- With USA assistant, the Tarapur atomic power plant was commissioned in India with a capacity of 2×200 and 2×540 MW based on boiling water Reactor (BWR) technology. It is still operational and supplying power to western grid
- Subsequent nuclear power project is established at Rajasthan, with external assistance from Canada, basing on pressurized, heavy water reactor (PHWR) technology. This plant is now indegenized and further developed.
Nuclear programme in India is under the control of department of atomic energy and its nuclear power corporation. Current nuclear capacity is 2225 MW based on BWR/PHWR technologies and constitute 2.65% of the total installed capacity.

(v) Hydropower :- Total potential for hydro power in India, based on river systems was assessed at 301117 MW at 60% load factor and economic post potential of 84044 MW. According to central electricity authority (CEA) study on 1980 total hydroelectric potential of the country region wise are given as follows :-

Region	Energy (TWH)	Potential at 60% LF	%age developed	%age under development
Northern	225.0	30155	14.30	8.03
Western	31.4	5679	31.94	26.97
Southern	61.8	16763	49.21	10.27
Eastern	42.6	5590	16.41	12.73
North eastern	239.3	31857	1.02	0.96
All India	600%	84044	15.07	7.23

(VI) Land Resources :-

Land as a resource :- In India land is respectively said as mother land, because for life sustainability the first and formost requirement is the land. In our country after 1950-51, the available land is classified into 9 categories (i) Forest (ii) land put to non-agricultural use (iii) barren and uncultivable land (iv) Permanent postures and grazing land (v) mice, tree crops and groves (vi) Culturable waste land (vii) Fallow land, (viii) current fallow (ix) net sown area

Factors determining land capability :-
There are the major soil characteristics of the land i.e the texture of top soile, its effective depth, permeability of top soil and subsoil and associated land features like the slope of the land, the extent of erosion, the degree of wetness, and susceptibility etc to overflowing and flooding.

Land Capability classes :- The land capability classes are based upon the intensity of hazard and limitations of use.

and capability falls into two groups or classes (a) Land suitable for cultivation and other uses (b) land not suitable for cultivation but suitable for other land uses.

Land suitable for cultivation and other land uses :-

Land suitable for cultivation and other land uses can be classified into four classes

Class-I (green colour) :- This class of land is suitable for cultivation and all types of other land uses. This class of land is nearly levelled and erosion hazard is low. The soils are deep well drained, easily worked, hold water well and either fairly well supplied with plant nutrients or are highly responsible to the application of fertilizers.

Class-II (yellow colour) :- This class of soil have some limitations like (a) gentle slopes (b) slight susceptibility to erosion (c) less than ideal soil depths (d) occasional damaging overflow (e) wetness for a longer time (f) slight to moderate salinity/alkalinity. These type of land needs terracing, strip cropping, contour bunding, contour cultivation, water disposal area, stable mulching use of fertilizers manure and lime.

Class-III (Red colour) :- This class of soil have moderate limitations of a) moderate sloping (b) moderately susceptibility to water and wind erosion (c) frequent overflow causing crop damage (d) very slow permeability of sub-soil (e) wetness or continuous water logging after drainage etc. The soil can be used for growing cultivated crops, pastures, forests and wildlife and cover.

Class-IV (Blue colour) :- This class of soil have severe limitations like a) steep slopes (b) severe susceptibility to water and wind erosion (c) severe effect of past erosion (d) frequent overflow including crop damage (e) severe salinity & (f) moderately adverse climate

Soil :- It is defined as a thin layer of earth's crust which serves as a natural medium for the growth of plants. soil is formed by weathering process of parental material rocks. The word 'soil' is derived from latin word 'SOLUM' which means ground. physical properties of soil are :-
(i) specific gravity (ii) pore space (iii) plasticity (iv) cohesion (v) colour (vi) texture (vii) soil temperature (viii) permeability.

Soil forming materials :-

Soil is formed during weathering process after decomposition of rocks. There are three main types of rocks (i) igneous rocks (ii) sedimentary rocks (iii) metamorphic rocks. Chemical contents of soil are- SiO_2, Al_2O_3, Fe_2O_3, MgO, FeO, CaO, Na_2O, K_2O, CO_3, P_2O_5, MnO, TiO_3 etc and water moisture.

Soil types and soil groups :- Important soil groups of the world are :-

(i) Soils of podsols group :- These are found in cold to temperate regions under humid conditions. The podsols and their congeners are completely leached soils eg:- Tundra soil, Pod soil, Prairie Soil, Brown forest soil.

(ii) Tschernozems and their related groups :- Such soils develop in semi arid climate. These are also known as black earths, due to the presence of humidified organic matter eg:- Black and cotton soil, Chestnut earths, Desert soil

(iii) Ground water soil including peat :- In these type of soil ground water table is either at or near to the surface. Such soils are found through the middle, northern and western parts of Europe.

(iv) Brown and grey soils of semi-desert :- Moving towards more arid areas from chestnut soil regions, brown and grey soil of the semi-desert are found. Calcareous and gypseous salts occur in such soil within inches of the surface.

(v) Saline, Alkaline and Solodi soils :- In such soils accumulation of mainly sodium salt with some amount of potassium salt is found. Sodium carbonate is present in alkaline soils.

(vi) Soils of the humid tropics and sub-tropics :- Such soils are formed by chemical weathering and addition of un-weathering minerals like quartz, magnetite etc. Such soils are red in colour eg: Red loams, Red earth.

(vii) Soil associated with calcareous parent rocks :- Two types of these soils are :-
① Soils of brownish or brownish grey colour eg: - Rendzinas.
② Soils predominantly red or reddish brown in colour it belongs to Terra Rosa soils.

Classification of soils in India :- Major soils groups found in India are :-

(i) Alluvial soil :- These soils being fertile contribute to maximum share of agricultural wealth and are formed from deposition laid by the tributaries of the Indus, Ganges and Brahmaputra systems. These include deltaic alluvium, calcareous alluvial soil, coastal alluvium and coastal sands. Alluvium is divided into ~~kador~~ ~~khadar~~ - (i) Khadar - light coloured sandy (ii) Bhangar - dark and full of kankar.

(ii) Black soil :- These soils are black in colour and particular type of it derived from deccan trap is called 'Regur' or black cotton soil.

(iii) Red soil :- These are formed from ancient crystalline and metamorphic rocks by intensive weathering. The red colour is due to wide diffusion of iron.

(iv) Laterite and lateritic soils :- Such soils are ~~a mix~~ mixtures of the hydrated oxides of aluminium and iron with small amount of manganese oxide and titanium.

(v) Desert soils :- These type of soils contains quartz, feldspar and horn blende grains along with calcareous grains. Also in some such soils high percentage of ~~sub~~ soluble salts and calcium carbonate are found.

(vi) Problem soils :- Such soils because of its characteristics can not be used economically for agriculture purpose. High eroded soils, ravine lands, soils on steepy sloping lands are such types.

(vii) Acid soils :- Soils having pH below 7 are considered to be acidic. These are are found in Himalayan region, Gangetic delta and ~~Pen~~ Peninsula.

Land degradation :- Degradation means loosing the characteristics of the land which makes it useable.
— In india 1.9 billion hactares of agricultural land have been degraded.
— 8 million hectares are converted to non-agricultural use, ie homes, highways, shopping centres, highways, factories etc. Land degradation is caused by ~~improvement~~ Impoverishment or erosion of soil, water ~~run~~ runoff, vegetation by shrinking of lakes etc.

Land degradation is an alarming situation for human civilization because soil formation process is very slow. Formation of 1 cm of soil crust from parent material take 300-400 years. Fertile soil have high percentage of organic matter and micro-organisms

Significance of land degradation :-

- Increase efforts to raise agricultural growth costs in the form of land and water degradation.
- Soil erosion, soil alkalanity and salinity, deficiency of micro nutrients, Waterlogging etc. causes of land degradation.
- According to Dept. of land resources & ministry of rural development Govt. of India, types of degraded land are.
  a) Uplands with or without scrub (b) Degraded notified forest (c) Saline - inland/coastal (d) Snow covered/glacial etc.

Land slides :- It is a sudden collapse of a large mass of land usually on a hill side. It makes earth along with rock mud debris to flow down. Landslide mostly occur - where land slide have occured before on steep slopes, on benches, where drainage in causing a problem and where certain geologic condition exists.

Types of land slides :-

1. Shallow disrupted land slide :- It is not huge and occur in steps phase after phase eg: South Sirsana mountains.
2. Deep coherent landslides :- Mainly caused by earthquake in which large volume of land disrupted. eg:- Rancho Tamules landslides.

Factors causing landslides :-

1) by earthquake saturation with heavy rain or crashing waves, the top earth becomes heavy and the bottom soil could not hold it still.
2) Excessive rainfall or snow melt saturates and lubricates soil to move it slide down
3) Forest fires taken away slope vegetation causing bad erosion and land slide on slopes
4) Man causes landslides by mining the earth underground excavation, pumping and draining ground water levels or over developing hill slides.

- Man induced land slides are caused by breaking hills & and mountains by using explosives, mainly for developement purpose.
- For establishment of factories digging out minerals etc. may cause landslides

Soil erosion :- It is the removal of soil substance from the surface by eroding agencies like running water, wind or even gravity.

Soil erosion in India

a) Normal or geologic erosion :- This type of erosion is normally happens as a geological process in which slowly but steadily erosion takes place. Erosion is compensated with formation of new soil and thus equilibrium is attained when equilibrium disturbed, geologic erosion becomes significant.

b) Accelerated soil erosion :- The removal of surface soil from areas denuded of their natural protective cover as a result of human and animal interface is called accelerated soil erosion.

(c) Wind erosion :- It takes place place in arid and semi-arid areas devoid of vegetation where the wind velocity is very high

(d) Water erosion :- Soil erosion by water can be of three types :-

(i) Sheet erosion :- It removes a thin covering of soil from large areas often from entire fields more or less uniformly during even rain which produces a runoff

(ii) Rill erosion :- When sheet erosion is allowed to continue un-checked the silt-laden runoff forms a well defined but minute finger shaped grooves over the entire field such thin channelling is known as reel erosion.

(iii) Gully erosion :- When reel erosion is neglected the tiny grooves develope into wider and deeper channels taking huge size. This is called gully erosion

(e) Land slide or slip erosion :- It is caused by land slide in which because of heavy rainfall or earthquake the rocks, soils etc fall down outward and slides down the slope of hilly areas.

(f) Stream bank erosion :- This type of erosion is caused by torrents which are hill streams characterized by wide spreading beads on emergence from the hilly with ill defined banks, fiery flows and swift currents.

Mechanism of erosion :-

(a) Water erosion :- It is caused by water is mainly due to rainfall and rainfall causes soil to erode in two ways (1) energy of the falling raindrops detach soil particles with even drop and (2) The surface flow of water takes away the soil particles and in the process also takes away more and more particles.

(b) Wind erosion :- Soil erosion by wind is of three types :-

(i) Saltation :- Soil carried by wind is moved in a series of short bounces called saltations. The soil particles of size 0.1 to 0.5 m is diameter, blown away with wind, pressure and collision with other particles.

(ii) Suspention :- Fine particles remain suspended over ground for a longer time and moves away to a far distance by wind pressure because of its very ~~light~~ its weight

(iii) Surface Creep :- Soil particles longer than about 0.5 mm in diameter but smaller than 1mm are too heavy to be moved in saltation but are pushed or spread along the surface by the impact of particles in saltation to form a surface creep.

Desertification :- It is a climatic process in which rich and fertile land slowly converted to barren and dry lands thus decreasing the productivity of the land drastically.

- End Situation of the desertification is conversion of fertile land into deserts
- It is characterised by devegetation, loss of vegetal cover, depletion of ground water, salinitation and soil erosion.
- Climatic change and anthropogenic are also responsible desertification
- Deforestation is also a major cause of desertification
- Mining and quarrying activities are also responsible for desertification

Role of individual in conservation of natural resources:-

- Planning a suitable strategy for conservation implementing it in the most judicious way is called conservation management.
- Environment planning, evaluation, monitoring and impact assessment are methods of conservation management.
- Taboo, philosophy of conservation of natural resources is to keep "harmony with nature".

* Important roles an individual co-play for conservation of natural resources are:

1. At once stop overutilization of natural resources
2. Instead of deforestation one must should be afforestation. Every individual should take part in plantation and caring the ~~for~~ plants
3. Protect wild life and teach everyone about various acts and rules of W.L Act
4. Mixed cropping, crop rotation are to be practised.
5. Instead of chemical fertilizers, manures and bio-fertilizers, organic fertilizers to be used.
6. Habit of waste disposal and restoring biodiversity.
7. Education local people of resources areas to protect and use judiciously.
8. Conserve electricity in domestic use and ~~s~~ shutdown the application when not in use.
9. Maintain a balance between resources and needs.
10. ~~Adopting~~ Adopting water harvesting in houses and clonies
11. ~~Recycling~~ Recycling of waste water for agricultural purpose.
12. Use of fossil fuel only when alternative is not available
13. Energy ~~&~~ Saving methods to be adopted
14. Soil erosion is to be prevented.
15. Drip and sprinkling irrigation is to be used for improving irrigation efficiency and reduce evaporation.
16. Renewable energy sources are to be used more.
17. Discouraging use of car, bike and ~~so~~ encouraging walk and cycle.

(c) Equitable use of resources for sustainable life style:-

- Equal distribution of natural resources should be for all irrespective of ~~rich~~ rich or poor.
- There must but be balance between the need and consumption of resources, particularly for drinking water, food, fuel etc.
- Present scenario is developed countries are having less population but consuming more resources, in the other hand developing and under developed countries have more population and not getting greater ~~share~~ share of resource to consume
- To have equitable use, the govt. heads in the country must implement policies and ~~so~~ rules for equitable distribution.

- There must be close - co-operation and co-ordination among the nations and there must be some common agreement.
- If all there peace, harmony and equity will be maintained world wide then a sustainable developed life style for the entire human civilization can be prevailed.

Ch-3

Systems Assignment - 3

Q1 Define ecology ? [2]

ans :- The scientific study of interactions of the organisms with their physical environment and with each other is called ecology.

- The word ecology is derived from two greek words - oikos means household and logos means ~~disc~~ study.
- so ecology deals with the organism and its place to live.
- or we can say ecology deals with inter relationship between the biotic and abiotic compounds of an ecosystem.

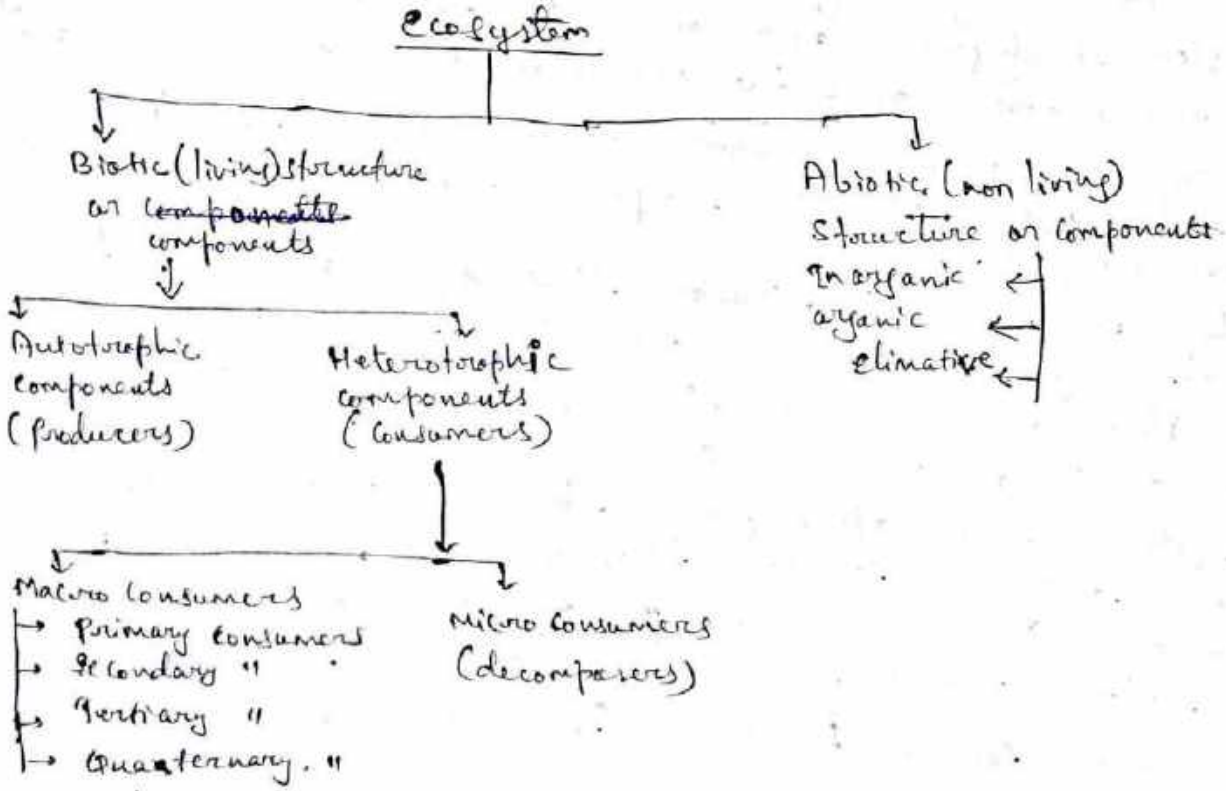
Q2 Explain the concept of ecosystem ?

ans - Ecosystem is defined as a community of organism interacting with one another and the environment in which they live.

- The ecosystem is like a home to the organism. eg :- for a fish or such water creature - a pond, a river, a lake, an ocean is an ecosystem.
  eg - (2) for a small microbe like algae any water body with very little volume of water may be an ecosystem
- A system in a process of many complex and co-ordinated units. It can be an open system or a cybernetic system.
- Ecosystem is an open system, because it derives energy from outside source (i.e the sun) and utilise it for its various functions and finaly disipates energy in the form of heat to the environment (outside).
- An ecosystem can be ! natural (river, sea) or artificial like an aquarium.
- An ecosystem may ~~b~~ not have a fixed size its size depends upon various factors.
- An ecosystem concept is that the living organism of a community not only interact among themselves ~~with their~~ but also have functional relationship with their non-living environment.
- The structural and ~~fu~~ functional system of communities and their environment is called an ecosystem.

Q3 Give the diagram of structure of an ecosystem? [5]

ans - Structure of an ecosystem is the description of the species of organisms that are present in the ecosystem.
- It also includes information on their life histories, populations and distribution in space.
- The structure of an ecosystem also provides a information about the range of climatic condition that prevail in the area composition and ~~organ~~ organisation of biological communities and abiotic compounds.
- According to the ecologist' odum' from the trophic (food) point of view, an ecosystem has the following components -



Q4 Define biotic and abiotic components of ecosystem and give a comparative study? [7]

ans :- Biotic components :- All living organisms are called biotic components of an ecosystem eg:- plants, animals, micro-organisms present in the ecosystem.

Abiotic components :- There are non living components consisting physical and chemical constituents.

Biotic Components :- These components exchange, expel, convert, assemble, disassemble, organise and other wise manipulate the constituents of earth, air and water.

- Biotic systems have three basic components like producers, decomposers and consumers.

— Biotic components can be of two types (producers and consumers. consumers can be of macro type (primary, secondary etc) and micro consumers are decomposers.

Abiotic Components :- There include two factors.

→ (a) Material or chemical :- chemical factor includes inorganic materials like water, minerals, atmospheric gases and other inorganic salts, and organic materials like amino acids, decay products, lipids, carbohydrates, proteins etc.

— The quantity of abiotic materials like the minerals present at any given time in an ecosystem is termed as the 'standing state" or 'standing crop'.

(b) — Energy or physical factor :- These are light, heat, stored, stored energy in chemical bonds annual rainfall wind latitude and altitude etc.

- for proper functioning of an ecosystem there must be a continuous flow of energy and cycling of minerals among the organism of the ecosystem.

Q.5 Give a comparative ~~study~~ explanation of autotrophic components and hetero trophic components? [5]

ans Autotrophic Components :- There are also called producers and all the activities like fixation of light energy and use of simple organic substance takes place on its own way.

