GUDLAVALLERU ENGINEERING COLLEGE

(An Autonomous Institute with Permanent Affiliation to JNTUK, Kakinada)
Seshadri Rao Knowledge Village, Gudlavalleru – 521 356.

Department of Computer Science and Engineering

HANDOUT

on

Environmental Studies

Vision :

To be a Centre of Excellence in computer science and engineering education and training to meet the challenging needs of the industry and society

Mission:

- To impart quality education through well-designed curriculum in tune with the growing software needs of the industry.
- To be a Centre of Excellence in computer science and engineering education and training to meet the challenging needs of the industry and society.
- To serve our students by inculcating in them problem solving, leadership, teamwork skills and the value of commitment to quality, ethical behavior & respect for others.
- To foster industry-academia relationship for mutual benefit and growth

Program Educational Objectives :

PEO1 : Identify, analyze, formulate and solve Computer Science and Engineering problems both independently and in a team environment by using the appropriate modern tools.

PEO2 : Manage software projects with significant technical, legal, ethical, social, environmental and economic considerations.

PEO3 : Demonstrate commitment and progress in lifelong learning, professional development, leadership and Communicate effectively with professional clients and the public

HANDOUT ON ENVIRONMENTAL STUDIES

Class & Sem. : I B.Tech – I Semester Year: 2018-19

Branch : CSE Credits : 2

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1. **Brief History and Scope of the Subject**

   Keeping the reader abreast with these chances fulfils the objective of introduction of the subject in the educational institutions. An attempt has been made to analyze and discuss various topics by including technical / semi technical details yet in a simple and lucid manner which could be understood by the reader of all disciplines. The purpose is to make them environmentally conscious so that each one of us contributes to keep the environment healthy and lead an environmentally respectfully life.

2. **Pre-Requisites**
   - Basic Knowledge is required

3. **Course Objectives**
   - Imparting basic knowledge about the environment and its allied problems.
   - Provides structural features and functional features of ecosystem.
   - Developing an attitude of concern for biodiversity richness and its conservation.
   - An understanding of the environmental impact of developmental activities.
   - Inculcate the knowledge towards environmental pollution and waste management.
   - To create awareness among the people about various renewable and non-renewable resources of a region.

4. **Course Outcomes:**

   Students will be able to

   CO1: know the multidisciplinary nature of environmental studies.
   CO2: analyze functional attributes of ecosystem.
   CO3: enumerate values of biodiversity.
   CO4: take appropriate actions to control the pollution
   CO5: know waste management activities
   CO6: understand various stages of Environmental Impact Assessment(EIA)

5. **Program Outcomes:**

   Graduates of the Computer Science and Engineering Program will have

   a) an ability to apply knowledge of mathematics, science, and engineering
   b) an ability to design and conduct experiments, as well as to analyze and interpret data

c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
d) an ability to function on multidisciplinary teams
e) an ability to identify, formulate, and solve engineering problems
f) an understanding of professional and ethical responsibility
g) an ability to communicate effectively
h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
i) a recognition of the need for, and an ability to engage in life-long learning,
j) a knowledge of contemporary issues
k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Mapping of Course Outcomes with Program Outcomes:

	a	b	c	d	e	f	g	h	i	j	k	l
CO1					H							
CO2								H		H		
CO3			H			H	M			M		
CO4	H	H	H	M	H	H					H	
CO5	H	H	H		H			H				H
CO6	H	H	H		H						H	

6. Prescribed Text Books

1. Environmental studies:Anubha Kaushik,C.P.Kaushik:New age international publishers
2. Society and Environment:Dr.Suresh K.Dhameja:S.K.Kataria and sons
3. Environmental studies:Benny Joseph:Tata Mc Graw-Hill publishing company limited.

8. Reference books

1. A text of Environmental studies:Shashi chawala:Tata Mc graw hill education private limited.
2. Environmental Science & Engineering : P.Anandan, R.Kumaravelan, Scitech Publications (India) Pvt. Lted.
3. Environmental Studies by R. Rajagopalan 2nd Edition 2011, Oxford University Press
4. Environmental Studies by Deeshita Dave & P. Udaya Bhaskar, Cengage Learning .

7. URLs and Other E-Learning Resources

www.biodiv.org/doc/legal/cbd-en.pdf
unfccc.int/resource/conv/conv.html
www.basel.int/text/com-e.htm
www.unep.org/ozone/montreal.shtmal
www.cities.org/eng/disc/text/shtml
www.unep.org/Documents/Default.asp?

8. Digital Learning Materials:

www.moef.ing.in
www.bnhs.org
www.kalpavriksh.inf.in

9. Lecture Schedule / Lesson Plan

S.No	TOPIC	No of. Periods	No. of Total Periods
	UNIT-I : Multidisciplinary nature of Environmental Studies		
1.	Definition Scope Importance	1	5
2.	Need for Public Awareness	1	
3.	Multidisciplinary nature of Environmental Studies	1	
4.	Awareness activities	2	
	UNIT-II : Ecosystem		
5.	Concept of an Ecosystem	1	9
6.	Structural features of Ecosystem	1	
7.	Food Chain and Food Web	1	
8.	Ecological Pyramids	1	
9.	Energy Flow	1	
10.	Biogeochemical Cycles	2	
11.	Ecological Succession	1	
12.	Major ecosystems	1	
	UNIT-III : Biodiversity & Its Conservation		
13.	Definition, Levels of Biodiversity	1	4
14.	Bio-geographical zones of India – Values of biodiversity (Consumptive use, productive use, Social, Ethical, Aesthetic, Option values, Ecosystem service values)	1	
15.	India as a mega diversity nation, Threats to biodiversity	1	
16.	Endangered & Endemic species of India – Conservation of biodiversity (In-situ & Ex-Situ)- Biodiversity Act, 2002.	1	
	UNIT-IV : Environmental Pollution		

17.	Definition – Causes – Effects & Control measures of – Air pollution	2	6
18.	Water pollution	1	
19.	Noise pollution	1	
20.	Soil pollution	1	
21.	Radioactive pollution.	1	
	UNIT-V : Environmental Management		
22.	Environmental Impact Assessment	1	6
23.	Environmental Impact Statement	1	
24.	Environmental Management Plan	1	
25.	Environmental Audit and Ecotourism	1	
26.	Green building and Green Development Mechanism	1	
27.	Environmental legislations-Wild life(protection) Act,1972-Water(prevention and control of pollution) Act, 1974-Forest (conservation) Act,1980-Air(prevention and control of pollution) Act, 1981-Environmental(protection) Act,1986.	1	
	UNIT-VI : Waste Management		
28.	**Liquid waste:** Industrial waste water treatment	1	6
29.	Municipal water treatment Drinking water treatment	1	
30.	**Solid waste:** Municipal solid waste	1	
31.	Biomedical waste	2	
32.	Hazardous waste and E-waste	1	
TOTAL			**36**

10. Seminar Topics : Nil

ENVIRONMENTAL STUDIES

UNIT-I

MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES

Objectives:

- To know the multidisciplinary nature of environmental studies.
- To create awareness among the people towards protection of the environment.

Outline of the chapter

- ❖ Definition
- ❖ Scope
- ❖ Importance
- ❖ Need for public awareness
- ❖ Multidisciplinary nature of environmental studies
- ❖ Awareness activities
- ❖ Role of a citizen in protection of environment

Learning Outcomes: Students will be able to

- know the multidisciplinary nature of environmental studies
- understand components and segments of the environment
- identify various awareness activities
- inculcate the knowledge among the people towards scope and importance of the environment

Learning material

INTRODUCTION

Definition of Environment: The word 'Environment' is derived from the French word 'environner' which means encircle or surround in this include all the physical and biological things are thus included in the environment.

(Or)

Thus Environment is sum total of water, air and land and the interrelationships among themselves and also with the human beings and property.

(Or)

The above definition is given by Environmental Protection Act in the year of 1986.It clearly indicates all the physical and biological things and their interactions.

COMPONENTS OF ENVIRONMENT

The environment is comprised of the following components:

(i) Abiotic components or non-living components: These includes

- Light
- Humidity and water
- Temperature
- Atmospheric gases
- Altitude
- Latitude
- Seasonal changes
- Topography

(ii) Biotic or Living components: These includes

- Plants (flora and fauna)
- Animals including humans, parasites, microorganisms and decomposers.

(iii) Energy components: These includes

- Solar energy
- Geothermal energy
- Thermo-electrical energy

- Nuclear energy

TYPES OF ENVIRONMENT

The environment can be categorized as

(i) Natural environment: The components of natural environment are air, water, soil, solar radiation, land, forest, wild life, flora and fauna etc.

(ii) Man made environment: These include housing, agriculture implements, industries, dams, energy such as hydro, thermal and nuclear energy etc.

SEGMENTS OF ENVIRONMENT

The environment is comprised of the following segments:

(i) Atmosphere

(ii) Hydrosphere

(iii) Lithosphere

(iv) Biosphere

Atmosphere: The cover of air that envelopes the earth is known as the atmosphere.

Hydrosphere: It is all of the water on the earth's surface. It covers about 75% of the earth's surface, either as salt water or fresh water.

Lithosphere: The layer of rock that forms the outer part of the earth is called the lithosphere. It mainly includes soil, earth, rocks and mountains etc.

Biosphere: The part of the earth's surface and atmosphere, in which plants and animals can live. It comprises of lithosphere, hydrosphere and atmosphere.