- All green plants are producers : These are also called 'converters' or 'transformers'.
- These are living members of the ecosystem and they utilize sunlight as their energy source to convert the simple organic materials from soil, air and water into more complex energy rich chemicals as their food
- The process of chemical conversion from simple to complex materials with the help of sunlight is called photosynthesis.
- These are also called photo - auto - trophs.

(b) Heterotrophic components

These utilize decomposes and rearranges the complex material synthesized by autotrophs. These are also called consumers. They derive their food directly or indirectly from the producers.

Consumers are of two types.

① Macro consumers - (i) Primary (ii) Secondary (iii) Tertiary (iv) Quertornary
② Micro consumers or decomposers.

Q6 Write notes on :-

(a) Primary Consumers :- There are also called herbivores because they directly get their food from producers (plants). Hence herbivores are plant eaters.
eg :- elephants deer

(b) Secondary consumers :- These are called carnivores and they eat the primary consumers
eg :- Chameleon which eats grass hopper.

(c) Tertiary Consumers :- These are Carnivores which eat other carnivores
eg : eagle eats snakes which eats rats.

- Some other types of consumers are

Omnivores : These are consumers which eat plants and animals. So these are both herbivores and carnivores.

Top Carnivores : These are animals or birs usually in the top class of the ecosystem which are not killed or rarely killed and eaten by other animals. eg :- lion, vultures

Detrivores : These are bottom living creatures which subsist on remains of the organic detritus from autotrophic layers
eg :- ants, crabs, termites.

Q7 what are the function of an ecosystem? [5]

ans:- - Functioning of an ecosystem is self regulating and self sustaining.
- Functioning of ecosystem depends upon flow of energy cycling of materials and perturbations both intrinsic and extrinsic.
- Functioning is a dynamic concept with structural heterogeneity based upon at least 4 phases:-

1. 'Rapid release' phase':- Consisting of tightly bound resources.
2. It is replaced by re-organisation phase
3. Then comes the exploitative phase.
4. Exploitative phase is gradually transformed into Conservation phase or climax phase.

Q8 what are the different types of ecosystem? [5]

ans Depending upon, species diversity, manner of organisation and functioning ecosystems are classified into (1) Terrestrial ecosystem (2) Aquatic eco-system.

Terrestrial ecosystem:- operate on land area. eg:- forest ecosystem, grassland, Desert ecosystem.

Aquatic ecosystem:- operate in water. It can be further divided into two types.

(i) Fresh water ecosystem:- operated in fresh water bodies like pond, river
(ii) Marine water ecosystem:- operated in ocean. It can be again divided into several phases as upper layer marine ecosystem and deep ocean ecosystem.

(2) Temporary and natural ecosystem:- There are short lived but operate under natural conditions.

(3) Artificial or Anthropogenic ecosystem:- There are artificial or man-made ecosystem eg: fishery farms, Dams, crop lands, aquariums.

Q9 Explain energy flow in an ecosystem?

ans Energy is required for all biological activity.
→ source of all form of energy is sun and from sun energy comes to each member in the ecosystem.
- Producer plants converts air, water and soil to nutrient products with the help of sunlight in the process of photosynthesis.
- This energy stored in plant tissues goes on and on to primary, Secondary and finally to the top carnivores
- From top carnivores it again lost to the environment but can not be recycled

- The direction of energy flow is only in one direction.
- Energy flow obeys the laws of thermodynamics.

Q 10 Define 1st law and 2nd law of thermodynamics? Explain how these laws are followed for energy flow in an ecosystem?

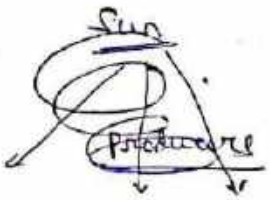
Ans

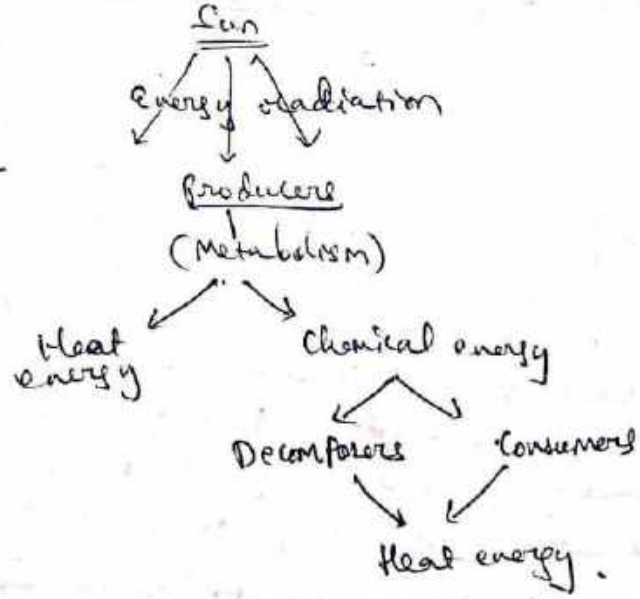
1st law :- The law states that
- energy can neither be created nor be destroyed, it can only be transformed from one form to another.
- As seen in an ecosystem, solar energy is converted to plant energy which goes to the consumers and finally to the environment.

2nd law :- The law states that - energy transformation involves degradation or dissipation of energy from a concentrated to a dispersed form.
- In an ecosystem energy transformation takes place in every trophic level; During this process about 90% of energy is lost and only 10% transformed to next trophic level.

Q 11 Explain Sun as the prime source of energy? Draw the flow chart for energy flow in different trophical levels? [4]

Ans
- Energy comes out from the Sun in the form of radiations.
- Most part of the total radiated energy from sun is in the region between UV and IR, that is the visible light spectrum which spreads over a wavelength from 0.38μ to 0.77μ.
- Autotrophs utilizes this energy to produce food.





Q12 Explain energy flow model and name two energy flow models in ecosystem? [5]

ans – Energy flow in one direc from sun to producers and then to various consumers.

– 34% of sunlight (energy) get reflected back to the atmosphere 10% held by ozone layer, water vapours and gases. 56% reaches earth ~~by green~~ surface from which only 1-5% is used by green plants for photosynthesis.

– Rest is absorbed as heat by ground, ~~veg~~ vegetation and water

– Chemical reaction explaining photo-synthesis is given by

$$6CO_2 + 6H_2O \xrightarrow[\text{chlorophyll}]{\text{Sunlight}} C_6H_{12}O_6 + 6O_2$$

– Popular energy flow models in ecosystem are

(a) Odum's energy flow model

(b) Lindeman's energy flow model.

Q13 Define ecological succession? [5]

ans – Ecosystem is dynamic in nature. Its characteristics change continuously with time. Characteristics like structure, organisation, physiology etc change continuously with time. This phenomenon is called ecological succession

– The rate of successional changes in rapid at initial stage and gradually slows down until a point of dynamic equilibrium is reached at which the community remains stable.

– A complete succession is called a 'sere' and a 'sere' consist of a number of ~~seq~~ seral stages.

According to great ecologist, Odum :-

Succession is the birth of an ecosystem and subsequent ageing ~~of an ecosystem~~ process of its abiotic and biotic features.

Succession has three parameters.

1. It is an orderly process of community development that involves changes in species structure and community process with time. It is reasonably directional and therefore predictable.
2. Succession is community controlled even though the physical environment determines the pattern, the rate of change and often sets limits as to how far development can go.
3. It culminates in a stabilized ecosystem in which maximum biomass (or high information content) and symbolic function between organisms are maintained per unit of available energy flow.

Q14 what are the different types of succession? Explain all types of it.

ans i) **Primary succession** :- It is the process of birth and development of a community in a site which was previously unoccupied by any living organism.

- The sere involved in succession is called pre-sere.
- The process starts at bare rock, sand dune or river delta or glacial debris and ends when climax is reached.

ii). **Secondary succession** :- It refers to community development on sites previously occupied by well developed communities but due to some short of calamities, presently either completely or largely devoid of vegetation.

- The sere involved in secondary succession is called Subsere.

Another type of classification (for both primary and secondary succession) is depending upon the moisture content —

The types are :-

(a) **Hydrach or Hydrosere** :- The succession starts in the aquatic environment like ponds, lakes, streams, swamps, bogs etc.

(b) **Mesarch or Meso sere** :- It is the succession which starts at intermediate moisture content.

(c) **Xerach or Xerosere** :- It is the succession which starts in xeric or dry habitat, such as rocks in xeric or dry habitat such as rocks, deserts, drylands etc. Xerosere is again three types —

(i) **Lithosere** :- Succession initiating on rocks

(ii) **Psammosere** :- Succession initiating on sands.

(iii) **Halosere** :- Succession initiating on saline water or soil.

On the basis of community metabolism succession can classified into two types :-

(1) **Autotrophic Succession** :- It is characterized by early and continued dominance of autotrophic organisms like green plant. It begins on a predominantly inorganic environment and the energy flow is maintained indefinetly.

(2) **Heterotrophic Succession** :- It is characterised by early dominance of heterotrophs such as bacteria, fungi, actinomycetes and other such animals. It begins in an organic environment and there is a progressive decline in energy content.

Another type of succession is one on the basis of replacement of one species by other.

(i) Autogenic succession :- It is the succession in which replacement of one type of community by another takes place due to modification of the environment by the community itself.

(ii) Allogenic succession :- It is the succession in which replacement of one type of community by another takes place due to modifications of the environment by external forces.

Q15 Explain the general process of succession ? what are the sequential steps followed in succession - explain? [4]

Ans The complete process of primary autotrophic succession involves the following sequential steps.

1. Nudation :- It is the beginning of the succession process, with the formation of a bare area or nudation, by several factors like volcanic eruption, flood landslide, erosion deposition, fire etc.

2. Invasion :- It is the process of animal of reproductive bodies or propagules of various organism and their ~~settled~~ settlement in the new or bare area.

- plants are the first invaders (pioneers) in any new or bare area as the animals depends upon them for food. It include three steps

(i) Dispersal or migration :- It is the process in which seeds, spores or their propagules leaves the parent plant and reach the bare area through various agents like air, water and animals.

(ii) Ecesis :- It is the successful establishment of migrated plant species into new area. It includes germination of seeds, growth of seedling into plant and starting of reproduction.

(iii) Aggregation :- It is the final stage of invasion in which the immigrant species increase there number by reproduction and aggregate in a large population in the area.

(3) Competition :- As the number of individual grows there is competition both inter specific (between different species) and intra specific (with in same species) for space, water and nutrition. They influence each other in a number of ways known as "reaction"

(4) Reaction :- when living organisms grow, use water and nutrients from the ~~substrate~~ substratum, and in turn they have a strong influence on the environment which is modified to a large extent and is known as reaction.

- when they become unsuitable for the existing species and favour some new ones the new species replaces them.
- Thus reaction leads to several seral communities.

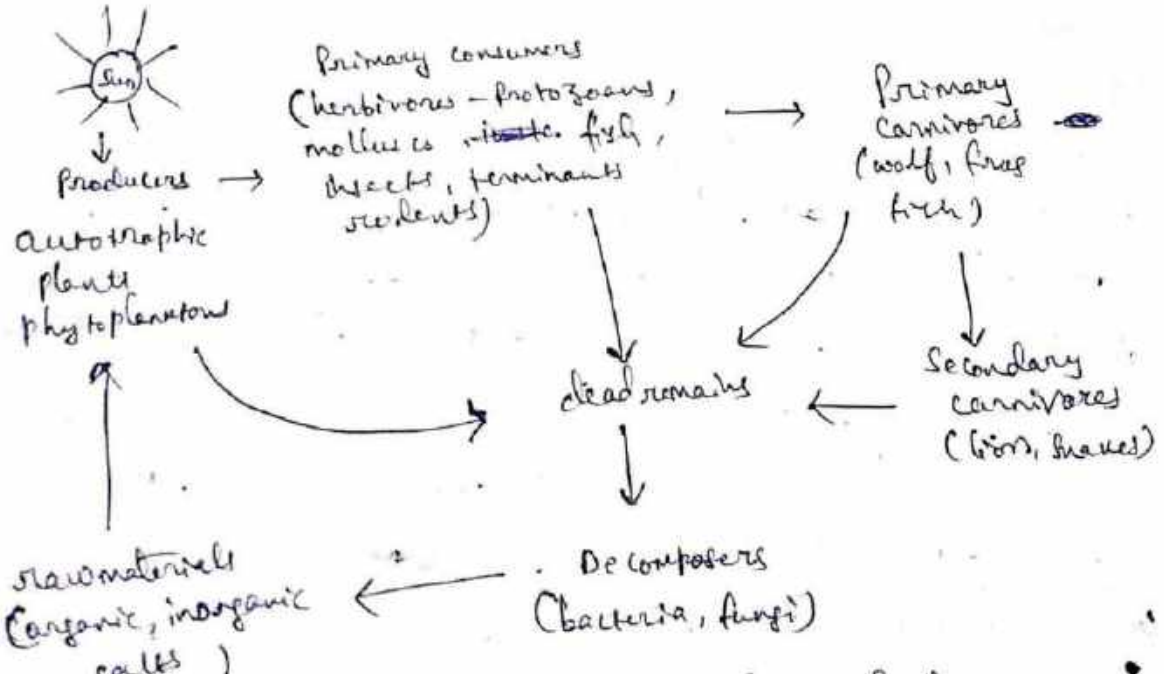
Stabilization or climax:- After long time a stage is reached when final terminal community becomes more or less stabilized for a longer period of time and it can maintain itself in the equilibrium or steady state with climate of that area.

- This last seral stage is self maintaining and self reproducing and relatively permanent and is called climax.
- This stable community is called climax community and the vegetation supporting it is the climax vegetation.

Q16 what is a food chain? what are the different types of food chain?

Ans Food is the basic necessity of a living organism for its dynamic activities. Food provides energy and it is transfered from one level to other.

- Plants get their food from earth, soil and water prepared in the process of photosynthesis by utilizing solar energy.
- From plants energy as food get transfered to herbivores ~~then~~ to ~~as food get~~ carnivores and so on upto top carnivores and finally it goes to the environment or atmosphere.
- The process of eating and being eaten with the resultant transfer of energy is called food chain.
- In food chain organisms of an ecosystem are linked together
- Each step of energy level (eating foods) is called trophic level and the study of energy flow through these steps is called trophic ecology.



Generalized food chain for ecosystem

- Energy flows from primary producer to primary consumer, from primary consumer to secondary consumer, then to tertiary consumer and so on.
- This simple chain of eating and being eaten is called food chain.

Examples ① Grass → rabbit → fox → wolf → Lion {Grass land ecosystem}
② Phytoplankton → water flies → small fish → Tuna (pond ecosystem)

In nature basically there are two types of food chains.

1. Grazing food chain :- This type of food chain starts from green plant to herbivores and then to primary consumers, to secondary consumers and so on.

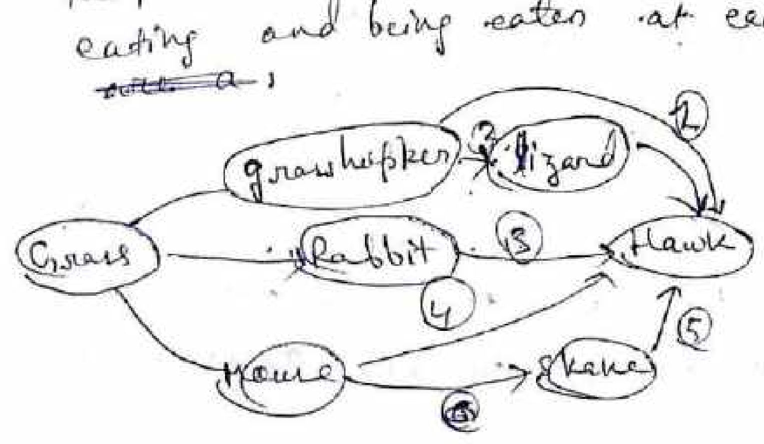
· Autotrophs (Primary producers) → Herbivores (Primary consumers) → Primary carnivores (Secondary consumer) → Secondary carnivores (Tertiary consumers) → So on

2. Detritus food chain :- Detritus is the organic waste, exudates and dead matter derived from grazing food chain.
- There are group of organisms (detrivores) which eat the detritus and from them, energy transfer to complex organism
- The organism of detritus food chain are algae; bacteria, slime moulds, fungi, actinomycites, protozoa, insects, mites, molluscs, worms, nematodes etc.

Detritus → Detrivores → Detrivore consumers → Small carnivores → large carnivores

Q.17 With appropriate example, explain food web? [5]

ans:- Simple food chains occur very rarely in nature. It is because of the fact that the food from one trophic level is being eaten by several eaters from a number of trophic levels. Similarly an eater in higher trophic level may take its food from various lower trophic levels.
- This interconnection of eating and being eaten is called food web.
So food web is defined as - A network of food chains where different organisms are connected in different trophic level so that there are a number of options of eating and being eaten at each trophic level.



food web

~~In the fig is shown a food web containing of 5 food chains~~ ~~the index~~.

In the fig is shown a food web containing the interconnection of 5 food ~~wef~~ chains.

1. Grass → Grass hopper → Predatory bird (hawk)
2. Grass → Grass hopper → Lizard → hawk
3. Grass → Rabbit → Hawk
4. Grass → Mouse → Hawk
5. Grass → mouse → Snake → Hawk

Q 18 what is an ecological pyramid? what are its types. [5]

ans Charles Elton in 1927, found that, the number of animals in the bottom level of a food chain is more than the No. of animals on top. ~~Secondary~~ secondly. There is some sort of relationship between the numbers, biomass content and energy content of the primary consumers, producers of the 1st and 2nd orders and so on to the top Carnivores. - These relationships are represented diagrammatically (graphically) and are ~~also~~ called as ecological pyramids or Eltonian pyramids.

Ecological pyramids are of 3 types :-

1. Pyramid of number (Based on number of organism at each level)
2. Pyramid of biomass (Based on biomass of organism)
3. Pyramid of energy (Based on rate of energy flow or land productivity at successive levels)

Q 19 Write notes on? [5×3].

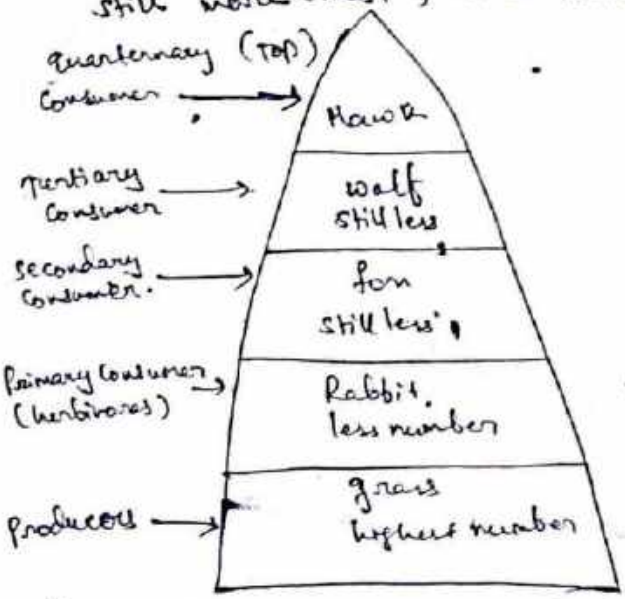
(a) Pyramid of numbers (b) Pyramids of biomass (c) Pyramid of energy

ans (a) Pyramids of numbers :-

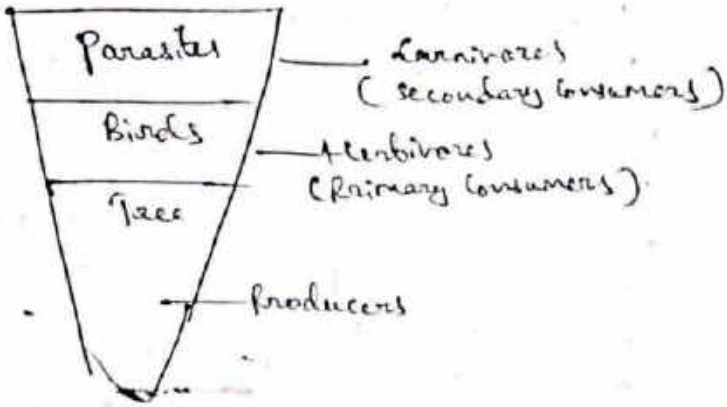
It can be conical or pyramidal upward or downward.