MAJOR REGIONS OF ATMOSPHERE

(i) Troposphere

(ii) Stratosphere

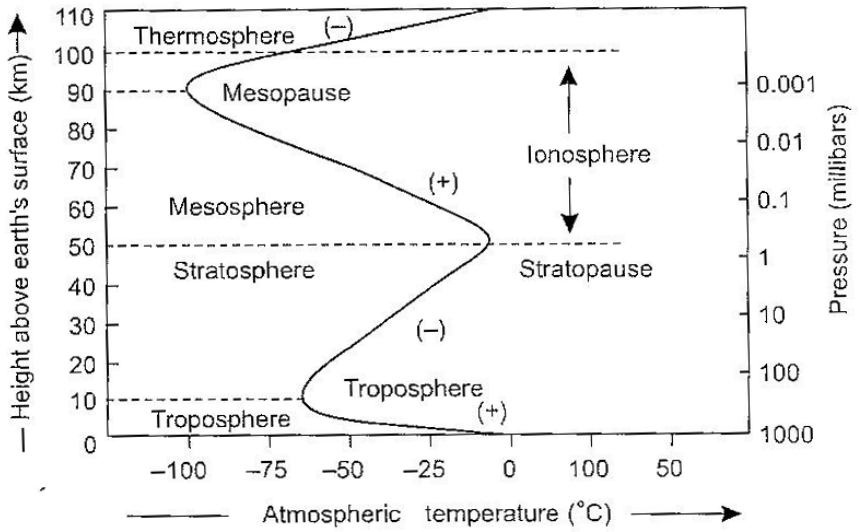
(iii) Mesosphere

(iv) Thermosphere

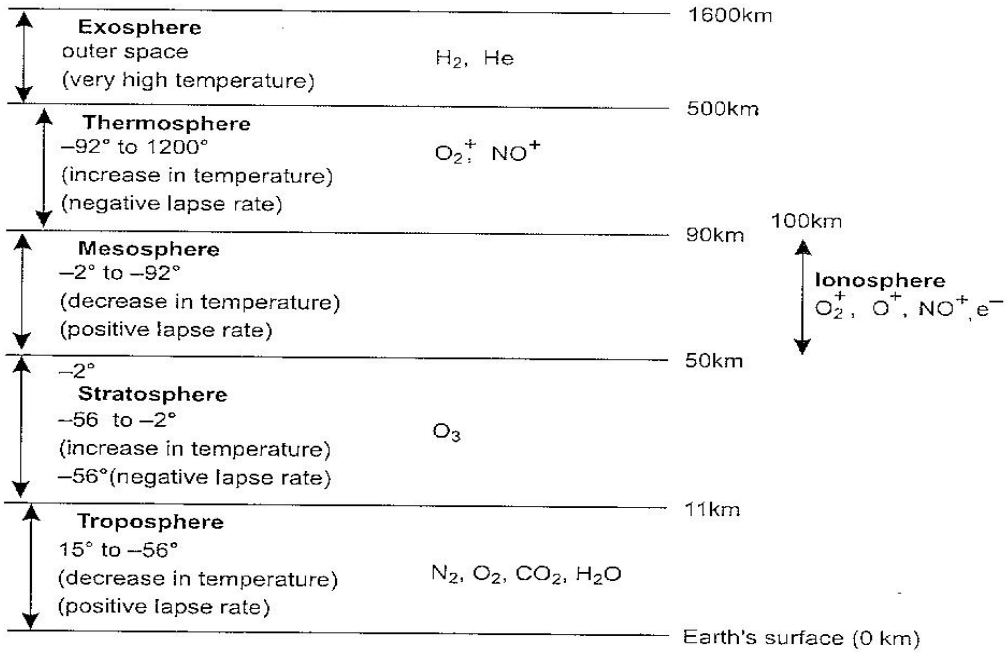
(v) Exosphere

(vi)Ionosphere

Region	Height Range (km)	Temperature Range (°C)	Main Constituents
Troposphere	0 – 11	15 to –56	O_2, N_2, CO_2, H_2O
Stratosphere	11 – 50	–56 to –2	O_3
Mesosphere	50 – 90	–2 to –92	O_2^+, NO^+
Thermosphere	90 – 500	–92 to 1200	O_2^+, O^+, NO^+



Simplified representation of various region of the atmosphere



Troposphere: The region nearest to the earth, extending up to a height of about 11 km is called troposphere. About 70 per cent of the total mass of air is contained in the troposphere. In this region, the temperature steadily decreases from ground temperature of about 15° to about --56^{o}c. It also contains argon, carbon dioxide and traces of helium, neon, methane, hydrogen, nitrous oxide, carbon monoxide, and nitrogen dioxide, sulphur dioxide etc.

Stratosphere: The region above the troposphere extending up to an altitude of about 50 km is the stratosphere. In this region, the temperature rises from -56° to -2°C. This increase in temperature is due to absorption of solar radiation. This region is rich in ozone, which absorbs the harmful ultraviolet radiations. In stratosphere, ozone is formed from oxygen by a photo-chemical reaction in which energy from the sun decomposes the oxygen molecules into reactive oxygen, which in turn combines with molecular oxygen to form ozone.

$$O_2 + h\nu \rightleftharpoons 2O$$
$$O_2 + O \rightleftharpoons O_3$$

Mesosphere: Next to stratosphere is the mesosphere, which extends unto an altitude of 90 km. It is characterized by low temperature (-2°C to -92°C) and very low atmospheric pressure. This region with temperature of about -92°C is the coldest region of the atmosphere. The decrease in temperature in this region is due to low levels of the ozone present, which is known to absorb UV radiations from the sun. The main constituents of mesosphere are the positive ions like O^{2}+, NO^{+}etc.

Thermosphere: This region is above mesosphere and extends up to a height of about 500 km. The temperature in this region rises from -92^{0}C to 1200°C.

Ionosphere: The region of atmosphere lying between the altitudes of 50 km to 100 km is the ionosphere. In this region, there are high levels of ions like O_2+,O^{+},$NO^{+}$and electrons.

Exosphere: It is the uppermost region of the atmosphere and extends up to a height of about 1600 km. This region contains hydrogen and helium. It has very high temperature due to solar radiations.

Scope

Environmental studies as a subject has a wide scope. It encompasses a large number of areas and aspects, which may be summarized as follows.

- Natural Resources- their conservation and management
- Ecology and biodiversity
- Environmental Pollution and control
- Social issues in relation to development and environment
- Human population and environment

❖ These are the aspects of environmental studies which have a direct relevance to every section of the society. Environmental studies can also be highly specialized concentrating on more technical aspects like environmental science, environmental engineering or environmental management.

❖ In the recent years, the scope of environmental studies has expanded dramatically world over. Several career options have emerged in this field that are broadly categorized as

- Research and Development in Environment
- Green Advocacy
- Green Marketing
- Green Media
- Environmental Consultancy

Importance

- Environment belongs to all and is important to all.
- Whatever the occupation or age of a person, he will be affected by environment and also he will affect the environment by his deeds.
- That is why we find an internationally observed environment calendar to mark some important aspects or s of environment.

➢ **Environment calendar**

World Wetland Day	February 2
World Forest Day	March 21
World Day for Water	March 22
World Meteorological Day	March 23
Earth Day	April 22
International Biodiversity Day	May 22
Anti-tobacco Day	May 31
World Environment Day	June 5
World Ocean Day	June 8
World Population Day	July 11
Ozone Week	Sep.16-23
World Car free Day	Sep.22
Green Consumer Day	Sep.28
World Farm animal's Day	Oct.2
World Habitat Day	Oct.3
World Animal Welfare Day	Oct.4
Wild life Week	Oct.1-7
International Day for Natural disaster reduction	Oct.13
World Conservation Day	Oct.24
International Day for Biological-diversity	Dec.29

➢ **Global vs. local nature of environment**

- Environment is one subject that is actually global as well as local in nature.
- Issues like global warming, depletion of ozone layer, dwindling forests, energy resources and loss of biodiversity etc. Which are going to affect the mankind as a whole are global in nature and for that we have to think and plan globally.

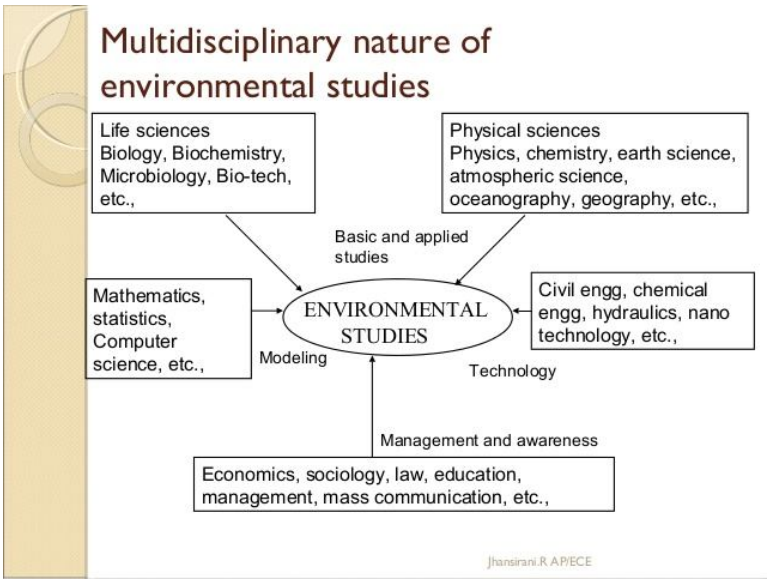
- However, there are some environmental problems which are of localized importance. For dealing with local environmental issues such as impact of mining, problem of disposal, management of solid waste, soil erosion, water logging, fluorosis problem in local population, arsenic pollution of ground water etc., we have to think and act locally.
- In order to make people aware about those aspects of environment with which they are so intimately associated, it is very important to make every one environmentally educated.

➢ **Individualistic nature of environment**

- Environmental studies is very important. It deals with the most mundane problems of individual such as dealing with safe and clean drinking water, hygienic living conditions, clean and fresh air, fertile land and healthy food.
- If we want to live in a clean, healthy, aesthetically beautiful, safe and secure environment for a long time and wish to handover a clean and safe earth to our children, grandchildren and great grandchildren, it is most essential to understand the basics of environment.

Multidisciplinary nature of Environmental Studies

❖ Keeping in view the complex nature of environment, knowledge inputs from various disciplines of science, social science, law and engineering are included in environmental studies.



- Life sciences including botany, zoology, and microbiology help in understanding the biotic components and their interactions.
- For understanding the physical and chemical structure of abiotic components of environment along with mass and energy transfers we have to make use of the basic concepts of physics, chemistry, geology, atmospheric science.
- Mathematics, statistics and computer science likewise serve as effective tools in environmental modeling.
- Subjects like economics, management and sociology provide the inputs for dealing with the socio-economic aspects associated with various development activities.
- A synthesis of civil engineering, hydraulics, chemical engineering and nanotechnology provide the technical solutions to environmental pollution control and waste treatment that are extremely important for protection of the environment.
- Environmental laws provide the guidelines and legal measures for effective management and protection of the environment.
- Environmental education and mass communication are two important subjects that are instrumental in disseminating environmental awareness.

- Environmental sciences, therefore, is a multidisciplinary subject where we deal with different aspects using a holistic approach.

Need for Public awareness

- The goals of sustainable development cannot be achieved by any government at its own level until the public has a participatory role in it.
- Public participation is possible when the public is aware about the ecological and environmental issues.
- A drive by the government to ban the littering of polythene cannot be successful until the public understands the environmental implications of the same.
- The public has to be made aware that by littering polythene, we are not only damaging the environment, but posing serious threat to our health.
- There is a Chinese proverb ***"If you plan for 1 year, plant rice, if you plan for 10 years, plant trees and if you plan for 100 years, educate people".*** If we want to protect and manage our planet earth on sustainable basis, we have no other option but to make all persons environmentally educated.

Public Awareness to Environmental Issues/Studies:

- Individuals of school, colleges, industries, service centers, village, urban centers etc., should realize the importance of day to day environmental issues.
- The individuals should practice environmental conservation principles and create awareness among family members.
- The individuals could expose the problems by writing in the newspapers.
- There is a need to meet the people and discuss again and again, so that the problem is alive till it is eliminated.
- The Government(Central and States) have instituted awards for individuals and organizations for their services to environmental management. The villages, panchayat unions, taluks, districts and other units can be made aware of such awards.
- The Non-Governmental organizations, in India and abroad, are doing tremendous efforts in conserving the environment.
- Several Universities and colleges have started Environmental Sciences/ Environmental Studies Departments. They conduct courses and research works related to local and regional environmental issues.
- Several Government/ Aided Institutions conduct and support environmental researches, organize seminars, conferences etc.

AWARENESS ACTIVITIES:

- Seminars, conferences and workshops for professionals, educated people, employees, working folk, housewives, and children of different age groups separately.
- Road shows and rallies of different kinds.
- Local gatherings for the local households and in rural areas and villages.
- Local camps for slums and poor people at their residences.
- Explaining the importance of environmental hygiene among the rural and slum dwellers by conducting public meetings.
- All government employees must address to this aspect in every official meeting.
- Publishing articles, inspiring stories, and advertisements in newspapers, through brochures and electronic media with very touching expressions in TV, radio, cinema etc.,
- Conduct simple quiz and make them aware of Pollution Control Boards, Ministry of Environment and Forests, Human Rights, Environmental Law and legislation etc.,

ROLE OF A CITIZEN IN PROTECTION OF ENVIRONMENT:

Different natural resources like forests, water, soil, food, mineral and energy resources play a vital role in the development of a nation.

Conserve Water:

- Don't keep water taps running while brushing, shaving, washing or bathing.
- Install water saving toilets that use not more than six liters per flush.
- Repairing any leakages from pipes.
- Treated waste water can be used for ferti-irrigation.
- Using grey water from washings, bath-tubs etc. for watering gardens, washing cars or paths help in saving fresh water.
- Use drip irrigation and sprinkling irrigation.
- Build rain water harvesting system in your house.
- In washing machines fill the machine only to the level required for your clothes.
- Selecting good qualities of detergents, which would reduce the usage of water.

Conserve Energy:

- Turn off lights, fans and other appliances when not in use.
- Dry clothes on sunny day instead of using a drier.
- Use of solar cooker for cooking your food on sunny days.
- Having good ventilation in the living place.
- Use public transportation.

- Recycle and reuse glass, metals and paper.
- Try riding bicycle or just walk down small distances instead of using your car or scooter.
- Increase plantation.

Protect the soil:

- Use of green manure and bio-fertilizers in the garden.
- Use mixed cropping so that some specific soil nutrients do not get depleted.
- Use of bio-pesticides instead of chemical pesticides.
- Prevent over irrigation.
- While constructing your house, don't uproot the trees as far as possible.

Promote sustainable agriculture:

- Do not waste food.
- Reduce the use of pesticides.
- Use of bio-fertilizers.
- Use drip irrigation to water the crops.
- Eat local and seasonal vegetables. This saves lot of energy on transport, storage and preservation.
- Control pests by a combination of cultivation and biological control methods.

UNIT-I

Assignment cum Tutorial questions

Section – A

1. The term 'environment' has been derived from the French word.....which means to encircle or surround.
2. World environmental day is celebrated on .....
3. Which one/two of the following statements is/are true [ ]

   (I) Troposphere chemical compositions are O_2& H_2 O

   (II) Stratosphere Chemical Compositions are H_2& H_e

   (III) Mesosphere Chemical Composition is O_3

   (IV) Thermosphere Chemical Compositions are NO^+, O^+_2& O^+

   (a) I & IV (b) II & III (c) Only II (d) Only III
4. Match the List-I and list-II and select the correct answer from the codes given below the list [ ]

List-I	List-II
(A) Physical components	(1) Water and soil
(B) Biological components	(2)Geothermal energy
(C) Energy components	(3) Plants and animals
(D)Chemical components	(4) Nitrogen and oxygen

Codes

	A	B	C	D
(a)	1	2	3	4
(b)	4	3	2	1
(c)	1	2	4	3
(d)	4	3	1	2

5. Match the List-I and list-II and select the correct answer from the codes given below the list. [ ]

List-I	List-II
(A)Troposphere	(1) NO^+, O_2+&O^+
(B) Stratosphere	(2) NO^+ &O_2^+
(C) Mesosphere	(3) O_3
(D)Thermosphere	(4) CO_2, NO_2, O_2, &H_2O

Codes

	A	B	C	D
(a)	1	2	3	4
(b)	4	3	2	1
(c)	1	2	4	3
(d)	4	3	1	2

6. The cover of air that envelopes the earth is known as [ ]
   (a) Lithosphere (b) Hydrosphere (c) Atmosphere (d) Biosphere
7. Match the List-I and list-II and select the correct answer from the codes given below the list [ ]

List-I	List-II
(A) Biosphere	(1) The cover of air that envelopes the earth
(B) Lithosphere	(2)All of the water over the earth surface
(C) Hydrosphere	(3) The layer of rock that forms outer part of the earth
(D)Atmosphere	(4) Part of earth surface and atmosphere

Codes

	A	**B**	**C**	**D**
(a)	**1**	**2**	**3**	**4**
(b)	**4**	**3**	**2**	**1**
(c)	**1**	**2**	**4**	**3**
(d)	**4**	**3**	**1**	**2**

8. Abiotic is a [ ]
   (a) Living component (b) Non-living components
   (c) Both a and b (d) Flora
9. Which of the following statement is /are correct [ ]
   (I) Troposphere show negative lapse rate
   (II) Stratosphere show negative lapse rate
   (III) Mesosphere show negative lapse rate
   (IV) Thermosphere show negative lapse rate
   (a) I & III (b) II & IV (c) Only I (d) Only III
10. Biotic environment includes [ ]
    (a) Water (b) Flora (c) Soil (d) Air

Section -B

Short Answer Questions

1. Define environment.
2. What are the types of environment?
3. List abiotic components.
4. Write biotic components.
5. What are the energy components?
6. List segments of environment.
7. Write major atmospheric regions.

Long Answer Questions

1. Write scope of environmentalstudies.
2. Why is environmental studies considered a multi-disciplinary subject?
3. Write importance of environmental studies.
4. Interpret need for public awareness on environmental studies.
5. List awareness activities.
6. Write the role of citizens in protection of environment.

UNIT-II ECOSYSTEM

Objectives:

- It provides the knowledge about ecological systems, causes, effects and relationships between the components.

Outline of the chapter

- ❖ Concept of an ecosystem.
- ❖ Structure and function of ecosystem.
- ❖ Food chain
- ❖ Food web
- ❖ Ecological pyramids
- ❖ Energy flow
- ❖ Biogeochemical cycles
- ❖ Ecological successions
- ❖ Major ecosystems

a) Forest ecosystem
b) Grassland ecosystem
c) Desert ecosystem
d) Aquatic ecosystem (ponds, streams, lakes, rivers, oceans, estuaries).

Learning Outcomes: Students are able to

- ➢ understand structural features of ecosystem.
- ➢ distinguish between biotic and abiotic components.
- ➢ analyze functional attribute of ecosystem.

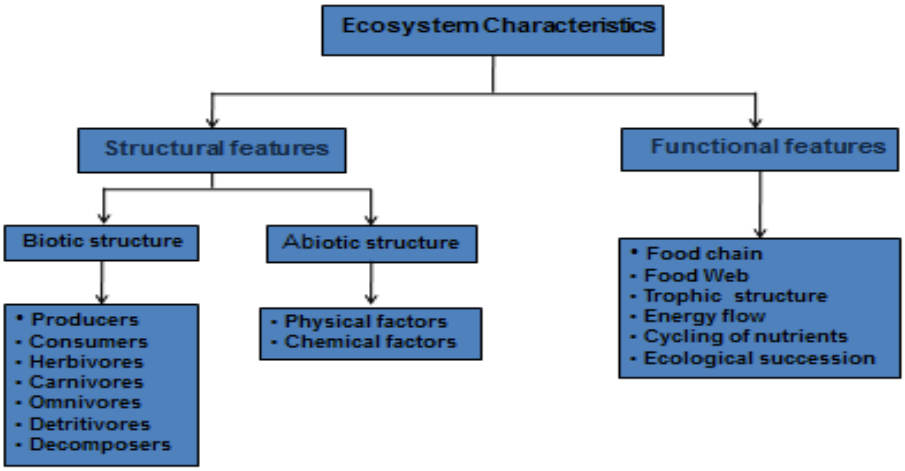
Learning material

CONCEPT OF ANECOSYSTEM

- The term **Ecology** was coined by Earnst Haeckel in 1869. It was derived from the Greek words Oikos- home + logos- study. So ecology deals with the study of organisms in their natural home interacting with their surroundings.
- An **ecosystem** is a group of biotic communities of species interacting with one another and with their non-living environment exchanging energy and matter. Now ecology is often defined as the study of ecosystems

STRUCTURAL FEATURES

Composition and organization of biological communities and abiotic components constitute the structure of an ecosystem.



I. Biotic Structure

The plants, animals and microorganisms present in an ecosystem form the biotic component. These organisms have different nutritional behaviour and status in the ecosystems and are accordingly known as Producers or Consumers based on how they get their food.

(a) Producers: They are mainly the green plants, which can synthesize their food themselves by making use of carbon-dioxide present in the air and water in the presence of sunlight by involving chlorophyll green pigment present in the leaves, through the process of photosynthesis. They are also known as photo autotrophs (auto=self; troph=food, photo=light).

There are some microorganisms also which can produce organic matter to some extent through oxidation of certain chemicals in the absence of sunlight. They are known as chemosynthetic organisms or chemo-autotrophs. For instance in the ocean depths, where there is no sunlight, chemoautotrophic sulphur bacteria make use of the heat generated by the decay of radioactive elements present in the earth's core and released in oceans depths. They use this heat to convert dissolved hydrogen sulphide (H_2S) and carbon dioxide (CO_2) into organic compounds.

(b) Consumers: All organisms which get their organic food by feeding upon other organisms are called consumers, which are of the following types:

(i) Herbivores (plant eaters): They feed directly on producers and hence also known as primary consumers. e.g.rabbit, insect, man.

(ii) Carnivores (meat eaters): They feed on other consumers. If they feed on herbivores they are called secondary consumers (e.g. frog) and if they feed on other carnivores (snake, big fish etc.) they are known as tertiary carnivores/consumers.

(iii) Omnivores: They feed on both plants and animals. e.g. humans, rat, fox and many birds.

(iv) Detritivores (Detritus feeders or Saprotrophs): They feed on the parts of dead organisms, wastes of living organisms. e.g. beetles, termites, ants, crabs and earthworms etc.

(c) Decomposers: They derive their nutrition by breaking down the complex organic molecules to simpler organic compounds and ultimately into inorganic nutrients. Various bacteria and fungi are decomposers.

II. Abiotic Structure

The physical and chemical components of an ecosystem constitute its abiotic structure.

(a) Physical factors: The sunlight and shade, intensity of solar flux, duration of sun hours, average temperature, maximum-minimum temperature, annual rainfall, wind, latitude and altitude, soil type, water availability and water currents etc.

(b) Chemical factors: Availability of major essential nutrients like carbon, nitrogen phosphorus, potassium, hydrogen, oxygen and sculpture.

FUNCTIONAL ATTRIBUTES

Every ecosystem performs under natural conditions in a systematic way. It receives energy from the sun and passes it on through various biotic components and in fact, all life depends upon this flow of energy.