- In a grass land ecosystem, No of grass is the most and herbivores like rabits are less in number than the No. of grass and the No of secondary consumers like fox is still less and No. of tertiary consumers like wolfs. is still less and at the top the No of top Carnivores or top quarternary consumers is the least.

- But in a forest ecosystem, the pyramid of numbers is inverted (cup side down). The No. of trees are least. The No. of birds living on food from trees are more in number & and the No. of parasites feeding on the body of birds like bugs, lice is still more (most) in number.

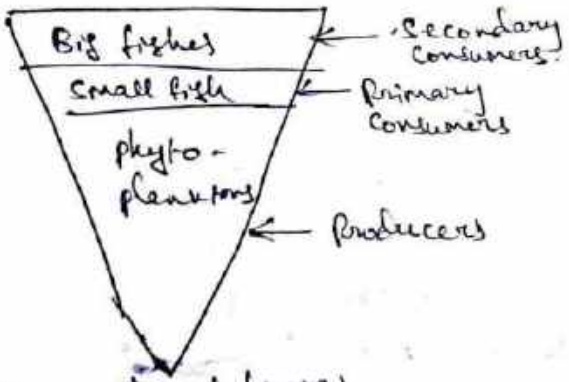


Pyramid of Number in grassland ecosystem



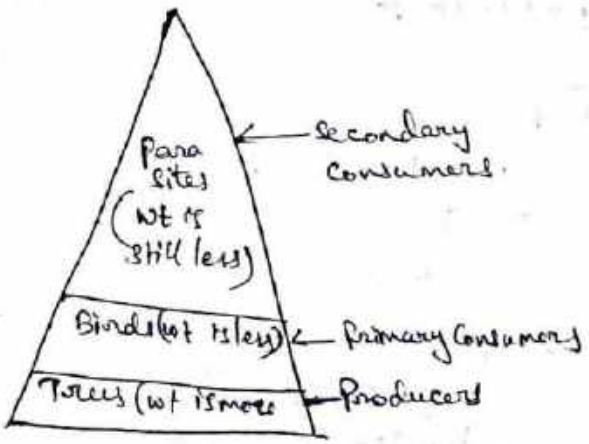
(b) Pyramid of biomass :- It represents the biomass or weight of the organism instead of their number. Pyramid of biomass can be upward & or inverted.

- The inverted pyramid of number in forest ecosystem will be upward for pyramid of biomass. The weight of a tree is the highest in comparison to that of birds and weight of bird is more than the weight of the parasites like bugs, lice, is the least.



Pyramid of biomass in an aquatic ecosystem

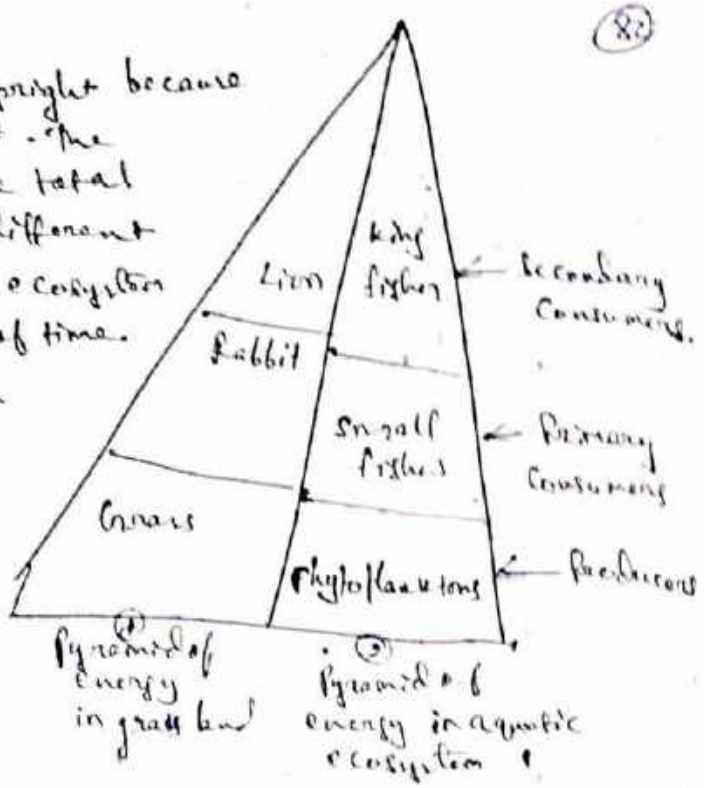
(inverted)



(c) Pyramid of energy :-

Pyramid of ecosystem is always upright because it takes time factor into account. The pyramid of energy represents the total quantity of energy utilized by different trophic levels organism of an ecosystem per unit area over a set period of time.

The energy transferred from bottom level to next top level decreases as we move upward. Total energy content of grass is not transfered rabits and all energy of a rabbits not transfered to Lion. So the amount of energy transfer decreases from bottom to top.



Q20 With its complete structure explain a forest ecosystem ? [5]

Ans - India 20% of the land is applied by forest.
- Tropical rain forest are found in western ghats, Andamans and North east Himalayas.

Different components of a forest ecosystem are :

Abiotic Components :- There are inorganic and organic components present in the soil and atmosphere.
- Minerals present in forest soil, dead organic debris etc.

Biotic Components :- There are living organisms present in forest ecosystem. There consist of :-

① Producers :- There are trees found in the forest ecosystem. Types of trees depends upon the type of forests.
- In northen coniferous forest needle leaves evergreen trees are found like spruces, fire, and pines etc.
- In deciduous forest, trees alongwith shrub and ground vegetation are present. Trees like tectona grandis, butea frondosa, -chorea rubusba etc. found.

② Consumers :-

(a) Primary consumers :- There are herbivores animals feeding on tree leaves i.e, ants, ~~flies~~ flies, beetles, leaf hoppers, bugs spiders etc.

- Larger herbivores like mouse, snow shoe grouse etc.
- Animals like deer, moles, rabbits, fruit bats, mongoose, elephants nilgai etc.

(b) Secondary consumers :- These are carnivores like snakes, birds, lizards, fox etc. feeding on herbivores.

(c) Tertiary consumers :- These are top carnivores like lions, tigers, bears, wolves etc.

(3) Decomposers : Varieties of micro-organisms like actinomycetes (streptomyces), bacteria (Bacillus, Clostridium, pseudomonas etc), fungi (coprinus, ~~pop~~ polyporus, fusarium etc) are the decomposers found in forest ecosystem.

Q21 With its complete structure explain a pond ecosystem? [5]

Ans Ponds are small water bodies having large littoral zone and very small or no limnetic and profundal region.

- Pond is an isolated body of standing water in which organic material are accumulated.
- Temporary ponds which made dry for some months in a year ~~supports~~ supports organism which can survive in dry ponds.
- Ponds are also be created by damming streams or basins.
- In Indian villages, ponds play an important roles for bathing, washing clothes, cattle bathing, swimming etc.

Components of pond ecosystem are :-

Abiotic Components : It may be organic and inorganic components like water, CO_2, oxygen, calcium, nitrogen, ~~phosp~~ phosphorus, amino acids etc. Heat and light are also the abiotic components.

Biotic Components :-

(1) Producers :- These are autotrophic plants and bacteria. They firm radiant energy and with the help of minerals from water and mud, they form complex organic substances like carbohydrates proteins, and lipids.

Two types of producers are gradually found.

(a) Phytoplankton :- These are minute, floating or suspended lower plants like ~~ul~~ ulothrix, spirogyra, ~~cl~~ Cladophora, oedogonium, cosmarium, volvox etc. Their biomass is estimated as weight of standing crop per unit area or volume.

(b) Macrophytes :- There are mainly rooted larger plants which includes partly or complete submerged floating and emergent hydrophytes. Common species of plants are - Trapa, Typha, Sagittaria, Nymphae, Chara, Hydrilla, Utricularia, Marsilea, Azolla, Sylvania etc.

(2) Consumers :-

(a) Primary consumers :- These are herbivores feeding directly on living plants. There are of two types.

(i) Benthos :- These are animals associated with living plants and bottom level animals fed on plant remains. Benthic animals are fish, larva, mites, molluscs, Crustaceans etc.
- Besides there are cows, buffaloes some water birds are also there.

(ii) Zoo planktons :- There are rotifers rotifers (Brachionus, Lecane etc), protozoans (Euglena, Colepis etc) Crustaceans (Cyclops, Stenolyphis etc).

(b) Secondary Consumers :- These are Carnivores live insects, fishes, which feed on zoo planktons.

(c) Tertiary consumers :- These are some large fish feeding on small fish.

(3) Decomposers :- These decompose organic matter of both producers and consumers in simple forms.
- Their role is to return the mineral elements again to soil.
- Example of decomposers are - bacteria, actinomycetes and fungi etc.

Q 22 With complete structure explain a stream ecosystem? [5]

ans - These are fresh water aquatic system.
- These are found in large numbers in rainy season in hill ramps and high lands.
- Water current in a stream is the major controlling factor of oxygen and nutrients in the water.
- Difference between stream and pond can be explain basing upon 3 conditions.

(1) Current :- - Velocity of current varies greatly in different parts of the stream and from one time to another.

- If the area of the ~~the~~ stream is very large then the current velocity may be reduced to very low so that stream becomes a pond.
- Velocity of current depends upon steepness of the surface and ~~with of the~~ width of the stream bed.

(3) Land water interchange :-

- Streams have large land - water surface function.
- Streams have producers like fixed, ~~filaments~~ e.g. filamentous green algae encrusted diatoms and aquatic mosses.
- Sometimes plankton and detritus coming from ~~bottom~~ quieter water are also acts as producers.

(2) Oxygen :-

- As streams have large surface area exposed to air, it have abundant supply of oxygen even when there are no green plants.
- For this reason streams animals are sensitive to reduced oxygen level and have narrow tolerance.

Zonation in streams :-

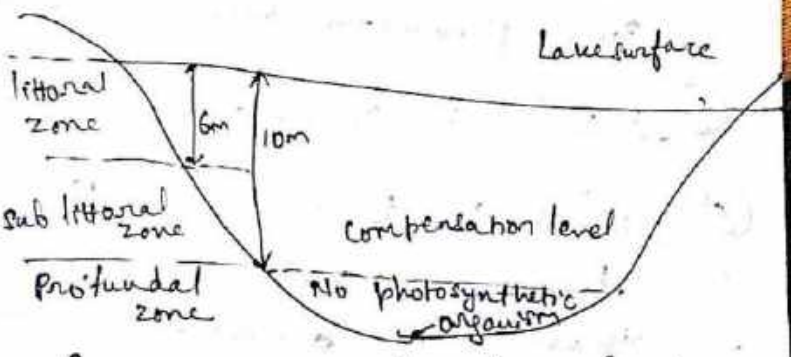
- In streams zonation is longitudinal
- zones increasingly older stages from source to mouth.
- Longitudinal distribution of community in a stream is profound.
- For fish no. of individuals decreased down, stream but size of fish increased, so that biomass, density remains constant.

Q23 With complete structure explain a lake ecosystem ? [5]

ans
- Lakes are inland depressions containing standing water.
- Some lakes have outlet mouth.
- In lakes there are 3 to 5 well recognized horizontal starta namely.

(1) Littoral zone :-

- Shallow water near the shore forms this zone.
- It contains upper warm and oxygen rich circulating water layer called epilimnion.



(Different zones of a deep fresh water lake)

(ii) Sub-Littoral zone :- It extends from rooted vegetation to the non-circulating cold water with poor oxygen zone i.e hypolimnion

(iii) Limnetic zone :- It is the open water zone away from the shore. It is upto the depth of effective light penetration where rate of photosynthesis is equal to the rate of respiration.

(iv) Profundal zone :- It is the deepwater area beneath the limnetic zone and beyond the depth of effective light penetration.

(v) ~~Neritic~~ Abyssal zone :- It is found only in deep lakes since it begins at about 200 meter from the surface

Classification of lakes :-

- According to Hutchinson (1957) depending upon temperature, lakes are classified into three types - dimictic, monomictic and polymictic.
- Basing upon humic acid content - lakes are of two types - clear water lakes and brown water lakes.

Biotic Communities of lakes :-

Organisms depending upon substratum are called pelonic forms and that are free from it. Called limnetic form -

Organisms found in lakes are -

(a) Neuston :- Neuston are floating plants such as duckweeds any many types of animals. Animals are called epineuston and insects are called hyponeuston.

(b) Plankton :- These are small plants and animals capable of very limited locomotion. Certain zoo-planktons are very active. Some planktons are called nectoplanktons.

(c) nekton :- These animals are swimmers.

(d) Benthos :- These include the organism living at the bottom of the water mass.

— Those living above the sediment water interface are termed benthic epifauna.

— Those living in the sediment are called as infauna.

Stratification in lakes :-

In the summer top water becomes warmer than the bottom water. The upper water layer is epilimnion. The next viscus and cold water level is called thermocline. The next bottom colder non circulating water level is hypolimnion.

Depending upon water circulation patterns, lakes are of the following types :-

(a) Dimictic (mictic = mixed) :- It has two essential periods of free circulation.

(b) Cold monomictic :- Here water temperature never goes above 4°C, it takes seasonal overturn in summer.

(c) Warm monomictic :- Water temperature never falls below 4°C, there is one period of circulation in water.

(d) Polymictic :- More or less continuously circulating with any sort of any stagnation period.

(e) Oligomictic :- Rarely mixed

(f) Micromictic :- permanently stratified.

Q24 With Complete Structure explain an ocean ecosystem? [5]

ans
- Oceans occupy about 70% of earths surface.
- Oceans are interconnected by currents, dominated by waves, influenced by tides and characterized by saline water.
- Ocean has a large and stable ecosystem.
- Oceans regulate many biogeochemical and hydrological cycles, thus regulating earth's climate.
- Ocean have major life zones like, Coastal, Euphotic, Bathyal and Abyssal zones.

Biotic Components of an ocean.

(1) Producers :- Autotrophic (producer) are mainly phytoplanktons, which trap radiant energy from Sun through their pigments.
- Microscopic seaweeds available at different depth levels are also comes in producer category.

(2) Consumers - Herbivores like Crustacians, molluscs, fish etc are primary consumers
- Carnivores fish like shad, herring etc are the secondary consumers.
- Top carnivores fishes like cod, Haddock, Halibut etc are tertiary consumers.

(2). Decomposers :- The ~~microbes~~ microbes active in the ~~decay~~ decay of dead organic matter are chiefly bacteria and some fungi.

Q25 With Complete structure explain an estuary ecosystem? [5]

- Estuary are semi closed coastal water bodies, which has a free connecting with open sea.
- Within it sea water coming in the form of tides get mixed with fresh water from land drainage.
- River mouths, coastal bays, ~~tidal~~ tidal marshes and water bodies behind barrier beaches are examples of estuaries.
- Estuaries can be classified basing upon the factors like (i) Geomorphology (ii) Water circulation and stratification (iii) System energetics.
- Pritchard in the year 1967, divided estuaries into 4 types depending ~~upto~~ upon their geomorphology.
  (i) Drowned river valleys (ii) fjord type estuaries
  (iii) Barbuilt estuaries (iv) Estuaries formed by tectonic process.

Besides these river delta estuaries are also there.
On hydrographic basis, estuaries can be classified into 3 broad categories as:-

(a) Highly stratified or salt wedge estuary.
(b) Partialy mixed or moderately stratified estuary.
(c) Completely mixed or vertically homogenous estuary

The hyper saline estuary is a special type of estuary.

Biotic ~~com~~ communities of estuaries :-

- Estuaries regions can be classified into upper, middle and lower reaches with increasing range of salinity and the mouth with salinity nearly equal to sea.
- Animals inhibiting in estuaries can be of two types
  (i) oligohaline (0.5 to 5% salinity) (ii) mesohaline (5-18% salinity)
- Some types of phytoplanktonic forms, several species of diatoms Synedra and Navicula are found in estuaries.
- Blue green algae like microcystics Oscillatoria are also found.
- Invertebrates and vertibrates fauna also found in some estuary.

Ch-4 Biodiversity and its conservation

Assignment - 4

Q1 Define Biodiversity ? [2]

ans:- According to article of convention on biodiversity (CBD) Biodiversity which is the short-form of biological diversity among living organisms from all sources including, inter alia, terrestrial, marine and other ecosystems and the ecological complexes of which are part. This includes diversity within species ~~between~~ and ecosystem.

— According to Harvey & Lillywhite (2002) biodiversity refers to "the variety and variability among living organisms and the ecological complexes in which they occur.

Q2 Explain biodiversity in three levels (a) level of ecosystem (b) level of species (c) level of genetics ? [7]

ans:- Biodiversity ~~of~~ is usually analysed at three levels

(a) level of ecosystem :-

Each ecosystem have a large number of varieties of flora and fauna which is different from those of any other ecosystem. Depending upon the availability of abiotic resources and conditions of the ecosystem there flora and fauna develops.

(b) level of species :-

A large number of varieties of species co-exist in an ecosystem. They react and interact with each other and with the abiotic factors in the environment. This type of diversity is called ~~specie~~ species diversity.

(c) level of genetics :-

With in a species there are often found a number of ~~as~~ variety or races or strains which slightly differ from one ~~as~~ another in one two, ~~as~~ three, or more number of characters such as shape, size, quality of their product resistance to insect, pests etc. This type of ~~as~~ diversity is called genetic diversity.

(Q3) What is biogeographical classification? Name the 13 biological regions of India ? [5]

ans — Collective study of biota (flora + fauna) is called biogeography. Usually there are two major approaches for study of biogeography.

- (I) Descriptive or static biogeography and (Q4)
  (II) Interpretative or dynamic biogeography
- Biogeographically India is situated at the trijunction of three realms - (a) Afrotropical realm (b) Indo-malayan (c) paleo-arctic realm.
- India is one of the 12 mega bio-diversity countries in the world with only 2.4% of land area. India counts for 7-8% of the recorded species of the world.
- The following 13 ~~biological~~ bio-geographical regions have been identified in India -

1. Himalaya
2. Thar desert
3. Deccan Peninsula
4. Malabar
5. Andaman ~~is~~ Islands
6. Nicobar islands
7. Gangetic plains
8. Laccadrive islands
9. Maldivel Chagoas islands
10. Western ghats
11. Burman/Assalian forest
12. Marine coast
13. Coromondal Mahanolions.

Q4 Explain about all the floristic regions of India? (7)

Ans India is divided into 9 floristic regions with respect to floral diversity.

① Western Himalayas :- It extends from Kumaon to Kashmir and has annual rainfall upto 200cm. There are three zones of vegetation in this region.

(a) Sub montane zone :- It constitutes tropical and subtropical parts and extends upto 1500 meter altitude. It comprises mostly the Siwalik ranges, here there is no snowfall. Plants like shorea robustica, Dalbergia sissoo, Cedrela toona, Eugenia, Jambolana etc are found in this area.

(b) Temperate zone :- It is above submontane zone and extended upto 3500 meter altitude plant species like acer, Alnus, Rhododendron, Betula, salix, populus etc are found here

(c) Alpine zone :- It extends above temperate zone upto 4500 meters altitude, Common tree species like Betula, Zanipeens; Rhododendrone are herbs like Primula, Pentintela, Polygonum etc are found in these region.

② Eastern Himalayas :- It includes regions of Sikkim and, NEFA, characterized by more rainfall, less snow and higher temperature. There are three zones, altitudinally.

(a) Tropical zone :- It entends upto 1800 mts altitude. This zone has tropical semi-evergreen or moist deciduous forest plants like Shorea Robusta, Acsabia Catechu, Delbergia Sisso are found.

(b) Temperate zone :- Above tropical zone of entends upto 3500 mts altitude and has montane temperate forests - Trees of oaks like Michelia, Quercus, Pyrus, Simplocus etc are found

(c) Alpine zone :- Above the temperate zone upto 5000 mts altitude it is entended, and alpine vegetation like juniperus and Rhodondendrons are found in this region.

(2) Indus planes :- This zones includes arid and semi-arid regions of punjab, Rajasthan, kutch parts of Gujrat and Delhi. Rainfall here is less than 70 cm and vegetation is tropical throne forest in semi-arid region and typical desert in arid region. Usually xeroplytic plants like Acacia Nelotica, Salvadora, Tecomila, Capparis, Tamarin etc are found in this region

(4) Gangetic planes :- This region entends over UP, Bihar, Bengal and parts of odisha and is characterised by Moderate amount of rainfall and most fertile (alluvial) soils. vegetation is mostly tropical moist and deciduous and dry deciduous forest type. Common plants are Acacia nelotica, Dalbergia Sisso, Madhuca Indica etc.