The major functional attributes of ecosystems are as follows:

(i) Food chain, food webs and trophic structure

(ii) Energy flow

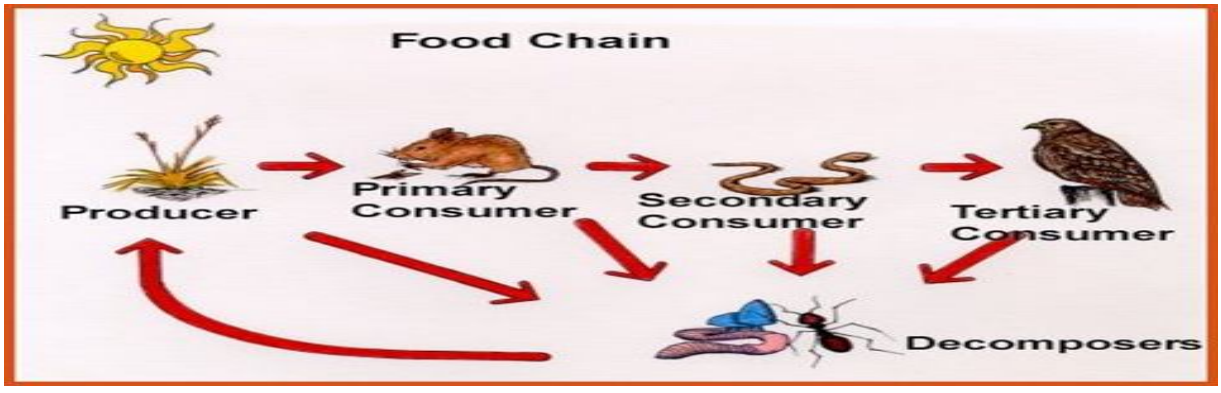
(iii) Cycling of nutrients (Biogeochemical cycles)

(iv) Primary and Secondary production

(v) Ecosystem development and regulation

FOOD CHAIN

The sequence of eating and being eaten in an ecosystem is known as food chain.



Major types of food chains:

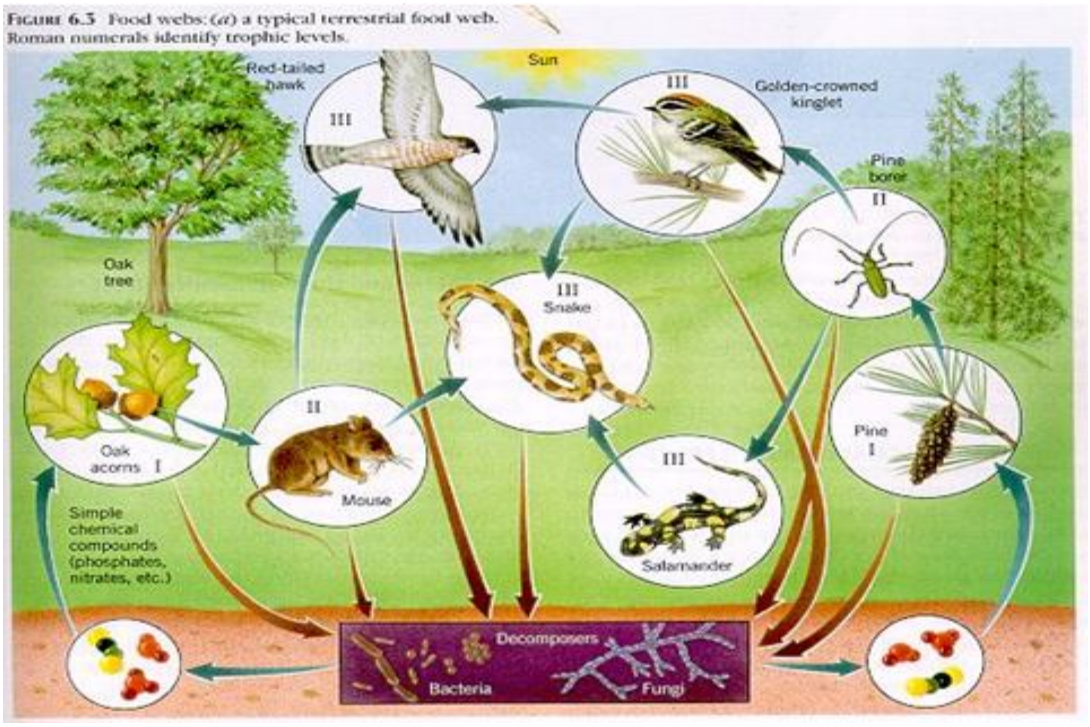
I. Grazing food chain: It starts with green plants (primary producers) and culminates in carnivores

Ex:-Grass→ hopper→ Frog →Snake →hawk

2.Detritus food chain: It starts with dead organic matter which the detritivores and decomposers consume.
Ex:-Dead mangrove tree leaves →carnivorous animals →Detritus feeders →Decomposers→Phytoplanktons

FOOD WEB

Food web is a network of food chains where different types of organisms are connected at different trophic levels, so that there are a number of options of eating and being eaten at each trophic level.



Significance of food chains and food web

1. Food chains and food webs play a very significant role in the ecosystem because the two most important functions of ***energy flow*** and ***nutrient cycling*** take place through them.

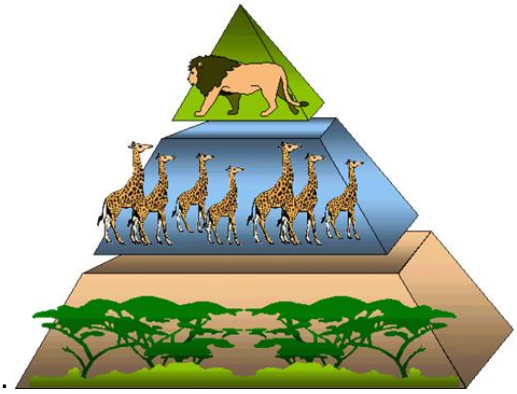
2. The food chains also help in maintaining and regulating the population size of different animals and thus, help maintain the **ecological balance.**
3.Food chains show a unique property of ***biological magnification*** of some chemicals.

ECOLOGICAL PYRAMIDS

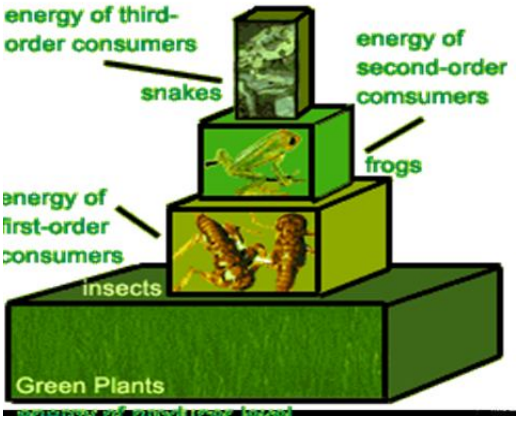
Graphic representation of trophic structure and function of an ecosystem, starting with producers at the base and successive trophic levels forming the apex is knows as an ecological pyramid.

Ecological pyramids are of three types:

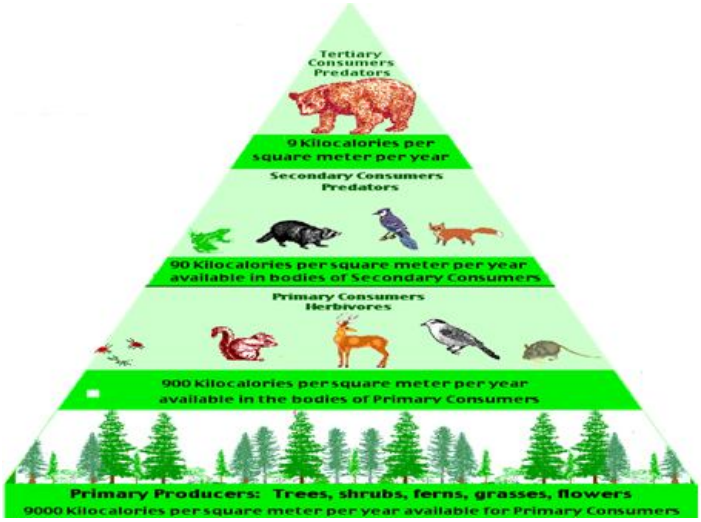
1. Pyramid of numbers: It represents the number of individual organisms at each trophic level. We may have upright or inverted pyramid depending upon type of ecosystem and type of food chain



2. Pyramid of biomass: It is based upon the total biomass (drymatter) at each trophic level in a food chain.



3.Pyramid of Energy: The amount of energy present at each trophiclevel is considered for this type of pyramid. Pyramid of energy gives the best representation of the trophic relationships and it is always upright.

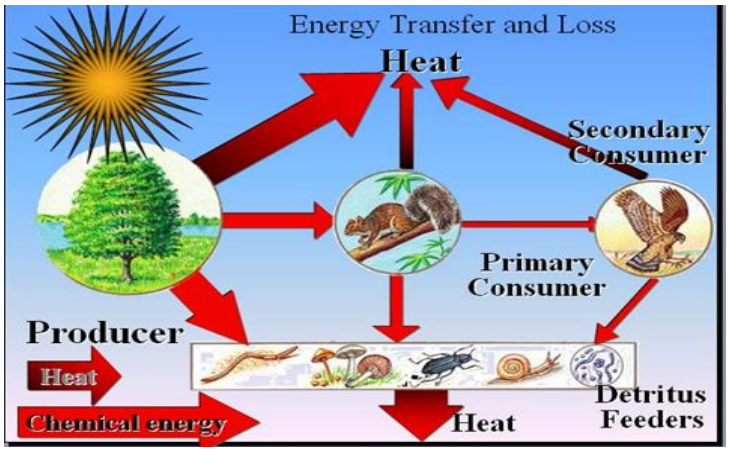


ENERGY FLOW IN AN ECOSYSTEM

(a) Universal energy flow model: Energy flow through an ecosystem was explained by E.P. Odum as the universal energy flow model. As the flow of energy takes place, there is a gradual loss of energy at every level, thereby resulting in less energy available at next trophic level as indicated by narrower pipes (energy flow) and smaller boxes (stored energy in biomass).

(b) Single channel energy flow model: The flow of energy takes place in a unidirectional manner through a single channel of green plants or producers to herbivores and carnivores. Illustrated the gradual decline in energy level due to loss of energy at each successive trophic level in a grazing food chain.

(c) Double channel or Y-shaped energy flow model: In nature, both grazing food chain and detritus food chain operate in the same ecosystem.



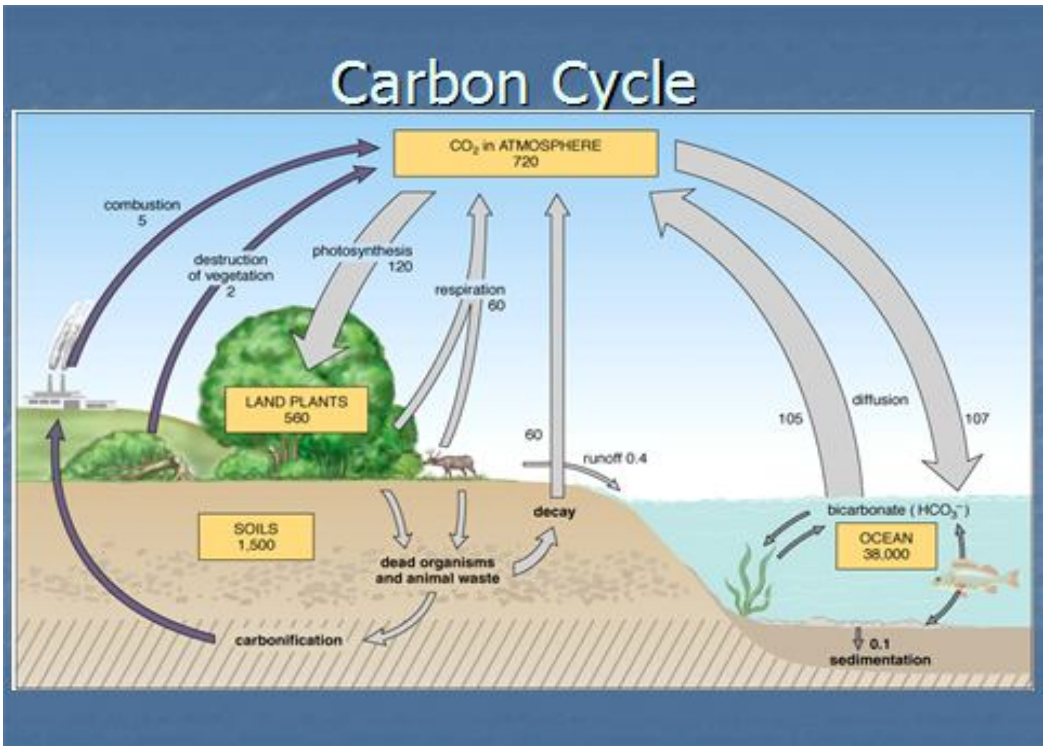
Biogeochemical cycles are two types

1. Gaseous cycle e.g. carbon, nitrogen, oxygen.

2.Sedimentary cycle e.g. phopsphorus, sulphur.

Carbon cycle

- Carbon is one of the most important elements.
- It is building block of life constituent of all organic components.
- Carbon is an essential constituent of carbohydrates, proteins, fats and a large number of organic components.
- Corbondioxide of the atmosphere and that dissolved in natural water is the main source of carbon.



Nitrogen cycle

- Nitrogen is an essential constituent of animals and plants.
- Which it is present as amino acids and proteins.
- Proteins are the building block of all living tissues.
- It is present 78% in the atmosphere

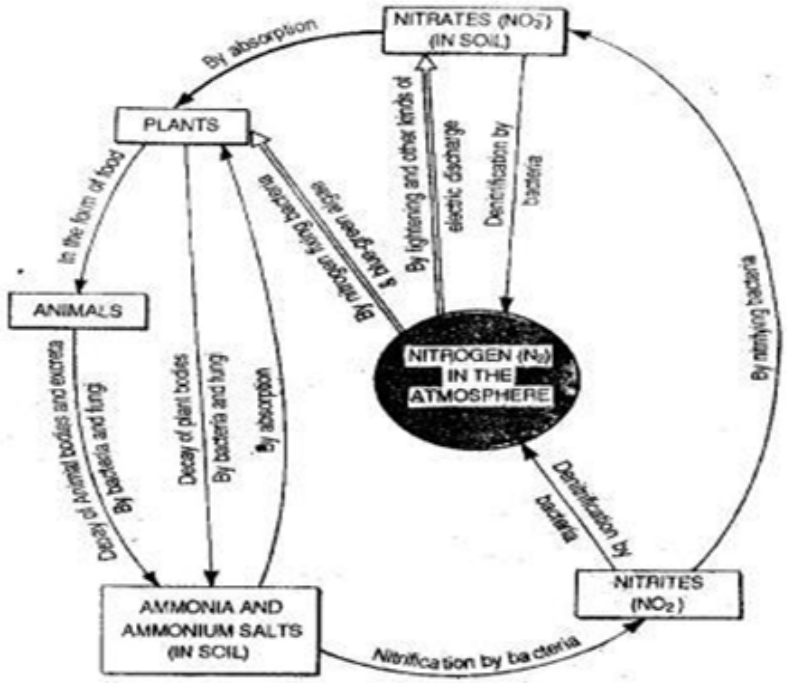


Fig. 6. Nitrogen cycle in nature.

Phosphorus cycle

- Phosphorus plays a vital indispensable role in living organisms.
- It is useful to growth and maintains of bones and teeth.
- We get glucose for photosynthesis of green plants.
- Green plants take phosphorus and nitrogen in the form of salts.

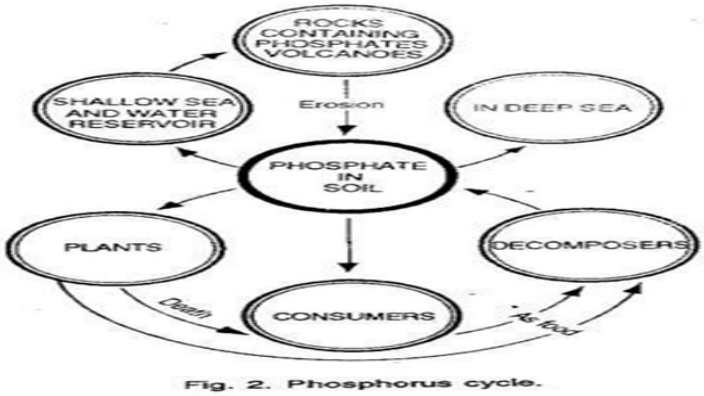


Fig. 2. Phosphorus cycle.

ECOLOGICAL SUCCESSION

Ecological succession is defined as an orderly process of changes in the community structure and function with time mediated through modifications in the physical environment and ultimately culminating in a stabilized ecosystem known as climax.

Ecological successions starting on different types of areas or substrata are named differently as follows:

(i) Hydrarch or Hydrosere: Starting in watery area like pond, swamp and bog.
(ii) Mesarch: starting in an area of adequate moisture.
(iii) Xerarch or Xerosere: Starting in a dry area with little moisture. They can be of the following types:
Lithosere: starting on a bare rock.
Psammosere: starting on sand.
Halosere: starting on saline soil.

Process of Succession

The process of succession takes place in a systematic order of sequentialsteps as follows:

(i) Nudation: It is the development of a bare area without any life form.
(ii) Invasion: It is the successful establishment of one or more species on a bare area through dispersal or migration, followed by ecesis or establishment
(iii) Competition and coaction: As the number of individuals grows there is competition, both inter-specific (between different species) and intra-specific (within the same species), for space, waterand nutrition. They influence each other in a number of ways, known as coaction.
(iv) Reaction: The living organisms grow, use water and nutrients from the substratum, and in turn, they have a strong influence on the environment which is modified to a large extent and this is known as reaction.
(v) Stabilization: The succession ultimately culminates in a more or less stable community called climax.

Major Ecosystems:

Forest ecosystems:

Depending upon the prevailing climatic conditions forests can be of various types

- **Tropical rain forests** are evergreen broadleaf forests found near the equator.
- **Tropical deciduous forests** are found a little away from the equator and are characterized by a warm climate the year round.
- **Tropical scrub forests** are found in areas where the dry season is even longer.

- **Temperate rain forests** are found in temperate areas with adequate rainfall.
- **Temperate deciduous forests** are found in areas with moderate temperatures.
- **Evergreen coniferous forests** are found just south of arctic tundra.

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Grassland Ecosystems:

Grasslands are dominated by grass species but sometimes also allow the growth of a few trees and shrubs. Rainfall is average but erratic.

Three types of grasslands are found to occur in different climatic regions:

- **Tropical grasslands** occur near the borders of tropical rain forests in regions of high average temperature and low to moderate rainfall. In Africa, these are typically known as **Savannas,** which have tall grasses with scattered shrubs and stunted trees.
- **Temperate grasslands** are usually found on flat, gentle sloped hills, winters are very cold but summers are hot and dry. Intense grazing and summer fires do not allow shrubs or trees to grow. In United States and Canada these grasslands are known as **Prairies,** in South America as **Pampas,** in Africa as **Velds** and in Central Europe and Asia they are known as **Steppes.**
- **Polar grasslands (Arctic Tundra)** are found in Arctic Polar region where severe cold and strong, frigid winds along with ice and snow create too harsh a climate for trees to grow. A thick layer of ice remains frozen under the soil surface throughout the year and is known as **permafrost.**

Desert ecosystem: Six percent of the world's land surface area is desert. Deserts receive less than 25 cm of rainfall annually.

Deserts are of 3 types, based on climatic conditions.

- **Tropical deserts** like Sahara and Namibia in Africa and Thar desert in Rajasthan, India are the driest of all with only a few species. Windblown sand dunes are very common.
- **Temperate deserts** like Mojave Desert in southern California where day time temperatures are very hot in summer but cool in winters.
- **Cold deserts** like the Gobi desert in China have cold winters and warm summers.

Aquatic ecosystems: Aquatic ecosystems dealing with water bodies and the biotic communities present in them are either fresh water or marine. Fresh water ecosystems are further of standing type (lentic) like ponds and lakes or free flowing type (lotic) like rivers.

Pond ecosystem: It is a small fresh water ecosystem where water is stagnant. Ponds may be seasonal in nature i.e. receiving enough water during rainy season. They contain several types of algae, aquatic plants, insects, fishes and birds.

Lake ecosystems: Lakes are usually big fresh water bodies with standing water. They have a shallow water zone called littoral zone, an open water zone

where effective penetration of solar light takes place called limnetic zone and a deep bottom area where light penetration is negligible, known as profundal zone.

Organisms: The lakes have several types of organisms

- **Planktons** that float on the surface of waters e.g. Phytoplankton's and zoo planktons.
- **Nektons**that swim e.g. Fishes.
- **Neutrons**that rest or swim on the surface
- **Benthos** that is attached to bottom sediments e.g. Snails.
- **Periphytons**that are attached or clinging to other plants e.g. Crustaceans.

Streams: These are fresh water aquatic ecosystems where water current is a major controlling factor, oxygen and nutrient in the water is more uniform and land-water exchange is more extensive. Although stream organisms to face extremes of temperatures and action of currents as compared to pond or lake organisms, but they do not have face oxygen deficiency under natural conditions.

River Ecosystem: Rivers are large streams that flow downward from mountain highlands and flowing through the plains fall into the sea. So the river ecosystems show a series of different conditions.

- The mountain highland part has cold, clear waters rushing down as water falls with large amounts of dissolved oxygen
- In the second phase on the gentle slopes, the waters are warmer and support a luxuriant growth of plants and less oxygen requiring fishes
- In the third phase, the river waters are very rich in biotic diversity. Moving down the hills, rivers shape the land

Oceans : Oceans cover approximately 70% of the earth's surface: therefore, they form the largest of all the ecosystems. Oceans are very large bodies of water characterized by high salinity of water *(3.5%)*. The major ocean ecosystems of the world are those of the Atlantic, Pacific, Indian, Arctic and Antarctic oceans.

The oceans have two major life zones

- Coastal zone with relatively warm, nutrient rich shallow water. Due to high nutrients and ample sunlight this is the zone of high primary productivity.
- Open sea – It is the deeper part of the ocean, away from the continental shelf (The submerged part of the continent). It is vertically divided into 3 regions
    - Euphotic zones which receives abundant light and shows high photosynthetic activity
    - Bathyl zone receives dim light and is usually geologically active
    - Abyssal zone is the dark zone, 2000 to 5000 meters deep. The abyssal zone has no primary source of energy i.e. solar energy. It is the world's largest ecological unit but it is an incomplete ecosystem.