(5) Central India :- It comprises MP, parts of odisha Gujrat. Rainfall is 150 - 200 cm and vegetation is thorny mixed deciduous and teak type, Common trees are Tectona grandis, Madhuca, Diospyrus etc.

(6) Malabar (west Coast) :- This region include western coast of India from Gujrat to Cape Camorine and has heavy rainfall. forest are tropical evergreen in extreme west, semi evergreen towards interior Sub-tropical or montane temperate evergreen forest in Nilgiris and mangroves near Bombay and Kerala coast.

(7) Deccan plateau :- This region entends all over peninsular India (Andhra pradesh, Tamilnadu and Karnataka) and has rainfall upto 100 cm This central hilly plateau has tropical dry deciduous forest. to the eastern dry coromondal coast has tropical dry evergreen forests.

(8) Assam :- This region is characterised by heavy rainfall (200 to 1000 cm) . The vegetation is either dense evergreen or sub-tropical.

(9) Andamans :- This region possesses a varied type of vegetation mangroves and beach forest at its coasts and evergreen forest of tall trees in the interior

India has large number of wetlands, mangroves and coral reefs to its credits.

Q5 What is called as values of Bio-diversity? What are the different values? [7]

Ans Both animals and plants have a number of values towards the whole human kind . Biodiversity, which is the diversity in biological organisms provide very valuable resources, which can be categorised as —

(a) Consumptive value :- whole human race get a large number of consumable products from biodiversity .
- Fuel woods, timbers are used by human beings.
- plant scales, leaf roots are used as medicines.
- Some tribal people use ~~timbers~~ tubers fruits, roots, seeds of plants and meat of wild animals as their food.

(b) Productive value :- Bamboos, grasses, canes essential oils, tanning material, dyes, gums, resin, drugs, spices, poisons, insecticides, soap substitutes, honey, wax, lacs, tussar etc. are forest products having high commercial values.
- Benefits like water quality, recreation, education, scientific research, regulation of climate ~~of cli~~ etc are indirect values of biodiversity.

(c) Social values :- Biodiversity has distinct social values attached with different societies, like
- Provision of food, ~~fuel~~ fuel, fiber
- Provision of shelter and buildings material
- Purification of air and water.
- Detoxification and decomposition of wastes.
- Generation and renewal of soil fertility, including nutrient recycling.
- Control of pests and diseases.
- Stabilization and moderation of earth's climate.
- Maintainance of genetic resources as key inputs to crop varities.
- Livestock breeds, medicines etc.

(d) Ethical values :- Ethical or religious is one of the indirect values of biodiversity and lies in the understanding that we are complementary to each other and well being of one lies in the well being of other.

- Hence people in all race and society worships trees, mountains, ~~rivers~~ rivers etc.

(e) Aesthetic value :- Aesthetic value of biodiversity has been expressed in many ways through art ; ~~poetry~~ poetry , song, litrecture, music and dance .

- We all have emotional and evolutional attachments with trees , mountains , rivers etc .
- Eco-tourism generate large revenues.

(f) option value :- .

- It is the indirect value of a species to provide an economic benefits to human society at some point in nearfuture .
- Option value is the value or a person's willingness to pay (WTP) to preserve the option of having an irreplacable resource available for future use.
- Mostly in the field of finding and developing new medicines and medicinal plants , there is an ~~insurance~~ insurance of option value

Q6 Explain

(a) Biodiversity in global level ? [5]

ans - It is estimated that 5 - 30 million species of living being exist on earth where only 1.5 million have been identified

- Identified species are - 300000 species of green plant and fungi , 800000 species of insects , 40000 species of vertibrates , 3, 60, 000 species of micro-organisms .
- So , rest of the plants and animals are required to be listed out and their behaviour be studied in detail.
- It is estimated that about 1, 25, 000 flowering plant species are existing out of which only 1-9% are identified .
- Largest storehouse of ecological biodiversity is in tropical rainforests.
- In tropical rainforests the condition for evolution is optimum and extinction is fewer.
- Biodiversity diversity is the result of interaction between climate , organisms, topography , parent soil material, time and heredity.

- Tropical deforestation is reducing the biodiversity by 0.5% every year.

- The 12 mega diverse countries as identified by IUCN are:
1. Brazil, 2. Colombia, 3. Venezuela, 4. Peru, 5. Ecuador,
6. Indonesia, 7. Democratic republic of Congo (Zaire),
8. India 9. China, 10. Malayasia 11. Australia, 12. Mexico.

(b) Biodiversity in National level? [5]

ans — Biogeographycally India is situated in South Asia, between 6° to 38° N latitude and 69° to 97° E longitude.

- Total geographically area of 3029 million hectares with Himalayas in North, Arabian sea in west, Bay of Bengal in east and Indian ocean on south

- The rich diversity of flora and fauna spreads from humid tropical western ghats to the hot deserts of Rajasthan from cold desert of Ladakh and the icy mountain of Himalayas to the warm coasts of peninsular India.

- In India 1,15,000 species of plants and animals are found which makes it one of the 12 mega diversity nations.

- various crops like rice, sugarcane, jute, mango, banana, several species of millets, several cucurbits etc, orchids, plants of medicinal and aromatic values are found

- In our country 45000 species of plants (about 15% of known plants) are found.

- North eastern region is the treasure house of orchids

- Rich in faunal wealth of about 75% animal species out of which 80% are insects.

- There are no clear estimates about the marine biota though the coastline is 7000 km long with a shelf zone of 4,52,460 sq km and extended economic zone of 20,13,410 sq km There is an abundance of seaweeds, fish, Crustaceans, molluscs, Corals, reptiles and manals

(c) Bio diversity in local level? [5]

ans → Biodiversity at local level can be understood from the richness of plants and animals of same habitat and genetic makeup.

Local biodiversity can be studies on following lines.

1. Richness of species at a given place.
2. physical characteristics of habitat and vegetation in a particular area
3. Change in species composition across different habitats.

4. Local diversity based in climates, geographical, ecological and other process responsible for reaction.
5. Rate of change across gradients and conditions. biodiversity at local level is generally affected by temperature and its variation rather than environmental variables.

Q7 What is threat to Biodiversity ? [2]

- In 1985 wilson described losses of biodiversity as a 'crisis'.
- Losses of biodiversity is more series in developing countries like India, since 1600 there have been over 1000 recorded extinctions of plants and animals species.
- According to wilson, we are loosing 10000 organisms a year. If this process will be continued then in next few decades millions of animals and plants species will be extinct
- Before man's appearance in this planet, rate of extinction was one species per thousand years. But because of human activities the scenario changed drastically.
- Between 1650 and 1950 about 30 species of higher animals becomes extinct.
- About 50000 invertibrates species are loosing every year.
- Indian wildlife Act -1972, sch. chedule-I, provides a list of about 150 endangered species.
- In India 33% reptiles and 62% bird species are endemic.

Q8 Explain the following threats :-

(1) Habitats loss : [5]

Ans :- Both flora and fauna are suffering a lot due to their habitat loss and thus forced to get extinct.

- Sometimes the natural habitat like forests, water bodies are divided into small patches called habitat fragmentation which squeezes the free movement area of animals.
- Natural forests and grasslands, which were the natural home for thousands of species including wild life species, are going cleared day by day for conversion into agriculture land, pastures, settlements or for developmental projects. Thus these species are perished due to loss of their habitat.

- Due to pollution and the presence of toxic and hazardous pollutants, fresh water resources have suffered and many species of aquatic birds, fish and mamals have threatened.
- Electric powerplants causes thermal pollution in biosphere which affects the aquatic communities and their natural food chain.
- Marine diversity is also under serious threat by human intervention
- Huge deforestation by human ~~reas~~ reasons and factors cause loss of habitat for plants and animals.

(b) Poaching of wildlife [5]

- Poaching of wild life is a serious threat to biodiversity. Hunters, collectors, smugglers are responsible for such threat
- Animal products like furs, horns, tusks, skins, even some live specimens and plant (herbal) products are smuggled for huge amount of money.
- Coats of royal bengal tigers, lions bears scales and skins of snakes and crocodiles are also very much costly
- plants of scientific and medicinal values are also smuggled

(c) Man-wild life conflicts :[5]

- Man wild life conflict is the struggle for existence in the form of safe shelter, food and water.
- when the free movement area of the wild animals get squeezed they turnip towards residential areas.
- Due to scarcity of natural flood, wild animals come closer to human habitat in search of food and water which causes conflict among them.
- Animals are prone to infection and deseases when they are under stress.

Q9 Give a brief note of the biodiversity region in the locality of your native habitat ? [5]

Ans In my locality the land is not fertile enough but it responds to fertilizers ~~as~~ . so many people ~~go~~ grow vegetables in their garden, and wide varieties of fruits as well.

In my locality there are two ponds in which 5 different types of fish and micro organisms live. Here a lots of trees are found in which different types birds lived like sparrow, which is now rarely seen in town. These are some of biodiversity in my locality.

Q10 As a student of environmental study give a list of your duties and responsibilities? [7]

Ans List of duties

(i) To make awareness of the biodiversity to the people.
(ii) To ensure that there is no damage to the biodiversity in his/her locality.
(iii) To aware people about the importance of biodiversity and educate them about it.
(iv) To aware people that if they harm the biodiversity it will result in their harm too.

Unit V

Environmental Pollution ①

a) **Air pollution:** According to U.S. public Health service, Air pollution is defined as, "the presence in the outdoor atmosphere of one or more contaminants or combination there of in such quantities and of such duration as may be, or may tend to be injurious to human, plant or animal life, or property, or which unreasonably interfere with the comfortable enjoyment of life, or the conduct of business."

- Atmosphere is a dynamic system and acts as a natural sink.
- Natural activities like forest fire, volcanic emptions, decay of vegetations, wind, storm etc produces pollutant gases like CO, CO_2, H_2S, S_2O, and NO_x and particulate matels like sand, dust etc to the atmosphere
- Man made pollutants like, CO_2, NO_x SO_2, hydrocarbons are also released to atmosphere
- When, the pollutants released to atmosphere at a faster rate than are absorbed by natural sinks, they gradually accumulate in air and produces air pollution.

classification of Air-pollutants:

Air pollutants can be classified in many ways-

(2) a) According to origin:

1. Primary pollutants: which are directly emitted to the atmosphere.
   EX: CO, NO_2, SO_2 and hydrocarbons.
2. Secondary pollutants: which are derived from primary pollutants by the chemical or photo-chemical reactions in the atmosphere.
   EX: ozone, peroxy-acetyl nitrate (PAN) photo chemical smog etc.

b) According to chemical composition:

1. organic pollutants: hydrocarbones, Aldehydes Ketones, amines and alcohols.
2. inorganic pollutants: carbon compounds (carbon monoxide and carbonates), nitrogen compounds (NO_x and NH_3), Sulphur compounds (H_2S, SO_2, SO_3, H_2SO_4) etc.
3. inorganic particles: flyash, asbestos, silica, dust from mining, metallurgy, transportations etc.

c) According to State of Matter:

1. Gaseous pollutants which get mixed with air but not normaly settlement. EX: CO, NO_x, SO_2.
2. Particulate pollutants which comprise of finely divided solids or liquids and often exists in colloidal state as aerosols.
   EX: smoke, fumes, dust, mist, fog, smog and sprays.

(3) Biochemical effects of some important air pollutants.

1. Oxides of sulpher (SO_x):

- SO_x comprises of SO_2 and SO_3. These are colorless, heavily water soluble, with pungent and irritating odour.
- SO_x pollution is due to volcanic activities, combustion of fuels, coal fired power stations, transportation, Refineries,
- In atmosphere SO_2 oxidises to SO_3 by photolytic and catalytic processes and produces photochemical smog.
- In humid conditions, SO_3 reacts with vapours to produce droplets of H_2SO_4 aerosol which give rise to 'Acid rain'.

$$SO_2 + O_3 \nearrow \rightarrow SO_3 + O_2$$

$$SO_3 + H_2O \nearrow \rightarrow H_2SO_4.$$

Biochemical Effects:

- Irritates the upper respiratory ~~ac~~ tract.
- Reacts with cellular enzymes.
- H_2SO_4 lowers PH, impairs enzymes and destroys functional molecules.
- leads to breathlessness, brochial spasms impaired lung clearance etc.

2. Oxides of nitrogen (NO_x)

- NO_x comprises of NO, NO_2, N_2O.
- NO is colorless and slightly soluble in water.

(4) - NO_2 is reddish brown gas, slightly soluble in water, it is an oxidising agent, reacting with water forms HNO_3 which is a powerful oxidising agent.

- NO_2 moves into the respiratory system.

Biochemical effects:

- oxidises cellular lipids, forms bonds with haemoglobin and reduces the efficiency of oxygen transport.
- Disrupts some cellular enzyme systems.
- Higher level and prolonged exposure cause pulmonary fibrosis, inflamation of ~~fatty~~ lungs tissues. etc.

3. Carbon monoxide: It is a colorless, odourless toxic gas. It is slightly soluble in water. It is very dangerous as it has greater affinity to haemoglobin than that of oxygen.

Biochemical effects: It combines with haemoglobin in competition with oxygen and displaces oxygen to form carboxyhaemoglobin thus reducing the oxygen carrying capacity of blood.

under normal condition: $O_2 + Hb \rightarrow O_2Hb$.
(oxyhaemoglobin)

In presence of CO: $O_2Hb + CO \rightarrow COHb + O_2$
Carboxyhaemoglobin

(5)

4. Ozone (O_3) and other photochemical oxidants such as peroxyacetyl nitrate (PAN)

Ozone is a pale blue gas, fairly water soluble, unstable and having pungent odour.
- It is a very reactive oxidising agent capable of combining with many organic compounds in cells and tissues.
- PAN is also very harmful for both animals and plants.

Biochemical effects:

- PAN and ozone toxicity is produced via generation of free radicals, which may damage DNA thus altering cellular genetic integrity.
- Ozone after inhalation, produces fluids in lungs (pulmonary edema) and damages lung capillaries and may cause mortality.
- Free radicals produced by ozone and other photochemical oxidants attack the sulphydril groups on the enzymes and also inactivate some enzymes.
- The sulphur containing aminoacid like cysteine is attacked by PAN.

5. Hydrocarbons (and other volatile organic compounds)

- Hydrocarbons are very reactive and can produce many kinds of compounds.

⑥ - Similarly volatile hydrocarbons and other organic compounds participate in atmospheric reactions producing ozone.

Biochemical Effects: Hydrocarbon and other organic compounds ~~participate~~ react with cell constituents.

- carcinogenic hydrocarbons like benzopyrene can react with DNA causing mutation and cancer.

6. Particulate matter:

- solid particles or liquid droplets including fumes, smokes, dust, and aerosols.

Biochemical effects:

- carbon and other particles cause scarring of lungs via complex walling off and fibrogenic reactions leading to a disease condition known as 'pneumoconiosis'.
- particles carrying absorbed mutagens lead to damage of DNA in the lungs.
- pulmonary fibrosis in asbestos mine workers, black lung disease in coal miners, and emphysema in urban populations are caused by particulate pollution.

7. Heavy metals and other principal pollutants

Heavy metals and other pollutants, with their sources and effects are given in the table.

(7) Effects of Air pollution on Man and Environment

1. Damage to materials:

- Effects of air pollution may be corrosion, abrasion, deposition and direct and indirect chemical ~~effects~~ attacks.
- Materials that may get affected are building materials, rubbers, elastomers, paper, textiles, leather, dyes, glass, enamels and surface coatings.

2. Damage to vegetation:

- Air pollutants like Sulphur dioxide, hydroflouride, particulate fluorides, smog, oxidants like ozone, ethylene, NO_x, chlorine etc and spray of herbicide and weedicide exert toxic effects on vegetation.
- Damage to vegetation may be in the form of chlorotic marking, banding, silvering or bronzing of inner side of leaf.
- Retardation of plant growth.

3. Damage to Animals:

- Arsenic, lead, and fluorides accumulates in vegetation and poison the animals when they eat the contaminated vegetation.
- Arsenic occurs as an impurity in coal and many ores. Arsenic poisoning causes symptoms like salivation, thirst, fever

(6) narcosis, depression of central nervous system.
- Lead is emitted from smelter coke ovens, and automobile exhausts. Lead poisoning takes place in horses depression, paralysis and breathing troubles.
- Cattle and sheep are particularly susceptible to fluorine toxicity.

4. Darkening of sky and reduction in visibility
- sky darkening is caused by heavy smoke, and fog or by dust storms.
- industrial fumes also reduce visibility.
- particulates having size from 0.4 to 0.9 μm may scatter light.

5. Effect on human healt and activities:
- Air pollution may cause health problems which causes absentism and sickness and so drop in production.
- As an example, the London smog of 1952, which lasted for 5 days and caused 4000 deaths.
- Epidemiological and toxicological studies indicate that - due to air pollution respiratory problems like chronic brothitis bronchial asthma, pulmory emphysema and lunge cancers are caused.
- irritation of nose, eyes, throat and skin is produced by air pollution.
- Sickness causes absentism and loss of efficiency.

⑨ Measures to check Air pollution:

Various measures to check Air pollution are

1. controlling Air pollution at source:

It is best to check air pollution at source by

- Modifying the process in such a way that pollutants donot form at all beyond the permissible limit.
- Before release of pollutants to atmosphere they can be destroyed, altered or trapped.
- Raw materials to the system may be so chosen to produce minimum pollution.
- Sulphur fuels may be avoided.
- Timely and regularly monitoring the process control system, so that it will ~~prod~~ create least pollution.
- Equiment alternation is to be given priority. Instead of vented tanks, floating roof tanks may be used.

2. Site selection / zoning

- Control measure based on the knowledge of the mechanics of the atmosphere is called 'zoning'.
- Site selection for setting of factories, should be done properly considering the

meterological and micrometerological conditions.

3. controlling air pollution by DEVICES/process/process modifications:

This method can be separately practised for gaseous pollutants and for particulate emissions.

a) For gaseous pollutants: The various methods used where gaseous pollutants are emitted are —

(i) Absorption: scrubbers are used for removal of gaseous pollutants. Scrubbers have suitable liquid as absorbent to remove or modify one or more pollutants. This technique is used for removal of NO_x, H_2S, SO_2, SO_3, fluorides etc.

(ii) Adsorption: Here the gaseous effluents are passed through porous solid adsorbents taken in suitable containers. The efficiency of adsorption depends upon surface area per unit weight of adsorbent.

(iii) combustion: The flame combustion or catalytic combustion of organic gaseous pollutants convert them into H_2O and CO_2. Flame combustion include fume incinerators stem injection while catalytic combustion is restored where lower temperature is needed.

(11) (iv) cold trapping or condensation: By lowering the temperature to -ve, the effluent gases can be condensed and trapped.

(B) For particulate emission:

Particulate pollutants are originated from stationery and mobile sources and their collection devices are based upon the size, shape and properties of the particulate. Various methods are —

(i) Filteration: Different types of filters like Fibrous, deep bed, cloth bag filters are used and when the contaminated gas is made to pass through the filters, the particles are trapped and collected by the filters — cloth and nylon filters are used upto 80° to 90° centegrade and silicon, asbestos covered glass, cloth filters can be used upto 250°-350°c

(ii) Mechanical: In mechanical process two methods are used —

1. Gravity settling: in which the velocity of the horizontal carries gas is reduced so that particles settle by gravitational force.
2. Sudden change of direction of gas flow, it causes particles to separate.

(iii) Precipitators: Electrostatic precipitators are used which are capable of removing particles with diameter as small as 0.0001 cm.

(2) The principle is — the stack gas is made to pass through the precipitator which have a series of plates, charged with a very high +ve and -ve voltages alternatively. The particles get charged ~~and ultra~~ (may be +ve or -ve) and get attracted by the oppositely charged plates and precipitate on it. Below every plate there is a hopper on which the particles are collected. Electrical attraction becomes weak when dust layer becomes 6mm thick.

(iv) Scrubbers: Scrubbers like cyclonic ~~sub~~ scrubbers and venturi scrubbers are used in which the particles are washed out of the gas flow by water spray and the particles are collected by the scrubbing liquid.