Estuary: An estuary is a partially enclosed coastal area at the mouth of a river where fresh water and salty sea water meet.

- **These are the transition zones** which are strongly affected by tidal action.
- **Constant mixing of** water stirs up the silt which makes nutrients available for the primary producers.
- **There are wide variations** in the stream flow and tidal currents at any given location diurnally, monthly and seasonally.
- **Therefore the organisms** present in estuaries show a wide range of tolerance to temperature and salinity. Such organisms are known as eurythermal and euryhaline.
- **Coastal bays and tidal marshes** are examples of estuaries.

UNIT-II

Assignment-cum-tutorial questions

Section-A

1. Pyramid of energy is always----------.
2. Detritivores are also known as ----------.
3. In United States and Canada the temperate grasslands are known as ----------
4. In an ecosystem the example of producer is green plant, example of consumer is animal, and example of decomposer is ----------.
5. Algae are eaten by insects and insects are eaten by the fish. In this food chain, algae are primary producer, insect is primary consumer and fish is---------- consumer.
6. The cold and dark zone at the bottom of the ocean is called as----------.
7. The complex interacting network of plants, animals and microorganisms is called as----------.
8. The orderly process of transition from one biotic community to another in a given area is known as----------.
9. Which of the following statement is/are correct? ( )
   (I) Phytoplanktons→Small Fish→ Zooplanktons→ Big Fish
   (II) Grass→Insects→Frog→Snake→Hawk
   (III) Zooplanktons→Fish→Phytoplanktons
   (IV) Phytoplanktons→Zooplanktons→Fish ( )
   (a) Only I (b) II & III (c) Only II (d) I, II, III, & IV
10. Match the List-I and list-II and select the correct answer from the codes given below the list. ( )

List-I	List-II
(A) Producers	(1) Bacteria & Fungi
(B) Omnivores	(2) Termites & Crab
(C) Detritivores	(3) Birds & Human beings
(D) Decomposers	(4) Plants & Chemoautotrophic

codes

	A	B	C	D
(a)	4	3	2	1
(b)	1	2	3	4
(c)	4	3	1	2
(d)	1	2	4	3

11. Which of the following statement is/are correct ( )
    (I) Herbivores depends on carnivores
    (II) Carnivores depends on herbivore
    (III) Top carnivores depends on carnivores
    (IV) Producers depends on herbivores
    (a) Only I (b)I&II (c)II&III (d)I, II, III, IV

12. Consider the following statement ( )
    (I) Energy flow in an ecosystem is bidirectional
    (II) Energy flow in an ecosystem is multidirectional
    (III) Energy flow in an ecosystem is unidirectional
    (a) Only I (b) I&II (c) Only III (d) I, II &III
13. In nitrogen cycle elemental nitrogen returns to the atmosphere by the following process. ( )
    (a) Nitrogen fixation (b) Ammonification
    (c) Nitrification (d) Denitrification
14. Which of the following statement is/are correct ( )
    (I) Grassland ecosystem show inverted pyramid regarding number
    (II)) Pond ecosystem show upright pyramid regarding energy
    (III)) Forest ecosystem show inverted pyramid regarding energy
    (IV) Parasitic food chain show inverted pyramid regarding number
    (a) Only I (b) II&IV (c) Only III (d) I, II,III&IV
15. Match the List-I and list-II and select the correct answer from the codes given below the list ( )

List-I	**List-II**
(A) Lithosere	(1) Starting in a dry area
(B) Psammosere	(2) Starting on a bare rock
(C) Halosere	(3) Starting on sand
(D) Xerosere	(4) Starting on saline soil

Codes

	A	B	C	D
(a)	1	2	3	4
(b)	4	3	2	1
(c)	1	2	4	3
(d)	4	3	1	2

16. Which of the following statement is/are correct ( )
    (I) Nudation is the development of a bare area without any life form
    (II) Invasion is the successful establishment of one or more species on a bare area
    (III) Coaction is influence each other in a number of ways
    (IV) Stabilization is ultimately culminates in a more or less stable community
    (a) Only I (b)II&IV (c) Only III (d) I, II,III&IV

Section-B

Short Answer Questions

1. Define ecology.
2. Define ecosystem.
3. What is food chain?
4. What is food web?

5. List types of food chains.
6. What is grazing food chain?
7. What is detritus food chain?
8. Define ecological pyramids.
9. List energy flow models.
10. Define biogeochemical cycle.
11. What is ecological succession?
12. Compare gaseous cycle with sedimentary cycle?
13. Define carbon cycle.
14. Explain process of ecological successions.
15. How elemental nitrogen converted to nitrates in the presence of non-living things?

Long Answer Questions

1. Identify significance of food chain and food web.
2. Show energy cycle in an ecosystem.
3. Show complex ecosystem is more stable than one with few species.
4. Identify process of nitrogen cycle.
5. Categorize biotic components.
6. Distinguish between food chain and food web.
7. Compare grassland ecosystem structure with pond ecosystem structure.
8. Divide bio-geo-chemical cycles.
9. Classify ecological pyramids.
10. Examine energy flow models.
11. Dissect ecological succession.
12. Analyze structural attributes of ecosystem.
13. Simplify functional features of ecosystem.
14. Discuss characteristics of ecosystem.

UNIT-III

Objectives:

- Basic understanding of ecosystem and its diversity
- To understand how species are related to each other, protection and preservation of their habitat

Outline of the chapter

- Introduction
- Definition
- Genetic and Ecosystem diversity
- Bio-geographical classification of India
- Values of biodiversity: consumptive use, productive use, social, ethical, Aesthetic, option values and ecosystem service values
- India as a mega diversity nation
- Threats to biodiversity: habitat loss, poaching of wild life
- Man- Wild life conflicts
- Endangered and endemic species of India
- Conservation of biodiversity: In – situ and Ex-situ conservation of biodiversity.

Learning Outcomes: Students will be able to:

- know the biogeography boundaries of the nation
- understand the difference between Direct and Indirect Values of Biodiversity
- recognize the Mega diversity of the nation
- identify threats to Biodiversity
- list remedial measures to check the conflicts of biodiversity
- distinguish between endangered and endemic species of the nation
- analyze conservative methods of Biodiversity

TEACHING LEARNING MATERIAL

INTRODUCTION:

Biodiversity is a neologism and a portmanteau word from bio and diversity. Thomas love joy coined the term biological diversity in 1980 and Watter Rosen American scientist coined the word biodiversity in 1985.and is used widely since 1992 Rio Earth Summit in which over 150 countries promised to protect the biodiversity of their countries and also of other poorer countries. The year 2010 has been declared as the international year of biodiversity.

Bio=living

Diversity= richness of species i.e., Population

Definition:

Biodiversity has been defined as the variability among living organisms from all sources including inter ali, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part.

LEVELS/TYPES OF BIODIVERSTIY

The three types of biodiversity are:

1) GENETIC LEVEL/GENETIC DIVERSTIY
2) SPECIES LEVEL/SPECIES DIVERSITY
3) ECOSYSTEM LEVEL/ECOSYSTEM DIVERSITY

GENETIC DIVERSIYT(OR)GENETIC LEVEL:

- The variation of genes in a species in called as genetic diversity.
- The variation can be in shape, size, quality, resistance to insects, pests and diseases and ability to withstand adverse conditions of environment.
- Genes are the basic units of hereditary information transmitted from one generation to other.
  Ex: The number of genes in E. coli is about 4000
  Rice 32,000 to50,000
  Man 35,000 to45,000
- The genes found in organisms can form enormous number of combinations each of which gives rise to some variability.

SPECIES DIRVESITY:

- Species diversity is the number of different species of living things in an area.
- Species is a group of plants or animals that are similar and able to breed and produce viable off spring under natural conditions.

Species diversity can be understood of two parameters namely:

- Species richness: is the number of species per unit area.
- Species evenness: is the evenness of individual in a species.

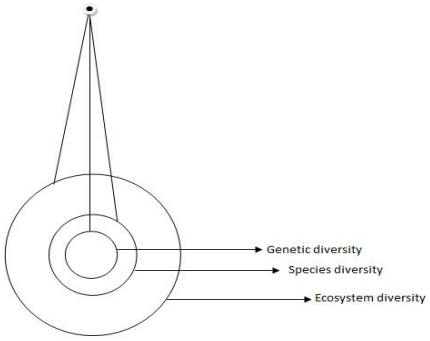
ECOSYSTEM DIVERSITY:

Ecosystem diversity refers to variety of ecosystems in a particular region (or) ozone.

Ex: Forests, grasslands,deserts,aquatic ecosystems like freshwater,marine,croplands etc.

These three levels of biodiversity must work together to create the complexity of life on earth.

Diagram:



BIOGEOGRAPHICAL CLASSIFICATION OF INDIA

The study of the geographical distribution of biological species related to the geological, climatological, geographical, biological reasons for the distribution is called biogeography.

- India is one of the top rich countries in biodiversity.
- India has different types of climate & topography in different parts of the country & these variations have induced enormous variability in flora and fauna.
- India occupies the tenth position among the plant rich nations of the world.

- Biogeography comprising of phytogeography and zoogeography deals with these aspects of plants and animals.
- In order to gain insight about the distribution and environmental interactions of flora and fauna of our country it has been classified into 10 biogeographic zones.

Each of these zone has its own characteristic climate,soil topography and biodiversity.

1) TRANS-HIMALAYAS
2) HIMALAYAS
3) DESERT
4) SEMI-ARID
5) WESTERN GHAT
6) DECCAN PENINSULA
7) GANGETIC PLAIN
8) NORTH-EAST INDIA
9) ISLANDS
10) COASTS

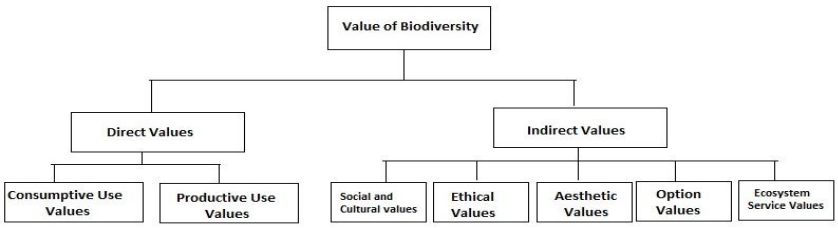
India's major biogeographic habitats:

S.No	Biogeographic Zone	Biotic, Province
	Trans- Himalyan	Upper Regions
	Himalayan	North – West Himalayas West Himalayas Central Himalayas East Himalayas
	Desert	Kutch Thar Ladakh
	Semi-Arid	Central India Gujarat-Rajwara
	Western Ghats	Malabar Coast Western Ghat Mountains
	Deccan Peninsula	Deccan Plateau South Central Plateau Eastern Plateau Chhota Nagapur Central Highlands
	Gangetic Plain	Upper Gangetic Plain Lower Gangetic Plain

	North-East India	Brahmaputra Valley North-Eastern Hills
	Islands	Andaman Islands Nicobar Islands Laskhadweep Islands
	Coasts	West Coast East Coast

VALUES OF BIODIVERSITY

The multiple uses of biodiversity or biodiversity valueshave been classified by MC Neely et al in 1990 as follows:



DIRECT VALUES:

1. CONSUMPTIVE USE VALUE:
   - These are direct use values where the biodiversity product can be harvested & consumed directly.
   - These goods are consumed locally & do not figure in national & international market.

a) Food:

- A large number of wild plants & animals are consumed by human beings as food.
- About 80,000 edible plant species & 90% of present day food crops have been domesticated from wild tropical plants.

b) Drugs and Medicines:

- About 75% of the world's population depends upon plants or plant extracts for medicines.

Examples:

Quinine: Anti malaria drug obtained from cinchona tree

Penicillin: A famous antibiotic is derived from penicillium, a fungus.

Tetracycline: It is obtained from bacterium.

Digitalin: It is obtained from foxglove (Digitalis) to cure for heart ailments.

Vinblastin and Vincristine: These two are obtained from periwinkle (catharanthus) plant, which possesses anti-cancer alkaloids & large number of marine animals are supposed to possess anti – cancer properties.

Fuel:

- Since ages forests have provided wood which is used as a fuel by tribals & local villagers. Moreover fossil fuels like coal, petroleum, natural gas are also product of biodiversity, hence falls under consumptive value.

2. PRODUCTIVE USE VALUES:

These are the direct use values where the product is commercially sold in national & International market.

Examples: Textile, Leather, Silk, Paper & Pulp industry etc.

International ban on trade ofproducts from endangered species like tusks of elephants.

a) Indirect Values:

- Biodiversity provides indirect benefits to human beings which support the existence of biological life & other benefits which are difficult to quantify.

These includes

- Social & cultural values
- Ethical values
- Aesthetic value
- Option values
- Ecosystem service value

b) Social & Cultural Value:

- Many plants & animals are considered holy & sacred in India & are worshipped like Tulsi, Peepal, Cow, Snake etc.

- In Indian society great cultural value is given to forest, tiger, peacock & lotus are named as national animal, bird & flower respectively.

c) Ethical Value:

- These values are related to conservation of biodiversity where ethical issue of "all life forms must be preserved" is laid down.
- It is based on the concept of "Live and Let Live".
- All species have a moral right to exist independent of our need for them.

d) Aesthetic Value:

- People from far& wide spend lot of time & money for recreational activities like bird watching, photography etc this type of tourism is now known as Eco-tourism.
- The willingness to pay concept.
- Ecotourism is estimated to generate about **12** billion dollars of revenue annually.

e) Option Values:

- These values include the potentials of biodiversity that are presently unknown & need to be explored.
- There is a possibility that we may have some potential cure for AIDS or cancer within the depths of marine ecosystem or a tropical rainforest.

f) Ecosystem Service Value:

a) The most important benefit of biodiversity is maintenance of Ecosystem service value such as

- Prevention of Soil erosion
- Prevention of floods
- Maintenance of Soil fertility
- Cycling of Nutrients
- Fixation of Nitrogen
- Cycling of water, their role as carbon sinks
- Pollutant absorption
- Reduction of the threat of global warming etc.,

INDIA AS A MEGA DIVERSITY NATION

India is one of the 12-mega-diversity countries in the world. The MoEF – Ministry of Environment and Forests, Government of India (2000) records 47,000 species of plants, 81,000 species of animals which is about is 6.5% respectively of global flora & fauna.

ENDEMISM:
Black footed gray langur

- Species which are restricted only to a particular area are known as endemic.
- About 62% of amphibians
- 50% of lizards are endemic to India.
- Western Ghats are the site of maximum endemism.

a) Center of Origin:

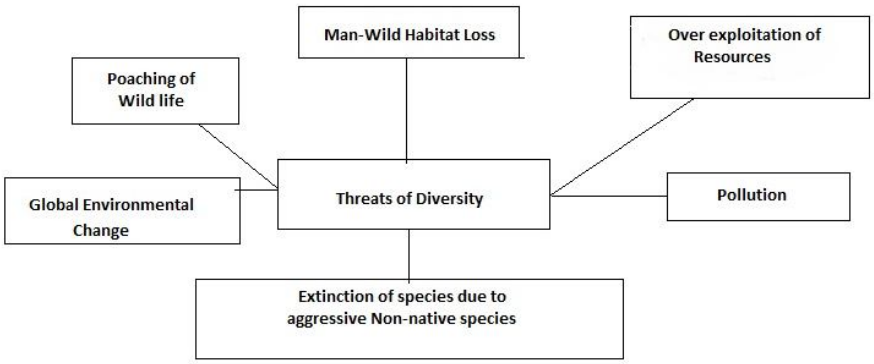
- A large number of species are known to have originated in India.
- Nearly 5000 species of flowering plants.
- 166 species of crop plants.
- 320 species of wild relatives of cultivated crops are located in India.

b) Marine Diversity:

Mangroves	Estuaries
	
Coral reefs	**Backwaters**

- Along 7,500 km long coastline of our country in mangroves,estuaries,coral reefs, backwaters etc.,
- More than 340 species of corals of the world are found here.
- It is rich in mollusks, crustaceans, polychaetes & corals.
- Mangrove plants & sea grasses are also found in our country.
- There are about **93** major wet lands are present in India.
- Indian forests cover 64.01 million hectares having a rich biodiversity.

THREATS TO BIODIVERSITY



Major Biodiversity Threats are:

- ❖ Loss of Habitat
- ❖ Poaching
- ❖ Man-Wild life Conflicts

➢ **Loss of Habitat:**

- ➢ Destruction & loss of natural habitat is the single largest cause of biodiversity loss.
- ➢ Habitat fragmentation is the division of habitat into small and scattered patches due to development of roads, Industries etc., in an original large habitat.

➢ **Poaching:**

- ➢ Illegal trade of wild life products by killing prohibited endangered animals commercially wild animals & hunted for

their produces such as skin, tusk, fur & decoration purposes.

- **Man – Wild life Conflicts:**
  - Usually the ill, weak & injured animals have a tendency to attack man.
  - Very often the villagers put electric wiring around their rip crop fields. The elephants get injured, suffer in pain & turn violent.
  - Earlier there used to be wild life corridors through which the wild animals used to migrate seasonally in groups to other areas. Due to the development of human settlements in these corridors, the path of the wild life has been disturbed & the animals attack the settlements.
  - Human encroachment into the forest areas arises a conflict between man & wildlife, perhaps because it is an issue of survival of both.
  - Earlier, forest departments used to cultivate paddy, sugarcane etc., within the sanctuaries when the favorite staple food for elephants i.e. bamboo leaves were not available.
  - The cash compensation paid by the government in lieu of the damage caused to the former crop is not enough.

Examples:

In Mysore, a farmer gets a compensation of Rs.400/- per quintal of expected yield while the market price is Rs.2,400/- per quintal.

REMEDIAL MEASURES TO CURB THE CONFLICTS

- Adequate crop compensation & cattle compensation scheme must be started along with substantial cash compensation for loss of human life.
- Natural forests are being deforested for timber & single species trees like teak, sal. This monoculture plantation creates imbalance ecosystem.
- Natural size of forest are reducing because of human encroachment, therefore animals often attack on human society & creates violence.
- Solar powered fencing should be provided along with electric current proof trenches to prevent the animals from straying into fields.
- Cropping pattern should be changed near the forest boarders & adequate fodder, fruit and water should be made available for the elephants within the forest zones.

- Wildlife corridors should be provided for mass migration of big animals during unfavorable periods. About 300 km^2 area is required for elephant corridors for their seasonal migration.
- In Similipal sanctuary, Orissa there is a ritual of wild animal hunting during the months of April – May for which forest is burnt to flush out the animals. Due to massive hunting by people, there is a decline in prey of tigers & they start coming out of the forest in search of prey. Now there is WWF- TCP initiative to curb this ritual of "Akhand Shikar" in Orissa.

- Tiger Conservation Project (TCP) has made provisions for making available vehicles, transquillizer guns, binoculars & radio sets etc., to tactfully deal with an imminent danger.

ENDANGERED AND ENDEMIC SPECIES OF INDIA

a) ENDEMISM:

- Species which are restricted only to a particular area is known as endemism.
- India has two biodiversity hotspots & thus possesses a large number of endemic species i.e., eastern Himalayas, Western Ghats out of about 47,000 species of plants in our country 7,000 are endemic. Thus the Indian subcontinent has about 62% endemic flora restricted mainly to Himalayas, Khasi Hills & Western Ghats.
- Some of the Important endemic flora include orchids & species like Sapria himalayana, Uvaria lurida etc.,
- A large number out of total of 81,000 species of animals in our country is endemic. The western Ghats are particularly rich in amphibians (frogs, toads, etc.,) Reptiles (Lizards, Crocodiles)
- About 62% amphibians & 50% lizards are endemic to Western Ghats.

Examples:

Toothbrush Orchid	Nepenthes Khasiana	Monitor Lizards
		

Reticulated Python	Indian Salamander	Viviparous toad- Nectophhryne
		

- International Union for conservation of Nature and Natural Resources (IUCN) publishes the Red Data book, which includes list of endangered species of plants & animals.
- This red data symbolizes the warning signal for those species which are endangered & if not protected are likely to become extinct in near future.
- In India nearly 450 plant species are under endangered, threatened or rare.
- Existence of about 150 mammals, 150 bird species is estimated to be threatened.

b) <u>ENDANGERED:</u>

A species is said to be endangered when its number has been reduced to a critical level or whose habitats, have been drastically reduced.

Example:

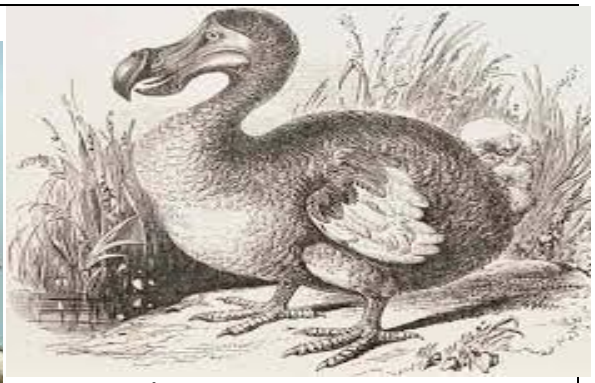
Bengal Tiger	Asciatic Lion	Snow Leopard
		
Black buck	**Red Panda**	**One Horned Rhinoceros**
		
Nilgiri Tahr	**Kashmir Red Stag**	

c) EXTINCT:

- A species is said to be extinct when it is not seen in wild for 50 years at a stretch.

Examples:

Passenger pigeon



Dodo

d) VULNERABLE:

- A species is said to be vulnerable category if its population is facing continuous decline due to over exploitation habitat destruction.

Examples:

Great Indian Bustard

Grey Jungle fowl

Dolphin

Lion-Tailed Macaque	Indian Bison
	

RARE SPECIES:

- Species which are not endangered or vulnerable at present, but are at a risk category.

Examples:

- Hornbill, Asiatic Buffalo, Desert fox.

CONSERVATION OF BIODIVERSITY

Definition:

Protection & preservation of species for present as well as for future usage is known as "conservation".

There are two approaches of biodiversity conservation.

a) In – Situ Conservation
b) Ex – Situ Conservation

a) In – Situ Conservation: [within habitat]

This is achieved by protection of wild life flora & fauna in Nature itself.