- In cyclonic scrubbers aerosol is introduced in a centrifugal manner and water is sprayed at the entrance of gas and plates are provided to remove moisture from gas after removal of dust. This is followed by a gravity settling chamber or cyclone.
- This type of scrubbers have efficiency of 90% and capable of removing dust particles of size of 5μm and cleaning 2000 ltrs of gas per minute.

(13)

- In venturi scrubbers, dusty gas is passed through the venture throat at a rate of 3400 - 126000 mm per minute and water enters at its throat.
- Such scrubbers have efficiency of 99%. and capable of cleaning very fine particles at a rate of 4000 litres of gas per minute.

4. Controlling of air pollution by growing vegetation.

- Trees absorb dust/dirt and some pollutant gases on its leaves. So planting trees thickly all around the source can reduce pollution. pollution resistant species are to be cultivated.
- Odours of gases can be absorbed by passing them through beds of activated charcoal of sand or soil.
- odours can be controlled by oxidation of compounds by oxidising agents like chlorine, ozone and hydrogen peroxide.

(b) Water Pollution:

- Water is essential for survival of any form of life.
- On an average a human being consumes about 2 ltrs of water everyday. 70% of the weight of the human body is due to water.
- About 80% of earth's surface is covered

with water.

- out of the total estimated 1,011 million km^3 of water present on earth only 33,400 m^3 of water is available for drinking, agriculture, domestic & industrial use.
- Rest water is locked up in ocean as salt water, polar ice caps and glaciers and underground.
- water is polluted by sewage, industrial waste and wide array of synthetic chemicals.
- water suitable for drinking is called potable water.

Characteristics of potable water:

1. It should be colourless, odourless and tasteless.
2. It should be free from turbidity and other suspended impurities.
3. It should be free from germs, bacteria, and other pathogenic organisms.
4. It should not contain toxic dissolved impurities such as heavy metals, pesticides etc.
5. It should have a pH range from 7 to 8.5.
6. It should be moderately soft, having hardness preferably in the range 50 to 100 PPm. It's hardness should not be above 150 PPm.
7. It should be aesthetically pleasant.

8. It should not be corrosive to the pipelines and should not cause any incrustations in the pipes.
9. It should not stain clothes while washing.

Water Pollutants and their sources:

Various types of water pollutants are —

1. organic pollutants:

a) oxygen demanding waste: These includes domestic and animal sewage, biodegradable organic compounds and industrial wastes from food processing plants, meat packing plants, slaughter houses, paper and pulp mills, tanneries etc and as agricultural run-off.

— wastes are decomposed by bacterias in presence of dissolved oxygen (D.O.), so D.O. level rapidly decreased.

— The optimum of D.O. in natural water is 1-6 PPM., which is essential to supports aquatic life.

— Any decrease in this D.O. value is an index of pollution.

b) Disease causing wastes: These includes pathogenic microorganisms which may enter waters alongwith sewage and other wastes.

— The microbes comprises mainly bacteria and virus.

— waterborne diseases like cholera, typhoid

dysentery, polio and infectious hepatitis are cause to human beings.

(c) Synthetic organic compounds:

- These are manmade materials like Synthetic pesticides, Synthetic detergents food additives, pharmaceuticals, insecticides, paints, synthetic fibres, elastomers solvents, plasticizers plastics and other industrial chemicals.
- All these are potentially toxic to animals and plants, also to humans.

(d) Sewage and agricultural runoff:

Sewage and runoff from agricultural lands supply plant nutrients, which may stimulate the growth of algae and other aquatic weeds in the receiving water body. This unwieldy plant growth results in the degradation of the value of water body, intended for recreational and other uses.

(e) Oil: Oil pollution takes place when oil spills from cargo oil tankers on the seas. losses during offshore exploration and production of oil, accidental fires on ships and oil tankers, accidental or intentional oil leaks, leakage from oil pipelines crossing waterways and reservoirs.

- Oil pollution reduces light transmission.

through surface water, thereby reducing photosynthesis by marine plants.

2. Inorganic pollutants:

- Inorganic pollutants comprise of mineral acids, trace elements, cyanides, sulphates, nitrates, organometallic compounds etc.
- Metal organic interactions involve natural organic species, such as fulvic acids and synthetic organic species as EDTA.
- Heavy metals like Hg, Cd, Pb and metaloids such as As, Sb, Se are most toxic.
- Water pollution by heavy metals occurs mostly due to street dust, domestic sewage and industrial effluents.
- Polyphosphates from detergent are also water pollutants.

(3) Suspended solid and sediments:

- Sediments are mostly contributed by soil erosion by natural processes, agricultural developements, strip mining and construction activities.
- Suspended solids in water mainly comprises of silt, sand and minerals eroded from the land.

(4) Radioactive materials: Radio active water pollutants originates in the following ways -

a) mining and processing of ores. i.e, uranium - in tailing.

(18) b) Increased use of radioactive isotopes in research, agricultural, industrial and medical (diagnostic and therauptic) applications. i.e, I^{131}, P^{32}, Co^{60}, Ca^{45}, S^{35}, C^{14}, Rb^{86}, Ir^{132}, Cs^{137}

(c) Radioactive materials from nuclear power plants and nuclear reactors e.g, Sr^{90}, Cs^{137}, Pu^{248}

(d) Radioactive materials from testing and use of nuclear weaponary.

(5) Heat: Thermal pollution is produced from e.g thermal power plants particularly the nuclear power based electricity generating plants.

— Using hot water as coolant and returning the waste hot water back to the water body increases the water temperature and decreses the DO content of water, thus affecting aquatic life

Effects of water pollutants:

1. Tannery effluents contain a large no. of water pollutants when discharged to sea, river, stream, land etc produces pungent odour.
2. Acidic or Alkaline effluents are corrosive to concrete and metal pipes.
3. Excess Hacl in effluents are also corrosive and make water unsuitable for irrigation
4. Pathogenic bacterias also present in effluents.
5. Dissolved chromium present in the effluents is toxic to fish and other aquatic life.

6. Suspended solids like hair, flesh, $CaCO_3$ etc, interfere with aeration and photo-synthesis activities of aquatic flora.
7. presence of excessive salt and Cr in the wastewater deteriorate the quality of ground water in affected areas.
8. Volatile substances such as alcohols, aldehydes ethers and gasoline may cause explosion in sewers.
9. Suspended solids such as silt and coal may injure the gills of the fish and cause asphyxiation.
10. Radioactive isotopes are toxic to life forms. for example, Sr^{90} which emanates from testing of nuclear weapons accumulates in bone & teeth and causes serious disorder in humanbeings. (maximum permissible level of Sr^{90} in water is 10 pico curies per liter)

Control of water pollution:

Various pollution control measures are —

1. Scientific techniques to be adopted for the environmental control of catchement areas of rivers, lakes, ponds & streams.
2. Industries should adopt recycling operations.
3. Instead of throwing solid wastes to water bodies, they can be used for Gobar gas plant, composting, manufacture of hard board, paper etc.
4. Minimum and appropriate quantity of fertilizers pesticides and insecticides ~~as~~ may be used for agriculture purpose, as excess causes pollution.

5. Public awareness must be created for controlling water pollution in electronic mass media.
6. Treatment plants be setup by Govt. and also by private persons.
7. Water resources should be used in proper economic and genuine ways.
8. Water pollution control and management may be introduced in study syllabus.
9. All must come forword for conservation of forests and planting more trees.
10. Water pollutants may be removed by using advanced technologies like adsorption electrodialysis, ion exchange, reverse osmosis etc.

(c) Soil pollution:

Soil is a very important constituent of lithosphere. Soil is derived from the latin word 'Solum' which means earthy material in which plants grow.

- Soil may be defined as the weathered layer of earth's crust with living organisms and their products of decay.
- It is a complex physiobiological system containing water, mineral salts, nutrients and dissolved oxygen (DO).

Importance of soil to Biosphere:

Soil plays a vital role in determining the quality and composition of biosphere which develops over it. Functions of soil are-

(21) 1. Soil provides mechanical support to plants.
2. Soil has water holding capacity because of its porosity, it supplies water to plants through their roots even when soil surface is dry.
3. Soil have ion exchange capacity, so it supplies micro and macro nutrients to the plants and also prevents excess leaching of nutrient ions thus maintaining pH.
4. The colloidal components of soil consisting of clay micelle and humus particles, absorb nutrient ions and supply it to plants.
5. Soil contains organotrophic bacteria, nytrifying bacteria, nitrogen fixing bacteria. Fungi, protozoans and other microbes which help in decomposition and mineralization of organic matter and regeneration of nutrients.

Major soil types in India:

Type of soil	availability
1. Alluvial soil	occur in the great northern plains of India and deltas of rivers in penisular India.
a. Khadar	very fine and new aluviam, very fertile
b. Bhangar	Relatively coarse and old alluvium relatively less fertile.
2. Mountain or hill soil & forest soil	Rich in organic mater (humus) occur in eastern & western ghats in

- central gndia and northern hilly regions of Himalayas.

3. Black soil - originate from volcanic ~~&~~ rocks. Highly fertile clay soil, occur in parts of MP. Tamilnadu, Gujarat and Decan trap region of Maharastra.

4. Red soils - Relatively less fertile, Deficient in organic and nitrogenous matter. occur in plateau of Kesla, Karnatak, AP, Tamil nadu, Odisha and Southern parts of Bihar

5. Lateritic soil - These are poorly fertile ~~and~~ but can support pastures and scrubb forests occur in tropically rainy climate of western ghats, chhotnagpur plateau Assam, Odisha, AP, Tamilnadu and Kesla.

6. Desert soils - These are acid sandy soils with low moisture and low humus content. It occur mostly on Rann of Cutch, Southern Panjab, Western Rajasthan and Haryana.

Plants as pollution indicators:

Some plant species have been used as pollution indicator for soil, air and water —

1. Plant species like chara utricularia and wolffia were found to grow well in polluted water.
2. Species like agrotis, festuca, anthoxanthum and impatiens are used as metallic tollerance plant indicators for Cu, Pb, Zn and Cd respectively

3. presence of diatoms indicate sewage pollution.
4. Escherichia coli bacteria indicate water pollution.
5. Leaf cabbage indicate accumulation of polycyclic hydrocarbons in the soil.
6. Growth of lichens was found to decrease when the soil is polluted.
7. Soil pollution inhibits plant growth and reduce productivity.

Sources of soil pollution:

Soil pollutants remain in direct contact with soil for a longer period and hence can alter the chemical and biological properties of soil. The hazardous chemicals can also enter human food chain from soil or from plants.

- Major sources of metallic contamination of soil includes mining, smelting, sludge, fertilizers, pesticides, composted town refuse etc. Metals such as Cd, Pb, Hg, Ni, Mo, Cr. etc are toxic to plant and animal life.
- Dumping of industrial waste and municipal wastes leads to leaching and/or seepage of toxic substances into the soil and pollution of ground water.
- Flyash generated from thermal power plants industrial waste dumped on land or discharged

to streams produces soil pollution.
- flue gas desulphurisation sludge, heavy metal sludge sets etc causes water and soil pollution.
- commercial and domestic urban waste like plastics, metal cans, glasses, street sweepings, waster paper, fiber, rubber etc contribute to soil pollution.

Effects of soil pollutants:

Major effects of various types of pollutants are-

a) Effect of modern agricultural practices

Synthetic fertilizers - These are used to increase soil fertility and crop productivity. Excessive and indiscriminate use of synthetic chemical fertilizers may lead to -
- crops grown on soils fertilized with NPK fertilizers may result in considerable reduction in protein content of crop.
- Excessive use of nitrogenous fertilizers leads to accumulation of nitrates in the soil which may contaminate the ground water.
- vegetation grown in nitrates reach soil may exert toxic effects on cattle.
- Excessive use of chemical fertilizers may reduce nitrogen fixation ability of plants.

(25) - excessive use of chemical fertilizers may enter the waterbodies nearby thus leads to 'eutrophication' (growth of algae and other aquatic plants to undesirable level).

- fruits and vegetables grown on potassium fertilized soils may have reduced amount of ascorbic acid (vitamin C) and carotene.

Pesticides:

- As per the report of WHO, about 50,000 people in developing countries are poisoned and about 5000 people die because of improper use of pesticides and other chemicals in modern agricultural practices.

Commonly used pesticides are —

a) chlorinated hydrocarbons (eg. DDT, Aldrin, Dieldrin, Lindane, BHC etc)

b) Carbonate compounds (eg. Carbaryl or Sevin, Zectron etc)

c) organo phosphorus compounds (eg. methyl & ethyl parathion, malathion, guthion etc)

d) Inorganic compounds (eg. As_2O_3, PbO_2, $HgCl_2$, $CuSO_4$ etc)

e) Miscellaneous compounds (eg. organic mercurials, 2·4D, 2·4, 5T etc)

adverse effects of pesticides are —

1. some arsenic pesticides may render the soil permanently infertile.

2. Pesticide residues on soil may be taken up by plants and cause phytotoxicity. They may enter the aquatic environment and enter the food chain.
3. Fruit vegetables, rice, wheat, barley, maize, etc, are known to contain considerable quantity of toxic pesticide residue such as DDT, BHC and other organochloro pesticides.
4. Irrigated water form pesticide contaminated soils may evaporate and spread the toxic pesticide vapours on the atmosphere
5. DDT can enter the food chain and accumulate in human fats and may lead to disorders such as impotency.
6. Herbicides such as dioxan may cause congential birth defects in offsprings.
7. Hunting birds feeding on grains contaminated with DDT are threatened of extinction.
8. Organophosphate pesticides may cause muscular disabilities, tremors and dizziness.
9. Farm animals drinking stagnant water in fields sprayed by pesticides developed toxic symptoms and may cause mortality.
10. Accidental spillage and leakage in pesticide manufacturing industries cause disastrous effects on the people residing in nearby areas due to pollution of water, air and soil. The Bhopal gas tragedy on 3rd

December 1984 is the lingering example.

11. Volatile pestricides may cause air pollution in the surrounding areas.

(b) Effects of industrial effluents:

Solid, liquid and gaseous chemicals from various industries as such paper and pulp, iron and steel, fertilizers, dyes, automobiles pestricides, tanneries, coal based thermal power plant etc contain a variety of pollutants such as toxic heavy metals, solvents, detergents, plastics, suspended particulates, and refractory / non-biodegradable / recalcitrant chemicals.

- If they are not properly treated at source they give rise to water, air and soil pollution
- Indescriminate dumping of untreated or inadequately treated domestic, mining and industrial wastes on land is an important source of soil pollution.

(c) Effects of urban waste:

- Million tonnes of urban waste are produced every year from critically polluted cities.
- The untreated or inadequately treated sewage sludge not only pose serious health hazards but also pollute soil and decrease its fertility and productivity.
- Other waste materials such as rubbish, used plastic bags, garbage, sludge, dead

animals, waste medicines, hospital and clinical waste, skins, tyres, shoes, cans, etc also cause land and soil pollution.

- Radioactive wastes dumped in the soil from natural and man made sources, soil erosion due to deforestation, unplanned irrigation and unscientific agricultural practices are also result in land and soil pollution.

Controll of soil pollution:

Various approaches to control soil pollution are—

1. Implementing stringent and proactive pollution control programmes.
2. Launching extensive afforestation and community forestry programmes.
3. Implementing deterrent measures against deforestation.
4. Formulation of stringent pollution control legislation and effective implementation with powerful administrative machinery.
5. Banning the use of highly toxic and resistant synthetic chemical pesticides or atleast regulating/restricting their use only for special purposes under thorough monitoring
6. Encouraging the use of biopesticides in place of toxic chemical pesticides.
7. Effective treatement of domestic sewage by suitable biological and chemical methods and adopting modern methods of sludge disposal.

(29) 8. Security land fills have to be constructed for permanent disposal of hazardous and recalcitrant industrial wastes.

9. Enforcing environmental audit for industries and promoting ecolabelled products.

10. Transforming intensive agriculture into a sustainable system by measures such as-

a) maintaining a healthy soil community microbes to regenerate soil fertility by providing organic manures, crop rotation, fallow periods avoiding excessive use of chemical fertilisers and pesticides.

b) Infusing biodiversity in agriculture by sowing mixed crops, crop rotation etc.

(d) Marine Pollution:

- Seas and unlimited source of water for human being and also main source of food and earnings for people living in coastal areas.
- When seas get polluted it affects the animals living inside it and also other food chain components.
- Generaly drainage from rivers, industries human activities form coastline areas. disposal of radioactive materials and toxic wastes, leakage form ships are

(20) main sources of marine pollution.

Sources of marine pollution:

1. Rivers carry wastes like sewage sludge, industrial effluents, detergents, agrochemicals, ~~and~~ plastics, scraps, etc in their drainage into seas.
2. Industries, big cities on the coastal lines produces large quantities of waste into seas.
3. When ships carrying toxic substances lubricating oils, paints & heavy materials suffers from accidents or natural calamities large quantity of waste get introduced into seas.
4. Testing of atomic weapons, space aircrafts, missiles and radioactive substances inside sea water and dumping of their wastes produces marine pollution.
5. Oil drilling in seas, tourism and recreation activities also pollute marine water.

Effects of Marine pollution:

major effects of marine pollution are-

1. Oils leaking from ships threats marine life specialy fishes, birds, invertebrates and algae.

(31)

2. & oil spillage affects sensitive flora and fauna, phytoplankton, zooplankton and other animals. In Alaska, Brittany (France), Elbe (Germany) thousands of birds died by oil spillage.
3. Sea animals takes plastic pieces through their food which harms them and others in their food chain.
4. Detergents from cleaning up water or other industries etc causes marine mortality.
5. Heavy metals (like lead and mercury) factory materials, mineral oils, acids and other biocides are also pose major threat to marine life.

Controll of marine pollution:

Steps already in operation:

1. Port authorities have introduced antipollutant measures by creating pollution cell. Coast guards are vigillant in this respect.
2. Research organisations, NGOs are working in the field of controlling marine pollution
3. Authorities are taking care of controlling and restricting oil spillage to marine water.
4. Urban and coastline corporations are trying to check the dumping of toxic wastes into marine water and taking ~~for~~ solid waste mangement techniques.

(22) 5. Govt. authorities are becoming strict in implementing laws and procedures for controlling marine pollution.

Suggested steps to control marine pollution:

1. Drainage, sewage sludge and effluents from industries should not be discharged into rivers joining the seas.
2. Developmental activities on coastal areas should be minimized.
3. Toxic pollutants from industries and treatment plants should not be discharged into sea.
4. Ships and ports should have certain facilities and techniques to reduce pollution.
5. Nuclear explosions and other such activities should be restricted or minimised to take up in seas.
6. Awareness must be created among people to produce less waste which ultimately goes to seas.
7. Oil drilling and other explorations must follow non-polluting scientific methods.
8. Direct dumping of municipal, medical, waste and also nuclear radioactive waste into sea must be banned.

(32)

(e) Noise Pollution

- Noise is the unwanted sound in a wrong time and wrong place.
- Sound is a form of energy and transmitted in the form of wave motion in air and have all characteristics of wave motion.
- Sound has several physical properties, the main two properties are- 'intensity' and frequency.
- Intensity is the measure of 'loudness' or strength and frequency is the major of the rate at which the compression wave arrive at or passes a fixed point.
- Intensity has the unit of decibel and frequency has the unit of Hertz or cycles per second.
- decibel is derived from two words - 'deci' means 'ten' and 'bel' means logarithm of the ratio.
- So, decibel is defined as the intensity of sound equal to 10 times logarithm of ratio of 'sound to be measured' to a 'reference sound intensity'.

$$\text{Decibel (dB)} = 10 \log \frac{\text{Sound intensity measured}}{\text{Reference sound intensity}}$$

- Human being (other animals also) have provided with the natural sense organ 'ear' which

(3) perceives sound.

- Sound in the frequency range of 20Hz to 20 KHz is the audible ~~frequency (All~~ sound. So 20Hz to 20KHz is the audible (or audio) frequency (AF) range.
- In USA, reference sound intensity is 10^{-12} watts per square meter (W/m^2) which is taken to be zero decibel (0dB), which is barely audible to human being.
- Some sources of sound have dB intensity as — alarm clock - 80dB, running a motor bike - 118dB; Jet plane take off - 150dB and launching of space rocket - 170dB.
- Similarly psychological and physical effects of some sounds are as follows —

65dB - intrusive.
80dB - annoying
88dB - Hearing impairment on prolonged exposure
110dB - discomfort.
135 dB - painful.

Effects of Noise:

a) physiological Effect:

- Sound in the intensity of 70dB can produce measurable physiological effects.
- Sound in the range of 120 - 150dB effects on respiratory system, dizzi-

ness, disorientation, loss of physical control
- At noise level of 150 dB, permanent hearing impairement may be caused.
- Still loud sounds increase secreting of adrinocortiotropic hormone (ACTH), which stimulate the adrenal gland, producing several other hormones, which may cause - increasing blood sugar level, weakening the immune system, decreasing detoxification capacity of lever.

(b) Psychological effects:

- At high noise levels, loss of concentration, mental disorientation may be caused.
- Noise also reduces working capability, work efficiency, increases error in work procedure etc.
- Noise interfere with sleep and so produces mental disabilities and disturbance

(c) Hearing loss:

- prolonged exposure to loud noise may cause problems like Temporary Threshold Shift (TTS), if exposure continues for longer time, it may cause permanent hearing loss.

(36) — Very loud, sudden and impulsive noise like bomb blast may cause acute damage to auditory system and an abrupt loss of hearing.

(d) Other health effects of noise pollution:

— Noise affects cardiovascular system also. Decreasing the amount of blood pumpout from heart, arterial blood pressure decreases,

— Heart bit rate is affected. Noise also affects the breething amplitude

— Noise pollution also causes, Eosinophilia, hyperglycaemia, hypokalaemia, hypoglycaemia etc.

Prevention and control of Noise pollution:

Some of the measures for prevention and control of noise pollution are —

1. Reduction of noise at source:

— Replacing noisy and rattling devices and machines and at least replacing noisy and rattling parts of the machines may reduce noise at source.

2. Application of sound proofing techniques:

— perforated sheets and other sound

absorbing materials may be used to absorb sound.

- Sound proofing and acustic techniques are also used for reducing noise.

3. Keeping residential localities free of noisy industries, busy highways, aerodromes etc.

- Aerodroms, busy highways and noisy industries should be far away and isolated from residential localities.

- Busy railway tracks and sound producing machineries should be kept away from residential areas.

4. Enactment of strict legislation and its effective compliance:

- Rules and regulations are framed against noise producing industries, bodies etc. but strict implementation of these laws are to be followed strictly.

5. Noise control methods in industries:

Various types of machines, petrol and diesel engines, electric motors, construction site equipements, pumps and pumping systems, compressed air systems, hydraulic systems, industrial fans etc produces noise.

(22) - Effective noise control measures should be taken during installation of these machines rather than affecting them latter.

Approaches for Noise control:

4 approaches are available for noise control -

1. Modifying some of the parts and procedures in order to minimize noise.
2. Shielding the sources of noise generation.
3. Shielding the noise receiver.
4. Shifting noise sources and things away from people.

(f) Thermal Pollution:

Thermal pollution can be defined as -

- Warming up of an aquatic system affecting the organisms.
- Addition of excess heat that affects the normal life and living of man, animal, plant

taken during installation of these measures rather than attenuating them later.

Approaches for Noise control:

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(f) Thermal Pollution:

Thermal pollution can be defined as—

- Warming up of an aquatic system affecting the organisms.
- Addition of excess heat that affects the normal life and living of man, animal, plant or aquatic life.
- Heated effluents from natural or man made sources contaminated with water supplies.
- Thermal pollution destroys aquatic life in stream eco-system.

(3) - Thermal pollution is a byproduct of rapid and unplanned industrial progress and over population.

Sources of Thermal pollution:

Followings are the sources of thermal pollution-

1. Nuclear power plants:
Wastes from nuclear power plants, emissions from nuclear reactors and processing instruments, in the form of heated effluents are discharged to water bodies, which produces thermal pollution.

2. Coal fired power plants:
Thermal power plants using coal as fuel, uses water from nearby water bodies and discharge the hot waste water back to the source which produces thermal pollution.

3. Industrial effluents:
Textile industries, paper and pulp industries nuclear and thermal power plants produces large volume of heated effluents discharged to nearest water bodies causing thermal pollution.

4. Hydroelectric power: Due to negative heading in hydroelectric power stations, the water body get heated which produces thermal pollution.

5. Domestic sewage: Domestic sewage is usualy discharged into rivers, lakes, streams, may be without any treatment. It increases the temperature of the water and also decreases the amount of Dissolved Oxygen (DO) from water, which

produces serious threat to water animals, plants and other living organism.

Effects Of Thermal pollution:

1. Reduction in Dissolved oxygen: concentration of dissolved oxygen decreases with increase in temperature. for example:, DO content decreases from 14.6 PPM at a temperature of 32°f to 6.6 ppm at a temperature of 64°F.
2. change in water properties: Rise in temperature changes the physical and chemical properties of water. Vapour pressure increases while viscocity of water decreases. The decrese in density, visousity and solubility of gases increses the settling speed of suspended particles, which seriously affected the food supply of aquatic organism.
3. Increse in Toxicity: Rise in temperature increases the toxicity of poison present in water. A 10°c rise in temperature doubles the toxic effect of pottasium cyanide, while an 80°c rise in temperature tripples the toxic effect of O-xylene causing massive mortality to fish and other aquatic animals.

4. Interference with Biological activities: Temperature is considered to be of vital importance to physiology, metabolism, and biochemical processes in controlling respiration rates, digestion, excretion and overall development of aquatic organism.

5. Interference with reproduction:
on fishes and other similar creatures activities like nest building, spawning, hatching migration and reproduction etc. depends upon some optimum temperature.

6. Variations in Reproductive Rate:
increase in temperature triggers deposition of eggs by female. Triggering is dramatic in estuarian fish, which spawns in four hours after the water temperature reaches critical level.

7. Changes in Metabolic Rate: Fishes show a marked rise in basal rate of metabolism with temperature to the lethal point.

8. Increased vulnerability to disease:
Activities of pathogenic microorganisms are accelerated by higher temperature.

9. Invasion to destructive organism:
Thermal pollutants may permit the invasion of organisms that are tolerant to warm water and highly destructive.

10. Undesirable changes in Algae Population:
Increase in algae population because of excess nutrients from washed waters from farmland thermal plants etc produces acceleration of eutrophic and other undesirable changes.

11. Destruction of organisms in cold water:
For, cooling purpose, when water is pumped

(12) from water bodies, many planktons, small fish and insect larvae are sucked and killed by thermal shock.

12. Biochemical oxygen demand: Due to increase in temperature of the waterbody the Biochemical Oxygen Demand (BOD), increases due to accelerated chemical or biochemical action.

13. Effect on marine life: Sea organisms are poikilothermic i.e, their body temperature varies with the surrounding water. Temperature affects their physiology, metabolism, growth and development.

14. Effect on Bacteria: Due to hot industrial effluents, bacteria are severely damaged, which effects coagulation of body protein, melting of cell fats, toxic action of metabolic products etc.

Control of Thermal pollutions:

Heat must be removed from condenser cooling water prior to their disposal to water body. Heat ~~must~~ b. can be lost in four ways — a) conduction b) convection c) radiation d) Evaporation.

Methods used to control high temperature caused by thermal discharges —

1. Cooling ponds: water from the condenser are stored in a earthen pond where

(B) natural evaporation brings down the temperature. The water can be recirculated again

2. Spray ponds: In spray ponds, water is sprayed in the cooling ponds with the help of spray nozzles to convert it into fine droplets which provides more surface area to facilitate efficient heat transfer to atmosphere

3. Cooling Towers: In wet cooling towers, hot water is brought in direct contact of continuously flowing air. The evaporation brings down the temperature.

4. Hot effluents discharged from industries may be used for certain beneficial purposes like green house, frost protecting during colds, aquaculture etc.

(g) Nuclear Hazards:

Nuclear hazard is the threat posed on living beings (plants and animals) by radioactive emissions emitted from nuclei of certain radioactive materials.

- Radiations ~~generate~~ originate from instability of the nuclei of an atom which loses subnuclear particles and energy to aquire a stable state
- Radioactive ~~elements~~ atoms having same

(14) charge of the nucleus and same mass are called isotopes. Radio isotopes are characterised by the properties like — a) Half life period b) mode of decays c) Energy of radiations and d) Definite energy state.

When a radioactive element transmutation or decays, following radiations takes place

1. Emission of alpha (α) particles:

Alpha (α) particles are nuclei of Helium. By emission of α particle, the element will change into another element of lower atomic number. Alpha particles get deflected by electric and magnetic fields and they are moving, strongly ionizing, weakly penetrating and stopped by 80 mm of air.

2. Emission of Beta (β) particles:

By emission of Beta particle, the element will change into another element with higher atomic number. Beta particles are high velocity electrons. These are strongly deflected by electric & magnetic field.

3. Emission of (γ) Gama rays: These are high energy electromagnetic radiations and can penetrate several cm of lead sheet depending upon the energy. These are undeflected in magnetic fields.

Radioactive decay is a spontaneous process arising from nuclear instability.

(15) Sources of Radio active Pollution:

1. Natural sources:

- main source of radio active pollution are cosmic radiations which are extra terrestrial, arising from sun or beyond that.
- cosmic rays are particles of very high energy, primarily protons and some heavy nuclei. These nuclei collide with gas molecules producing intense ionization and produces secondary cosmic rays which consists of neutrons, mesons and gamma rays.
- Thus a complex mixture of particles reaches earth surface which consists of $_1H^3$ and $_6C^{14}$ isotopes in atmosphere.
- Another natural source of radioactive pollution is radionuclides. Naturally occuring radionuclides on earth are Uranium, Thorium and Potassium-40. Soil, rock and some other building materials contain small quantities of $_{19}K^{40}$ and uranium and its daughter elements.

2. Manmade sources:

a) Nuclear weapons: Testing of nuclear arms comprises — i) the use of Uranium-235 and plutonium-239 for fission and ii) hydrogen or lithium as fusion material

Atomic explosions are uncontrolled chain reactions

They give rise to very large neutron flux condition that cause other material in the surrounding to become radioactive.

2. Atomic Reactors and nuclear fuel:

Common fuel used for fission in nuclear power plants are Uranium, Thorium and plutonium - Starting from mining upto burning out in reactor, these fuel undergo several processes and the whole time is called nuclear fuel cycle.

In all stages of nuclear fuel cycle gaseous, liquid and solid radioactive wastes are leaked to environment which poses serious threat to life.

3. Radioactive isotopes:

Radioactive isotopes like ^{125}I, ^{14}C and ^{32}P and their compounds are widely used in research laboratories. Their wastes mixed with water are discharged to water body and causes water pollution. It may enter to bodies of fishes as food and then to human beings.

4. Other sources:

During medical treatments, X-rays used for detecting skeletal and dental disorders and radioactive (cemo) therapy for cancer treatment also produces nuclear hazards in human body.

(17) Damages to Biological Systems:

on two main ways (modes) radioactive pollution can be dangerous to a biological system.

1. Damages caused by radiations from outdoor source
2. Damages caused by radiations from sources inside the body.

Damages caused by radiations at diff. level.

a) Damages at molecular levels – Damages to macromolecules such as enzymes, DNA, RNA etc through ionization cross-linkages within and between two affected molecules.

b) Damages at sub-cellular level – Damages to cell membranes ~~enzymes~~ nuclei, chromosomes such as fragmentation, mitochondria etc.

c) Damages at cellular level – inhibition of cell division death, delay and transformation to malignant state.

d) Damages to tissues and organs – Disruption of such systems as central nervous system, loss of sight, inactivation of bonemarrow activity resulting in blood cancer malignancy and ulceration of intestinal tract.

e) Damages to an individual and whole Population

- Death or shortening of life due to radiations changes in characteristics due to mutations.
- Effects of radiations are little at early stage but after 12-24 hours symptoms like reddening of skin, anemia, anorexia, vomiting and diarrhoea may be seen.
- With heavy doses of radiation, blister formation, pigmentation of skin, burning sensation all over the body, loss of sight etc. may be produced.

Hazards associated with radioactive pollution:

- Radioactive pollutants can never be converted to harmless material like other pollutants.

Major hazards associated with radioactive pollution are—

1. As the unstable nuclei have to decay till ~~the~~ acquire a stable state, no physical, chemical or biological process can stop or influence ~~bio~~ radioactive emissions.
2. Some radioactive isotopes have very long half life period — e.g.,
   - Thorium-232 ($_{90}Th^{232}$) takes 14,0000, 00000 years to lose half of its radioactivity.

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(49) - Uranium-235 ($_{92}U^{235}$) takes 710,000 years to disintegrate to half.
- Neptunium-237 ($_{93}Np^{237}$) decays to half in 21,00,000 years.

3. Radioactive radiations have high penetrating powers. They can penetrate through thick steel sheet, RCC walls etc.
4. Nucleic acids (DNA & RNA) absorbs these radioactive emissions and which causes carcinogenic, mutagenic and teratogenic effects.
5. As there is no visible difference between normal isotopes and radioactive isotopes - they are absorbed by body in any way.
6. Radioactive isotopes absorbed at lower level of food chain get highly biologically magnified and enters as a concentrated source at higher tropic levels.
7. The only way to dispose of the hazardous radioactive waste is to keep them away (buried underearth) for millions of years, which is very difficult and sometime may ruptured to leakage.
8. Harmful effect of radiation is that it destroys organic molecules of human body cells. The damage depends upon the energy and type of radiation.

(50)

- Energy of radiations is expressed in Rads (1 Rad is the absorption of 100 ergs or 10^8 joules of energy per gram of tissue).
- Total biological effect of radiation is expressed in Rems.

Number of Rems = n x number of Rads

where n = 1, for β and γ and X-rays
= 10, for α radiations or high energy neutrons.

Control of Radioactive Pollution:

- Natural radioactive pollution is impossible to control. only artificial radioactive pollution can be controlled.

* following measures may be taken for control—

- low level wastes ~~with~~ can be treated to separate the radioactive materials before their disposal to environments.
- High level wastes which can be not be treated for separation of radioactive materials, are required to be contained and stored out of the rich of human environment.
- in any way, radioactive materials are to be contained and kept away from exposure to environment.

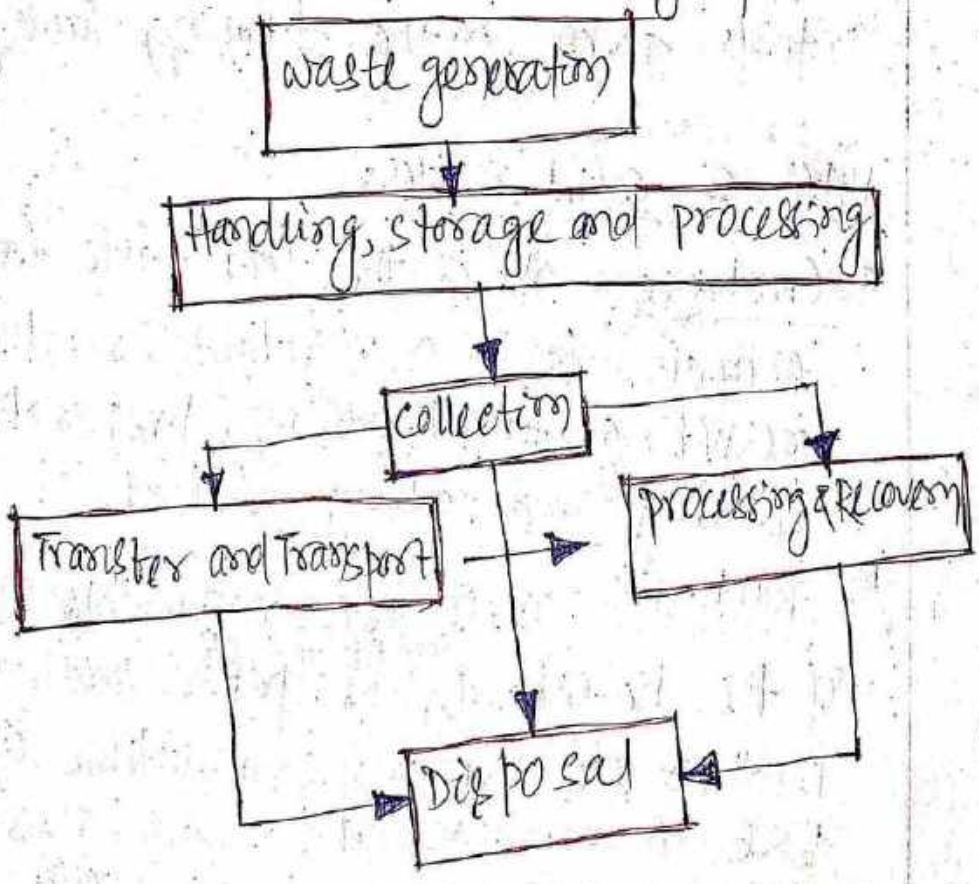
(8) Solid waste Management:

Solid waste is the solid material thrown away or discarded as useless.

Study of solid waste consists of -

- Identify the various types of solid waste and their sources.
- Examine the composition of wastes
- Consider the elements involved in their management.

Activities involved in solid waste management starting from point of generation upto final disposal can be grouped as follows -



- Total quantity of solid waste generated in an area depends upon its population

(2) & and urbanization.

- Solid waste generation is also directly related to income. Higher the income, greater is waste generation.

Sources of solid waste:

Sources of solid wastes can be classified into following categories.

1. Residential
2. commercial
3. Municipal
4. Industrial
5. Open areas
6. Treatment plants.
7. Agricultural
8. Hazardous wastes
9. construction cites.

Details given in the following table 5.6 Pg-56.

Types of solid wastes:

a) Garbage: It is the food waste from animals, fruits or vegetable residues resulting from handling, preparation, cooking and eating of food.

b) Rubbish: These are combustible solid waste of the household, institutions etc like papers, cardboard, leathers etc and non combustible items like aluminium and tin cans, glass pieces etc.

c) Ashes & Residues: These are waste materials remaining from the burning of wood, coal, coke and other combustible materials.

(13)

c) Construction and Demolition wastes:
Wastes from construction and demolition of residential, commercial buildings, roads, bridges etc.

d) Special wastes: Street sweepings, road side litter, catch basin debris, dead animals and abandoned vehicles are classified as special wastes.

e) Agricultural wastes: Wastes and residues resulting from diverse agricultural activities i.e, planting and harvesting of row, field, tree and vine crops, farm wastes from feeding, milking, animal slaughter, etc

f) Hazardous wastes: These are chemical, biological, flamables, explosives, and radioactive wastes which are harmful to animals, plants and human.

Collection of solid wastes:

- Collection of solid waste is very complex in urban areas as waste generated in every home, apartment, commercial, official and industrial establishments, also in parks, streets, vacant areas of the community.
- Transportation of collected waste to the dumping yard or treatment plant also needs labour and fuel cost.

(5)

Effects of solid wastes:

- Accumulation of waste, attract virus, fungi, bacteria and worms which decompose the waste and pollute the surroundings
- Germs develope on waste and reach human beings through air, water and food and cause infections diseases like cholera, diarrhoea, dehydration etc.
- Harmful fumes from industries, asbestos dust, from asbestos industry, heavy metal particles cause serious disease in human.
- Dumping of huge waste chokes drainage system and may cause flood like situation in rainy season.
- Waste decomposition may go underground and affect/pollute ground water and soil.
- Improper disposal/dumping/treatment of waste causes severe pollution and health hazards.

Management of solid waste:

1. Methods of solid waste disposal:

a) physical removal: It involves manual activities like collection of waste and segregation to different groups like reusable, decomposible and non-decomposible form.

(b) Dumping: It is the transfer of solid waste to the place of disposal (dumping site)

(c) Compaction and Baling: Solid wastes are spread over place area and pressed by bulldozer. This is called compaction. These compacted layers are also rolled and poked. This is called baling. Now the waste is ready for dumping into landfill.

2. 3 R (Reduce, Reuse, Recycle) of solid waste

a) Reduce: It is the process of reducing waste at source. Household waste can be reduced by using reusable cotton bags for bringing commodities, using maximum part of food cooking materials.
- Similarly hazardous wastes from industries, laboratories, plants etc can be reduced at source.

b) Reuse of waste materials: Instead of using paper plates, cups, glass etc for taking food items, we can use metal utensils which can be reused after washing after each meal.
Similarly some wastes can be reused after proper treatment.

c) Recycling of waste materials:
Recycling of solid waste materials can be done in following ways—

(56)

i) Sewage treatment: It is done through following steps —

a) Sewage mixed with lime and sent through setting chambers, where sewage is neutralised and sediments are removed.

b) Neutralised sewage is passed through upflow Anaerobic Sludge Blanket (UASB), where decomposable materials get decomposed through bacterial activities in absence of oxygen. Then air and bacteria are mixed in aeration tanks.

c) Dissolved substances are removed by processes like chlorination, evaporation, absorption and exchange techniques.

ii) Pulverisation: The volume of solid waste is reduced through grinding or smashing for easy handling to transport and disposal.

iii) Composting: Composting is the process of making manure of decomposable wastes with the help of microbial activities. It is of two types — a) aerobic (in presence of air b) anaerobic (in absence of air). The biodegradable waste (solid or semisolid) are filled in different pits dug on ground and filled pits are covered with layer of soil.

water is added time to time. Average time of composting is 1 to 6 months.

3. Sanitary land filling: In sanitary land filling waste materials are filled up in low lands in scientific ways so that garbage and other wastes are in layers covered with clay or plastic foam, so that they will not creat any type of health hazard to public.

A. Thermal process: It is the process of burning solid waste under controlled conditions. In presence of air burning is called 'incineration' and in absence of air it is called 'pyrolysis'.

- incineration is not a healthy practice because of the followings —
  - It destroys the whole waste.
  - It creates toxic gas and ash.
  - Releases dioxins after burning of mixed wastes.

Role of an individual in prevention of pollution:

An individual can do the following safety measures to prevent pollution.

1. one should start first in the field of environmental awareness to protect the pollution.
2. We should go place to place to teach the

lessons of awareness and prepare volunteers.
3. Give the messages to save environments through newspapers, magazines, TV, radio.
4. To promote for plantation and conservation of forests.
5. To organise seminars, workshops, debates on the subjects related to pollution.
6. One should go in rural areas during festivals, functions, gatherings to convince people for prevention of pollution.
7. As awareness is effective in childhood, it must be taught and imbibe to children in schools.
8. World Forest day, World environmental day, Earth Day and other such functions should be organised in mass scale for awareness of common people both in Govt and private ~~sector~~ initiatives.
9. Population growth should be reduced.
10. We should use and promote mass transport system. for short distances walking on foot or bycycle can be used.
11. We should not use materials containing CFC.
12. We should discourage the use of more fertilizers, insectiricides, pestricides but encourage the use of bio-fertilizers.

(59) **Disaster management**: Disaster management includes the strategic operations starting from forecast of a disaster, precautions to be taken, management during the disaster period, relief and rehabilitation after the disaster is over.

- The disaster may be natural calamities like, flood, cyclone, earthquake, landslides etc or manmade disasters like war, violence, ~~robbes~~ or accidental disasters like ~~fire~~ epidemic, pandemic, fire, etc.

1. Floods:

- India is one of the highest flood prone countries of the world.
- Flood is a natural disaster which is caused by heavy to very heavy rains in a very short period, so that the water bodies swells and covers the residential areas.
- Flood may cause damage to crops, property by demolishing houses, roads, and other communication systems like electric & telephone connections etc.
- High flood may kill wild and domestic animals, even human population also.
- After flood epidemic like situations prevail

(6a) as the food and water get highly polluted

The type and degree of flooding is influenced by many factors. The principal factors can be classified to fall under three groups.

(1) - climatological.

(2) - hydrological and environmental conditions

(3) - local geomorphology of the flood plain.

In addition coastal flooding also depends upon the coastal configuration and tidal conditions.

Adverse effects of floods:

- human suffering and heavy toll of loss.
- Apart from casualties, injuries and disablement may caused.
- prevailing crop loss and submerged cropland may strewn with sand leading to loss of crop production and consequential disruption.
- Houses may damaged or completely destroyed
- private utilities, industrial establishments may get disturbed.
- public health get severely affected due to insanitization after removal of flood water and stacking of garbage and debris and even dead bodies of animals etc.

- Flood damage cause a comprehensive loss to the nations economy and prosperity.

preparedness:

Disaster preparedness could be defined as the detailed planning for the prompt and efficient response immediately as soon as the anticipated mishap materializes.

- The effort to be very comprehensive includes public education and awareness programme/campaign ahead, provisions for issuance of timely warnings, development of orderly evacuation plans, preparations for providing the evacuees with food, clothing, shelter on emergency basis.
- local residents could be provided with adequate advance training/rehearsal on mitigating suffering and losses.
- Small babies, aged old people, disease affected persons, pregnant ladies are to be taken special care during evacuation to safer places.
- Documents like certificates etc and land and other records are to be safely placed.
- Some common medicines and first aid arrange

ments are to be made.

- Dry foods / drinking water as much possible may be stored and taken with during evacuation.
- Torch lights, candles, match box, and other valuables are to be taken with.
- As other sources of communication may not be effective, Radio sets with batteries may be kept in readiness.

(2) Earthquake:

Earthquake may be defined as a natural phenomena which creates panic due to the trembling vibrations of sudden upheaval of a portion of earth's crust caused by splitting of a mass of rock, (Tectonic), or by volcanic or other disturbances.

- The exact spot underneath earth's surface at which earthquake originates is called 'focus'; while the point just vertically above ~~of~~ the focus on the surface is called 'epicentre'.
- The seismic shocks originating from a depth of 50 km or less is called 'shallow focus earthquake', otherwise it is 'deep

(2) focus earthquake:
- The energy released from the focus, get transmitted in all directions causing earthquake
- Power (energy) of an earthquake is defined in terms of its magnitude which is measured on an open ended Richter scale from 1 to 9.

* General characteristics:
- It is not yet possible to predict magnitude, time and place of occurance of earthquake.
- The onset is usualy sudden.
- Earthquake prone areas are well defined geologicaly and due to past occurance of earthquake.
- Major effect arises due to ~~spillage~~ slippage of rocks (Tectonic plates) underground.
- On an average about 18000 people die each year worldwide of this disaster.
- About 200 large magnitude ($M > 6.0$) earthquake occur in a decade.
- World's earthquake problem seems to be increasing with the increased population, high rise buildings and crowded cities.

* - The primary waves (P waves) of velocity of several kilometers per second are transmitted due to longitudinal vibrations and create horizontal push and pull movements on earth's

(64) surface and the secondary (S-waves) waves (also called surface or slow waves) creates up and down movements on earth's surface.

Precursors: instrumental & non-instrumental

Though it is not possible to predict earthquake, there are some indications (instrumental & non instrumental) which forecasts the occurance of earthquake. These are called precursors.

Instrumental precursors: (measured by instrument)

a) change in velocities of P & S waves.
b) Fore shocks and after shocks.
c) statistical pattern of shocks.
d) uplift or subsidence of ground.
e) changes in gravity.
f) Faults, displacements in earth.
g) changes in electrical resistance of rocks.
h) Tilt and strain in underground rock formation.
i) changes in earth's magnetic field.
j) Emission of Random Gas from the ground.
k) Unusual sounds from inside earth.

Non-instrumental precursors:

a) Sudden rise or fall of water level in wells

and lakes.
b) mud and sand shows up on surface water.
c) Changes in flows of natural springs
d) Increase in salinity of water.
e) Advance and retreat of seas.
f) unusual behaviour of animals.

Vulnerability: Vulnerability of disasters like earthquake can be indicated in terms of physical, social and economic vulnerabilities.

physical vulnerability: It relates to buildings, infrastructure and agriculture.

social vulnerability: The following category of people are particularly at risk-
- Single parent families, - children
- Elderly persons, - mentaly & phyzaly handicaped people, - women, particularly when pregnant or lactating.

Economic vulnerability: Economic vulnerability can be studies on the basis of
a) direct loss potential i.e, damage or destruction of physical and social infrastructure and its repair & replacement cost as well as crop damage and losses to the means of production.

(06) b) Indirect loss potential i.e, the impact on lost production, employment, vital services and income earning activities.

Impact and Effects

1. Injury, loss of life and loss of livelyhood.
2. Damage and destruction of property of subsistence and cash-crops.
3. Disruption of production and so lifestyle.
4. Disruption of essential services.
5. Damage to natural infrastructure and disruption of administrative and organizational systems
6. National economic loss.
7. Sociological and psychological after effects.

CYCLONE: cyclones are flow of extremely violent (sometimes turbulent) winds and very heavy rains causing floods and storm tides causing coastal inundation.

- In our countries cyclones and cyclonic storms are formed in Bay of Bengal or Arabian sea and heat the coastal area from both the sides.

characteristics:

- Tropical cyclones are large, rotating, atmospheric phenomena extending horizontaly from 150 to 1000 km and vertically from surface

(9) to 12-14 Km high.

Types of cyclone with & with speed can be given as-

category	wind speed
1. Low pressure area	< 30 Kmph.
2. Depression	30 to 55 Kmph.
3. Deep depression	55 to 65 Kmph
4. Cyclonic storm	66 to 90 Kmph
5. Severe cyclonic storm	90 to 115 Kmph.
6. Severe cyclonic Storm with core of hurricane wind	> 115 Kmph.

- A well developed cyclone consists of a central region of light winds called 'eye'. The eye has an average radius of 20 to 30 km. Eye is a practicaly cloud free zone surrounded by very strong winds.

Cyclone warnings:

Cyclone warnings are provided by the cyclone warning centres located at - Kolkata, Bhubaneswar Visakhapattanam, Chennai, Mumbai & Ahmedabad.

- warnings are issued through the following means -

1. Telegrams with highest priority 2) Telecast through DD
3. Broad cast through AIR 4. Bulletins to the press.
5. Broadcast through Department of Telecommunications, coastal radio stations for ships on the high seas, and coastal areas.
6. INSAT based disaster warning System.

(b) — cyclones are tracked with the help of INSAT, powerful cyclone detection radars and conventional meteorological observations including wether reports from ships.

— cyclone detecting radars are installed at i) Kolkata ii) paradeep iii) Visakhapattanam iv) Machhali pattanam v) chennai, vi) Karaikal on the east coast and vii) Goa viii) cochin ix) Mumbai and x) Bhuj along the west coast.

— cyclone warnings are provided in two stages — a) 'cyclone alert' is issued 48 hours before the anticipated time of commencement of adverse weather and b) 'cyclone warning' is issued 24 hours before the cyclone's anticipated landfall.

preparedness:

— preparedness means measures which enable Govt. organisations, communities and individuals to respond rapidly and effectively to disaster situations.

— preparedness includes a detail plan of action and its effective execution.

— Safe storage of non-perishable food and other essential needs, adequate stock of drinking water and medicines have to be made.

Risk reduction process:

The following risk reduction processes may be adopted-

— Structural measures like construction of cyclone shelters, embankments, dykes, reservoirs and coastal afforestations are some long term risk

reduction measures

- Creation of proper awareness, training and education of people in the vulnerable communities, introduction of insurance, can be some of the nonstructural measures.

Effects:

principal dangers from a cyclone are — i) very strong wind ii) torrential rain iii) high storm tides.

- Heavy rainfalls and flood comes next.
- collapse of buildings, falling of trees, flying debris, electrocutions, air craft accidents etc.
- disease from contaminated food and water.
- loss of life and property.

LAND SLIDES:

- Land slides are caused mainly in rainy seasons in hilly regions where the stock of ice increases the mass of rain water disturbs a part of the hillside to fall down in the form of Land slide.
- In ice covered regions of Himalayas, avalanches can also cause land slides.

Areas Stricken frequency and intensity:

Areas prone to Land slide includes — Eastern and Western Ghats, The Nilgiris, Vindhachal mountains in the northeastern states, and the great Himalayan ranges.

- In these regions, landfall occurs during or after heavy rainfall.

after heavy rainfall.

Types of landslides:

- Sometimes landslides are combination of rockslide and rockfall. and involve movement of mass.

- Landslides can be of the following 5 types-
  i) Slump with earthflow ii) Debris slide
  iii) Debris fall iv) Rock slide.
  v) Rockfall.

Relief and Rehabilitation:

Relief steps comprise the following -

1. Search and rescue.
2. Medical assistance to the injured.
3. Disposal of the dead
4. Food and water
5. Emergency shelter for the homeless.
6. Opening of access roads and restoration of communication channels.
7. Psychological counselling of the survivors who have lost their close relatives.
8. Repair of houses and facilities.
9. Assistance (technical & financial) to restore economic activity.
10. Reconstruction through long planning.

Long term measures in the direction of disaster mitigation can be as follows —

1. Reducing the hazard proneness of the unit through engineering measures such as strengthening

11) or modifying the slopes, removing fragile and unstable portions, securing snow accumulations by snow fences, snow nets, or by cribbing and improvement of drainage.

2. Stopping indescriminate quarrying and mining in hilly areas.

3. Afforestation of zones prone to landslide so that trees and vegetation provides a binding force to prevent slippage of debris, rock and snow.

4. creation of voluntary, community based preparedness system of watch, monitoring and alert.

5. provision of assistance for economic rehabilitation by arranging work, employment loans & grants.

If landslide cause a locality completely ruined or not fit for reuse, then relocation and reconstruction can ~~take~~ be made in a suitably chosen location to minimize risk and vulnerability.

— x —

Unit VI

Social Issues & The Environment (1)

6.1. From unsustainable to sustainable developement :

- Natural resources available in the earth is to be availed equally to all its habitants irrespective of whether they are technologicaly, economicaly developed or not.
- But the developed nations are consuming most of the natural resources at the cost of our life supporting systems like air, water, soil and other resources. This is called unsustainable developement.
- Sustainable developement got its importance after Stockholm declaration in 1972 and in 1987, Brundtland defined sustainable developement as the developement that meets the needs of the present, without compromising the ability of the future generations to meet their own needs.
- In the Earth summit at Rio-de-janeiro in 1992, it is declared that to achieve sustainable developement, eradication of poverty and environmental protection must go simultaneously.
- There are two aspects of sustainable develo-

(2) pement -

i) intergenerational equity: It emphasizes on stoping over exploitation of resources, reduction in waste discharge and emissions and maintaining an ecological balance.

ii) intragenerational equity: This emphasizes that technological developement should support economic growth of the poor countries so as to reduce the wealth gap within and between the nations.

Measures for sustainable developement:

a) To promote environmental education and awareness: From childhood, a feeling of belongingness to may be developed among children and subjects on environmental studies may be introduced in early education. Media can also help to aware the society.

b) 3-R approach: Three R, means, reduce, reuse and recycle. overexploitation of resources to be reduced, resources can be reused and recycled.

c) Appropriate technology: Using appropriate technology, resources can be less consumed and less waste is produced. The technology should be ecofriendly, adaptable, efficient and culturaly suitable.

d) Utilizing resources as per carrying capacity of the environment:

Sustainability can be achieved if the resources are utilized within the carrying capacity, otherwise environmental degradation may takeplace. carrying capacity has two basic components —

i) supporting capacity - it is formed of productive and protective systems.

ii) Assimilative capacity - it is formed of the systems which utilize the wastes produced by human activities.

6.2 Urban problem Related to Energy:

- Urban areas like cities, metropolies are developing very fast by influx of population from rural areas and suburbans, mostly for employment and better living conditions.
- Energy is required in every walk of life like industry, transport, defence, agriculture, trade, education, communication etc.
- Demand for energy is much more higher than its production and it is more serious in urban areas than in rurals, so in urban areas in someway or other every problem is related to energy.
- main causes of energy problem, are —

(A) 1. Due to increased population and industrialization, use of energy for domestic and commercial purposes, increases.
2. Industrial plants using big portion of energy
3. Non-renewable energy sources like, coal, petroleum and natural gases are decreasing.
4. Means of transport increasing.
5. Decreasing production of hydroelectricity due to insufficient rains.
6. Transmission loss, due to poor and ineffective distribution system.

Following steps may be taken to solve energy problems
1. To control urbanization.
2. To develop renewable resources of energy like solar radiation, wind power, hydel power, nuclear power, bio-mass power etc. These are also pollution free.
3. Non renewable energy resources should be used only when non-conventional source of energy is available.
4. Creating awareness on energy saving.
5. Effective measure for transmission loss and energy theft.

3.(a) water conservation:

Water is so indispensible for almost all human activities that it is called life. Out of the total amount of fresh water 24,366,200 cubic kms available on earth about, 60,000,000 cubic kms are ground water and 24,000,000, cubic kms are in snow caps, ice sheets and glaciers etc, rest amount in ponds, lakes, streams, and soil moisture.

- important sectors of human activity that need water can be grouped as —

a) irrigation b) industries c) livestock management d) thermal power generation e) domestic requirements f) hydroelectric generation g) fisheries, navigation & recreational activity

- The following steps should be taken for water conservation.

a) water economy, reuse & recycling: water is to be used economically. It can be reused and recycled also. In thermal power plants large amount of water required for cooling can be reused after proper treatment.

b) Agricultural runoffs from fields: water from agricultural runoffs can be used effectively downstream with proper drainage facilities.

(6) c) Efficient distribution system: Rivers having large amount of water even in dry seasons can also be diverted and used in other water ways with efficient distribution.

d) Enhancement of surface storage capacity: About 27000 cubic kms of water runs down to ocean, which can be stored in reservoirs, tanks etc, to use in dry seasons.

e) Reduce evaporation loss: Water loss through evaporation and seepage are required to be reduced.

f) Improvement of underground storage capacity: Fresh water stored in underground deposits charges the water table which supplies water to streams, ponds, lakes nearby. So groundwater storage capacity is to be improved.

g) Desalination of seawater: If desalination of seawater can be made in large scale, then huge amount of freshwater can be available.

h) Afforestation and reforestation of hill slopes to check loss of water in floods.

i) Artificial rain making and precaution of water pollution is to be taken up.

3(b) Rainwater harvesting:

- Rainwater harvesting is a system where the rain water is collected and stored in an underground tank and then discharged to ground water table near the point where ground water is taken for use.
- It can be of two types — a) domestic (roof top) rain water harvesting b) rainwater harvesting for agriculture, erosion control, flood control and aquifer replenishment.

Main objectives of rainwater harvesting are—

1. To restore supplies from the aquifers depleted due to overexploitation.
2. To improve supplies from aquifers lacking adequate recharge
3. To store excess water for use in subsequent times.
4. To improve physical & chemical properties of ground water
5. To reduce storm water runoff and soil erosion.
6. To prevent salinity ingress in coastal areas.
7. To increase hydrostatic pressure to prevent or stop land subsidence.
8. To recycle urban and industrial waste waters etc.
9. To rehabilitate the existing ~~water~~ traditional water harvesting structures like village ponds, percolation tanks, baolis, etc.

(8)

10. To convert the traditional water harvesting facilities with minor scientific modifications.
11. To use the existing defunct wells and borewells after cleaning and also the operational wells as recharge structures.

Methods and techniques of rainwater harvesting

1. Rooftop & rain water harvesting and its recharge to underground through existing wells or borewells or by constructing new wells borewells, shafts, spreading basins, storm water drains etc.
2. Harvesting runoff in the catchments by constructing structures such as gabions, checkdams, percolation trenches, sub-surface dykes etc.
3. Impounding surplus runoff in the village catchement and water sheds in village ponds and percolation tanks.
4. Recharging treated urban and industrial effluents underground by using it for direct irrigation or through recharge ponds and wells.

Advantages of rainwater harvesting:

a) rise in groundwater levels in wells.
b) increased availability of water from wells.
c) to prevent decline in water level
d) reduction in flood hazards and soil erosion.
e) Improvement in water quality.
f) arresting sea water ingress.

g) mitigating the effects of drought and achieving drought proofing.
h) effective use of lakes of defunct wells and tubewells as recharge structures.
i) upgrading the social and environmental status.

3(c), watershed management:

- watershed is a drainage area in earth's surface from which, run off, resulting from precipitation flows past ~~out~~ a single point into a large stream, a river, a lake or ocean.
- It is a geohydrological unit and drains at a common point. has been accepted world over as a scientific unit of area development.
- The watershed can range from a few square kilometers to few thousand square kilometers in size.
- Watershed development is the rational utilization of natural resources of soil water and vegetation for increasing and stabilizing the productivity of land on a sustainable basis.
- The development of watershed will result in increase of subsoil water regime, recharge of wells.

Objectives of watershed management:

1. To increase agricultural production, ie, increasing the availability of fodder, fuelwood, timber and raw materials for industries.
2. The rational utilization of resources like water, soil and vegetation.

3. To minimize the risk of floods, droughts and land slides.
4. To manage the watershed for developmental activities like domestic watersupply, irrigation, hydropower generation.
5. To develop the rural areas and their lifestyle.

Under the development of national policy, watershed management was included in 5th five year plan. Now adays various watershed management programmes are going on. Various measures necessary for watershed management are-

1. Scientific mining and quarrying must be done in the watershed areas because hills loose stability and get disturbed by improper mining.
2. Water harvesting in the watersheds to be used in dry seasons in low rainfall areas.
3. Afforestation and agro forestry (crop plantation) should be promoted to prevent runoffs loss and soil erosion and increase soil measure.
4. Woody trees like Eucalyptus and Leucaena should be grown in between crops to reduce the runoffs and loss of fertile soil in high rainfall areas.
5. Some mechanical measures like teracing, bunding bench terraceing, contour croping etc are used to minimize runoff and soil erosion in the slopy regions.
6. To promote soil binding plants like Vitex.
7. Peoples participation should be ensured including farmers and tribals in the watershed management.

(11) 1. Resettlement and Rehabilitation of people: its problems and concerns.

Problems and issues relating to resettlement and rehabilitation of people arises during development of projects like, construction of dams, mining, creation of parks etc and during natural calamities like earthquake, landslides, volcanoes, floods, droughts, cyclones etc.

- Displacement disturbs the socioeconomic and ecological base of local community which are generally forest and tribal people.

Various types of projects result in the displacement of local/native people —

1. Displacement due to Dams:

We cannot imagine of living life without energy, and most easily accessible and ecofriendly form of renewable energy is hydropower.

- India's exploitable hydropower potential is 89041 MW.
- River Narmada has 3000 MW hydropower potential in Madhyapradesh.
- Sardar Sarovar project (Gujarat), Hirakud (Odisha), Bhakra Nangal Dam (Punjab), Tehri Dam (Uttaranchal) and Indira Sagar project (MP), have displaced more than 25 million people.

Case Study: Sardar Sarovar project, Indira Sagar project.

2. Displacement due to mining:

- Mining is also one of the important means in the field of prosperity.
- Due to developmental activities in mining thousands of people get displaced.

- Most of the people are poorest of poors and tribal.
- They lose much more than they get from the projects.

Case study: Jharia coalfield in Jharkhand.

3. Displacement due to National Parks:

- To conserve flora and fauna sometimes larger forest areas are covered under National Park and Sanctuary.
- It is declared as core area and entry of local dwellers, tribals and villagers from nearby area are prohibited.
- They are deprived of their right of access to the benefits of forests.

Case study: Valmiki Tiger reserve area in West champaran district of Bihar has displaced 142 villages of Tharu community tribals.

Rehabilitation:

- United Nations Universal declaration on Human Rights [article 25(1)] has declared that "Right to housing is basic human right".
- This urges that better rehabilitation, adequate compensation, job opportunities, civic amenities, religious and cultural benefits must be provided to the displaced persons (families).
- Under land Acquisition Act 1984, GoM has power to vacate any land from people for public (GoM) use by giving notice.
- So, GoM and other agencies are providing a number of facilities and compensations for the displaced persons.

(19)

5. Environmental Ethics: Issues and possible solutions

- The issues, principles, and guidelines relating to human interaction with their environment or, human obligations towards the environment and living beings are called Environmental Ethics or Earth Ethics.
- These ethics constitute some rules or codes which bind us to act accordingly in order to live friendly and sustainably with nature.
- It is the nature of human beings that our acts follow our thinking. This thinking can be of human-centric or earth centric.
- In this regard, there are two world views -

1. Eco-centric world view:

- It states that, earth resources are limited and they are not for human beings alone but for all the species.
- Our requirements should be within the limit, beyond which there will be degradation.
- As a healthy economy depends upon healthy environment, therefore success of mankind depend upon how we co-operate with nature while drawing resources from it.

2. Anthropocentric world view:

- Most of the industrial society believes in this view that man is the most important species in nature and can exploit the resources to fulfill their needs.

(14) – The success and healthy economy of mankind depends upon how nicely man deserves the benefits from nature.

To check environmental crisis, we must follow certain environmental ethics, which are –

i) one should love and honour the earth.
ii) We should celebrate the turning of seasons.
iii) Do not waste or exploit natural resources.
iv) To bring awareness regarding conservation of life supporting systems.
v) We should be ~~fare~~ fair in sharing of resources.
vi) We should be respectful to animals and plants which provide us food, cloth, shelter.
vii) We should conserve the ecosystem, and promote appropriate sustainable development.
viii) We should not do anything at the cost of nature.
ix) We should consume natural resources moderately so that all should get their share.
x) We should concentrate on general awareness regarding environmental ethics from primary education.
xi) A healthy economy depends upon healthy environment.

6. a) Climate change:

– Climate is the average weather or environmental factors of an area. It includes quantity of light, temperature, humidity, wind, gases, water etc averaged over a period of about 30 years.

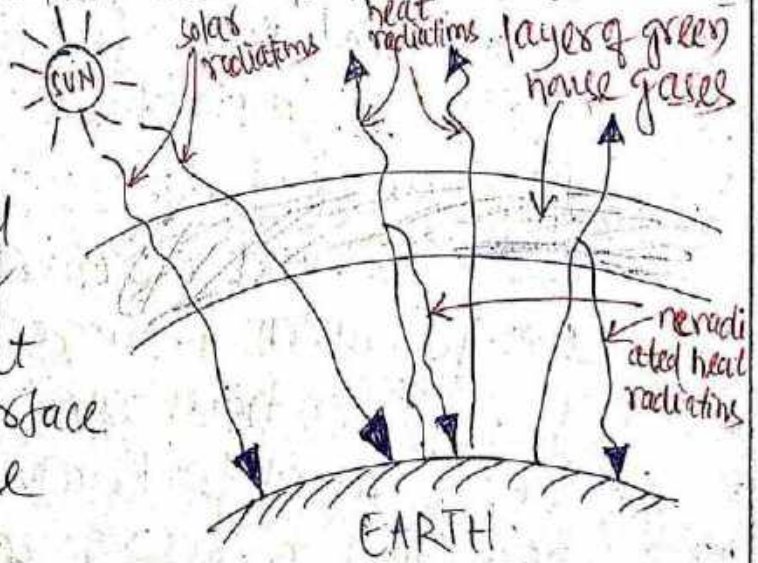
(15)

- This changes in environmental conditions of an area over long period of time is called climate change.
- Climate change has a greater effect on agriculture, migration of animals & birds, hydrological cycle, thermal gradient between the poles and equator, wind pattern, distribution of rainfall etc.
- Despite of rapid development in the field of science and technology, man-made (anthropogenic) activities are responsible for depleting of natural resources and upsetting ~~imbalance~~ the delicate balance between various components of environment.
- Some such activities are like excessive use of fossil fuels, deforestation, desertification, loss of fertile soil, rapid industrialization and urbanisation, indiscremenate use of chemical ~~manu~~ fertilizers & pestisides, increase of automobiles etc.
- All these imbalances the environmental conditions and collectively called as climate change, which produces further problems like, green house effect, Ozone layer depletion, rise of world temperature, melting of glaciers and increasing sea-water level etc.

(15)

6(b) Global warming : Global warming is an alarming process in which the average temperature of Earth rises to a very high value.

- Average global temperature is 15°C.
- The lowermost layer of the atmosphere i.e, troposphere, traps the heat by a natural process due to the presence of certain gases called green house gases.
- Green house gases are carbon dioxide(CO_2) ozone, methane, nitrus oxide, chlorofluro carbon (cfc) and water vapours.
- In absence of green house gases, the average global temperature would have been (−18°C) instead of 15°C.
- Warming of earth's climate due to increased concentration of green house gases, is called green house effect, which contributes to a temperature rise to the tune of 33°C.
- These gases acts like the glass covers used in botanical green house trapping the reradiated heat near the earth's surface and warming the planet.



(Green House Effect)

(17) Green house gases

a) Carbon dioxide (CO_2): It is the most dominant factor producing green house effect. The atmosphere contains only 0.0375% of CO_2 by volume and its amount is controlled by carbon cycle.
- major pools or reservoirs of CO_2 are fossil fuels, atmosphere, biosphere and ocean.
- Deforestation is the main cause of increase in CO_2

b) Chlorofluorocarbons: (CFCs)

CFCs trap heat 20,000 times more efficiently than CO_2 and also destroy ozone layer, main source of CFCs includes leaking air conditioners and refrigerators, evaporation of industrial solvents, production of plastic foams, aerosols propellants (CFC-11) etc. concentration of CFC is rising by 5% per year.

c) Methane (CH_4):

Methane is produced by the action of anaerobic bacteria on vegetation, decomposition of organic matter, incomplete combustion of vegetation, natural gas pipeline leaks, burning of biomas during production and use of oil and natural gas etc. It is rising by approx. 2% per year

d) Nitrous oxide (N_2O): It is released from nylon products, from burning of biomass and fuels, from breakdown of fertilizers in soil, livestock wastes, nitrated contaminated ground water. Its concentration is 0.3 ppm in atmosphere and increasing by 0.2% annualy.

(12)

e) Ozone (O_3): It comes mostly from hydrocarbons and nitrogen oxides. It causes irritation to eyes and respiratory organs. It decreases the resistance power to infections and aggrevates illness.

Impact of Global warming

a) Climate change (increase in global temp.)

Increase in the concentration of greenhouse gases causes global warming. According to (IPCC), world temperature has increased by 0.3 to 0.6°C in last century and it is expected to rise by 5.5°C in this century.

- Global warming effect the biological community severly, some plant species may not be able to survive.
- It also effects rainfall, species composition, plants reproduction cycle and biogeochemical cycle.

b) Rising in sea level: Rising temperature will cause glaciers to melt and icecaps to shrink. As a result sea level may rise by 0.2 to 1.5 m over next 50 to 100 years.

c) Reduction of biodiversity:

Increase in temperature will make some species vanished and get extinct. Their distribution will also get affected thus producing reduction in biodiversity.

d) Effect on Agriculture:
Effect of global warming is different for C_3 (wheat, rice & beans) type and C_4 (maize, millet and sugarcane) type of crop plant.
- In certain plants, rise in temperature with rise in CO_2 level, decrease soil-moisture and evapotranspiration.
- But in certain plants, increase in CO_2 level increases photosynthesis, greater root production and increased nitrogen fixation.

e) Effect on human health: Global warming increases temperature of the environment and affects rainfall pattern thus increasing the spread of vectorborne diseases like malaria, filariasis, elephantiasis etc. High temperature and humidity will produce respiratory and skin diseases.

f) Effect on arctic ecosystem: Global climate change will have profound effects on arctic ecosystem like in Tundra.

g) Ecological disturbance: Global warming increases deserts. Change in hurricane, cyclone, floods will damage lagoons, estuaries and coral reefs.
- Global warming may cause extinction of more than one million species of animals and plants by 2050 A.D.

(20) Measures to check Global warming:

To check global warming following steps may taken

1. Plantation of more trees (afforestation)
2. Controlling population growth.
3. Cutdown the current rate of CFCs and fossil fuel.
4. Use of non conventional energy sources.
5. Shift from coal to natural gas.
6. To trap and use methane as a fuel.
7. Reduce beef production.
8. Efficiently remove carbondioxide from smoke.
9. Use of photosynthetic algae to remove atmospheric CO_2
10. Adopt sustainable agriculture.
11. Use energy more efficiently.

6(c) Acid rain: Acid rain was first coined by Robert Angus in 1952 and by 1968 more ~~discoveries~~ a research done on it and found that rainwater is becoming increasingly acidic with each passing year.

- Normal rainwater is always acidic because CO_2 present in the atmosphere get dissolved in rainwater forming (H_2CO_3) carbonic acid.
- The presence of sulphur dioxide (SO_2) and nitrogen oxide (NO_2) as pollutants in atmosphere the pH of rainwater further reduced and this is called acid rain.
- So, ~~rainwater~~ acid rain means literaly as the presence of excessive acids in rain water. H_2SO_4 is major contributor (60-70%)

(2) and (HNO_3) ranks second (30-40 %) and HCl is third.

- Acid rain is a manmade phenomena, human activities like cars, houses, factories, power stations etc. produces SO_2 and NO_2.
- acid rain also produced by volcanoes, swamps and planktons in the oceans.
- pesticides sprayed on crops evaporates and in stratosphere they react with water vapour

Formation of Acid rain:

on daytime Nitric oxide get oxidised ~~by~~ by oxygen, ozone —

$$NO + O_3 \rightarrow NO_2 + O_2$$

$$H_2O \rightarrow H^+ + OH^-$$

$$NO_2 + OH^- \rightarrow HNO_3 \text{ (nitric acid)}$$

Similarly — $SO_2 + OH^- + X \rightarrow HSO_3^- + X$

where $X = O_2$ or N_2 in atmosphere

HSO_3^- undergoes a number of reactions producing H_2SO_4.

$$HSO_3^- + O_2 + X \rightarrow HOO^- + SO_3 + X$$

$$SO_3 + H_2O \rightarrow H_2SO_4$$

Similarly, the Hydroperoxyl ~~acid~~ radical HOO^- can also react to produce HNO_3 —

$$NO + HOO^- \rightarrow NO_2 + OH^-$$

$$NO_2 + OH^- + X \rightarrow HNO_3 + X^-$$

So, all these acids formed, mixed with rain water producing acid rain.

Effects of Acid rain:

1. Fish and other aquatic population decreases as they cannot survive in acidic water.
2. Bacteria and blue green algae are killed due to acidification, disturbing ecological balance
3. Plants leaves in crops and forests get damaged due to acid rain.
4. Growth of crops like, pea, beans, radish, potato, spinach, carrots decreases due to acid rain
5. Acidic lakes, rivers have low level of phytoplankton
6. Acid water decreases the activities of bacteria and other microscopic animals.
7. Acid rain causes extensive damage to buildings and structural materials like marble, lime stone, mortar etc.

   $CaCO_3 + H_2SO_4 \rightarrow CaSO_4 + H_2O + CO_2$.

   attack on marble is called stone-leprosy.
8. Acid rain corrodes houses, monuments, statues, bridges, fences, railways etc.
9. The Taj Mahal in Agra is suffering from SO_2, H_2SO_4 and other fumes, pollutants released from industries like Mathura refinery.
10. Acid rain water affects human digestive, respiratory and nervous systems and can cause severe neurological problems.

6(a)

(23) 6(a) Ozone layer depletion:

Various layers of atmosphere and beyond upto 6370kms; radius of earth, is as shown in figure.

- Stratosphere region is approximately between 15-50kms above earth's surface
- Naturally occuring ozone gas, with maximum mixing ratio is found at the altitude ranging from 15-30 km above the earth. This region is known as ozone layer or ozonosphere.
- This ozonelayer stops the harmful solar radiations such as ultraviolet rays, entering the atmosphere, thus protecting life on earth.
- Ozone is an effective filter capable of absorbing UV radiations with wavelength between 200nm and 315nm.

Formation of ozone:

- In lower mesosphere, the atmosphere oxygen absorbs UV radiations < 240 nm and photodissociates into two oxygen atoms. These atoms subsequently combine with molecular oxygen of upper stratosphere

producing ozone. Ozone is also capable of absorbing short wavelength UV radiations releasing oxygen atoms.

$$O_2 + UV\ (\lambda < 240\ nm) \rightarrow O + O$$

$$O + O_2 \rightarrow O_3$$

during decomposition $O_3 + UV\ (\lambda = 230-320\ nm) \rightarrow O_2 + O$

$$O + O_3 \rightarrow O_2 + O_2$$

- By this mechanism, ozone equilibrium is not disturbed as the loss of ozone is compensated by creation of ozone. So in ozone layer the ozone concentration is maintained at 10 PPM.
- The thickness of ozone layer is measured in Dobson Unit (DU), where 1DU = 0.01 mm of the compressed gas at 0°c and 760 mm mercury pressure.
- The average thickness of ozone layer in stratosphere has been estimated to be about 230 DU. It varies marginaly with latitude.

Mechanism of ozone Depletion:

Ozone depletion takes place in two ways –
i) natural process ii) Anthropogenic process.

Natural process: Naturaly ozone is a powerful oxidising agent. ~~Along with~~ Oxygen along with UV radiations produces ozone

Again ozone decomposes into oxygen in presence of UV radiations.
— So naturaly ozone layer can be depleted but it get compensated naturaly.

Anthropogenic process:

Human activities produces a number of free radicals like HO_x, NO_x and ClO_x. These species are capable of destroying ozone layer. (70% of destruction by HO_x near atmosphere)

Effects of ozone depletion:

1. Ultraviolet radiations are very harmful to all living being, depletion of ozone layer increases the chance of influx of harmful UV radiations to earth's atmosphere
2. Biological systems are affected in two ways — one is confined to patches on skin and second to affect the immune system
3. UV rays caused skin cancer like Basal cell carcinoma, squamous cell carcinoma, and melanoma.
4. UV radiations cause sunburn, Leukemia and breast cancer.
5. UV radiations falling on cornea and lense in the eye leading to photokeratitis & cataracts
6. ozone at ground level (of low concentration) exerts its toxic effects directly on lungs.
7. Ozone exposure also cause lung cancer & DNA breakage.

8. Micro phytoplanktons cannot survive when exposed to UV radiations, thus in turn also affects zooplanktons.
9. Ozone is highly toxic to fish and harms their reproduction, affecting costal people.
10. Plant proteins are also susceptible to UV injury.
11. In plants ozone enters through stomata, and damages the leaves decreasing photosynthesis.
12. Ozone reacts with fibres like cotton, nylon, and polyster etc.
13. Ozone depletion, allows UV radiations to cause greater evaporation and reducing soil moisture content.

(6) Nuclear Accidents & holocaust:

a) Nuclear accidents on Hiroshima & Nagasaki:

- On 6th August 1945, the first atomic bomb (little boy) exploded over Japanese town Hiroshima at a height of 580 meters in the atmospher.
- The bomb used Uranium (U-235) with a half life period of 8.5×10^8 years and reported to kill about one lakh people and injured and missed about few lakh people.
- On August 1945, the 2nd atomic bomb (fat man) exploded at a height of 507 meters on the sky of Nagasaki. It used plutonium (P-239) having a half life period of 24000 years
- Because of the longterm radioactive radiations

(58) from these explosions, people of Japan are still suffering from pulmonary oedema, anoxia, brain damage and increased risk of sterility.

- The first hydrogen bomb was exploded in 1954 on Bikini island in the pacific ocean in which the crew members of the Japanese fishing boat 'luck dragon' have got killed, and injured.
- In 1957, 1958, USA, USSR and UK detonated nuclear weapons having a total yield of about 85 megatons.
- In 1961, Russia detonated a bomb of 57 mega tons.

Case study: Chernobyl accident

Chernobyl nuclear accident had happened on April 26, 1986 at Chernobyl nuclear power plant in the state of Ukraine in USSR.

- The accident was due to poor design of the reactor and the operators negligence. The operator's hard ~~bot~~ ignored the warnings from some sensors and even disconnected the emergency core cooling system.
- On enquiry it is found that — "Neutrons went out of control and enormous steam built up in pipes. The explosion sent the graphite slabs of the reactor core through the roof setting it a fire and spewing radioactive materials around the world."
- 20% of the plant's radioactive iodine escaped along with 15 to 20% of radioactive caesium,

hazardous plutonium and mixture of several radio isotopes. Radiation level reached 100 time more than normal.

- Chernobyl nuclear disaster had created havoc not only in USSR but over all western Europe and spreading radioactive nuclear dust over entire Europe.
- More than 4000 Ukrainians who took part in the hasty cleanup effort since 1986 disaster have died and 70,000 were disabled by radiation.
- About 3.4 million of Ukrain's 50 million people including some 1.26 million children have been affected.
- Lots of wild life (both animals, birds, insects and microorganisms) have been affected.
- Finaly, on 15th December 2000, the reactor power plant have been closed officialy.

7 Air (Prevention and control of pollution) Act. 1981