Example: Biosphere Reserves – 147
National Parks – 80
Wild life sanctuaries – 420
120 – Botanical gradens.

a) Biosphere Reserves: The man & biosphere (MAB) programme of UNESCO brought the concept of Biosphere reserves in 1975. The Biosphere reserves are protected areas of land / or coastal environments where in people are an integral component of the system, it is usually more than 5,000 km^2 in area -14

Example: Sunderbans -West Bengal
Gulf of manar – T .N
The Nilgiri – T .N
Nanda Devi -Utarakhand
Nokrek-Meghalaya

b) National Parks: National Park is an area exclusively reserved for the welfare of wild life and activities such as forestry.

Example:

Kaziranga National park – Assam – Single horned Rhino 	Gir National Park – Gujarat – Indian Lion 	Periyar National Park – Kerala – Elephant, Tiger 

c) **Wildlife sanctuaries:** A wild life sanctuary is an area allocated for the conservation of animals only. Timber harvesting, collection of forest produces and private ownerships are allowed, but such activities shall not affect the animals adversely.

Example:

Ghana Bird sanctuary – Rajasthan – 300 species of birds (Including Migratory) 	Hazaribagh Sanctuary – Bihar – Tiger, Leopard 
Mudamalai bird sanctuary – Tiger, Elephant, Leopard  Leopard	Wild Ass Sanctuary – Gujarat – Wild ass, wold, Nilgai, Chinkara 

These two are meant for the protection of one (or) more species & their habitats.

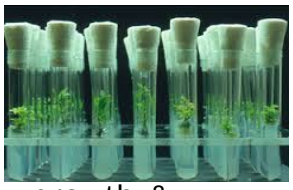
They are usually small reserves which on an average range between 100 km^2 to 500 km^2.

d) **Ex-situ Conservation:** [Outside habitats] This is done by the establishment of gene banks, seed banks, 200, botanical gardens cultural collections etc.,

- **Bolanical / zoological gardens :** Aquarium & research centers

- **National Bureau of plant Genetic Resources (NBPGR):** It is located in New Delhi. Here agricultural and horticultural crops & their wild relatives are preserved by Cryo – preservation of seeds, pollens etc., by using liquid nitrogen at temperature as low as – 196^0C.
- A seed could remain viable for 5 – 25 years at -5^0 c but it could be viable for hundred years if preserved at 20^0 C.

- **National Bureau of Animal Genetic Resources: (NBAGR)** Located at karnal, Haryana. It preserves the semen of domesticated bovine animals.
- **National Facility for plant Tissue culture Repository: (NFPTCR)** for the department of a facility of conservation of variety of crop plants / trees by tissue culture. This
- facility has been created within the NBPGR.



e) In Vitro [In glass]: This refers to the storage under laboratory conditions. The meristem tips, buds & stem tips are kept under low temperature [-3^0C to 12^0C] for slow growth & long storge.

THE BIOLOGICAL DIVERSITY ACT, 2002 : An Act to provide for conservation of biological diversity, sustainable use of its components and fair and equitable sharing of the benefits arising out of the use of biological resources, knowledge and for matters connected therewith or incidental thereto.

WHEREAS India is rich in biological diversity and associated traditional and contemporary knowledge system relating thereto.

AND WHEREAS India is a party to the United Nations Convention on Biological Diversity signed at Rio de Janeiro on the 5th day of June, 1992; AND WHEREAS the said Convention came into force on the 29th December, 1993;

AND WHEREAS the said Convention reaffirms the sovereign rights of the States over their biological resources;

AND WHEREAS the said Convention has the main objective of conservation of biological diversity, sustainable use of its components and fair and equitable sharing of the benefits arising out of utilization of genetic resources;

AND WHEREAS it is considered necessary to provide for conservation, sustainable utilization and equitable sharing of the benefits arising out of

utilization of genetic resources and also to give effect to the said Convention.

UNIT-III

Assignment cum Tutorial questions

SECTION-A

Objective Questions.

1. When variations occur within a species due to new combinations of genes, this is called.....diversity.

2. Match the following:

List-I	List-II	[ ]
A) Endemism	1) Illegal trading of animals	
B) Diversity	2) Immediate danger	
C) Endangered	3) Richness of species	
D) Poaching	4) Restricted to a particular area	

(a) A-2,B-3,C-4,D-I (b)A-4,B-3,C-2,D-1

(c)A-3,B-2,C-1,D-4 (d)A-1,B-4,C-3,D-2

3. Match the following:

List-I	List-II	[ ]
A) NBPGR	1) Preserves semen	
B) NBAGR	2) Preservation of seeds	
C) NFPTCR	3) Preservation of meristems	
D) Invitro-preservation	4) Preserves crop& plants by tissue culture	

(a)A-2, B-1, C-4, D-3 (b) A-3, B-4, C-2, D-1

(c) A-1, B-2, C-3, D-4 (d) A-4, B-3, C-1, D-2

4. Illegal trading of wild animals is termed as [ ]

(a)Poaching b) Fragmentation c) Habitat loss d) Invasion of Exotic species

5. Quinine is obtained from the bark of .....tree.

6. Species restricted only to a particular area are called.....

7. Vinblastin and vincristine these two anti-cancer drugs have been obtained from [ ]

(a) Periwinkle b) Cinchona c) Bacterium d) Jelly fish

8. Red data book giving the list of endangered species of plants and animals is published by.....

9. Nanda Devi, Manas and Sunder bans are examples of .....

10. Which of the following is an example of ex-situ conservation [ ]

(a) Biosphere reserve b) Gene bank c)Sanctuary d) All of the above

11. Kaziranga national park is famous for [ ]

(a) One horned rhino b)Hangul c)Tiger d) Elephant

12. India has on record 47,000 species of plants and 81,000 species of animals (True/False)

13. Cryopreservation of plant seeds and pollen is done at a very low temperature of -196^{0}C by using [ ]

a) Ice b)Carbon tetrachloride c)Liquid nitrogen d) Ammonia

14. Illegal killing of prohibited endangered animals is called.....

SECTION-B

Descriptive questions

1. Define biodiversity.
2. What is genetic diversity?
3. What is species diversity?
4. What do you mean by point, α,β and γ richness.
5. Define Endemic species.
6. Define Endangered Species.
7. What do you mean by Extinct, vulnerable & Rare species.
8. Define Threats.
9. Define Poaching.
10. Write importance of Red data book.
11. Define conservation.
12. Define In-Situ Conservation.
13. Define Ex-Situ Conservation.

Essay Questions:

1. a) List levels of biodiversity. (6M)
   b) Write bio-geo-graphical zones of India. (6M)
2. a) Enumerate values of biodiversity.(12M)
3. a) Why India is a mega diversity nation.(6M)
   b) List direct values of biodiversity.(6M)
4. a) List endangered and endemic species of India.(6M)
   b) Enumerate indirect values of biodiversity.(6M)

5 a) Define threats and poaching.(4M)
   b) Identify major threats to biodiversity.(8M)

6. a) What is in-situ conservation? List in-situ conservation practices.(6M)
   b) Define ex-situ conservation. Write ex-situ conservation practices.(6M)

Environmental Studies
Learning Material

UNIT-4
ENVIRONMENTAL POLLUTION

Objectives:

- To provide causes, effects and control measures of environmental pollution
- To understand basics of Radioactive pollution.

Syllabus:

UNIT IV : Environmental pollution

Definition, cause, effects and control measures of

a) Air pollution
b) Water pollution
c) Noise pollution
d) Soil pollution
e) Radioactive pollution

Prescribed text books:

- Environmental studies:Anubha Kaushik, C.P. kaushik., New age International Publishers., P.No.177 to 204.
- Environmental Science and Engineering: P.Anandan, R.Kumaravelan, Scitech Publications., P.No. 3.1to 3.37.
- Environmental studies:R.Rajagopalan, Oxford University Press, P.No. 169 to 201.
- Environmental studies: Deeksha Dave, P.Udaya Bhaskar, Cengage Learning, P.No. 164 to 189.

Outcomes:

Students will be able to:

- trace causes, effects, control measures of air pollution.
- list out main categories of water pollutants and their effects.
- describe effects of noise pollution and control measures.
- design soil pollution control methods.
- analyze environmental impacts of radioactivity.

Learning Material

Environmental Pollution can be defined as any undesirable change in the physical, chemical or biological characteristics of any component of the environment (air, water, soil), which can cause harmful effects on various forms of life or property.

1. According to the form in which the pollutants persist after release into the environment, they may be primary or secondary.
   - **Primary pollutants** persisting in the environment in the form they are passed into it, e.g., DDT.
   - **Secondary pollutants** which are formed by reaction amongst the primary pollutants. For example, peroxyacetyl nitrate (PAN), are formed through reaction between nitrogen oxides and hydrocarbons in the presence of sunlight.

2. According to their existence in nature, the pollutants may be qualitative or quantitative.
   - **Qualitative pollutants** which do not normally occur in the environment but are passed into it through human activity, e.g., DDT and other pesticides, fungicides, herbicides, etc.
   - **Quantitative pollutants** become pollutants only when their concentration reaches beyond a threshold value in the environment, e.g., CO, CO2, nitrogen oxides.

3. According to their natural disposal, the pollutants may be biodegradable or non- biodegradable.
   - **Biodegradable pollutants** are actually waste products which are slowly degraded by microbial action. Pollution results when their production exceeds the capacity of the environment to degrade them.
   - **Non-biodegradable pollutants** which do not get easily decomposed. They include wastes (e.g., phenols, plastics, and glass or metallic containers) or poisons (e.g., pesticides like DDT, Salts of heavy metals, radioactive substance).

AIR POLLUTION

It is an atmospheric condition in which certain substances are present in concentrations which can cause undesirable effects on man and his environment.

Types and sources of air pollution:

- Air pollution occurs due to the presence of undesirable solid or gaseous particulate in the air, in quantities that are harmful to human health and the environment.
- The air may become polluted by natural causes such as volcanoes, which release ash, dust, sulphur and other gases, or by forest fires that are occasionally naturally caused by lighting.

- Pollutants that are emitted directly from identifiable sources are produced both by natural events (e.g., dust storms and volcanic eruptions) and human activities (emission from vehicles, industries, etc.).

- Secondary pollutants which are formed by reaction amongst the primary pollutants. For example, peroxyacyl nitrates (PAN), are formed through reaction between nitrogen oxides and hydrocarbons in the presence of sunlight.

Types of particulates

Term	Meaning	Examples
Aerosol	General term for particles suspended in air	Sprays from pressurized cans
Mist	Aerosol consisting of solid particles that are blown into the air or are produced from larger particles by grinding them down.	Sulfuric acid mist
Dust	Aerosol consisting of solid particles that are blown into the air or are produced from larger particles by grinding them down.	Dust storm
Smoke	Aerosol consisting of solid particles or a mixture of solid and liquid particles produced by chemical reaction such as fires.	Cigarette smoke, smoke from burning garbage.
Fume	Generally means the same as smoke but often applies specifically to aerosols produced by condensation of hot vapors of metals.	Zinc/lead fumes
Plume	Geometrical shape or form of the smoke coming out of a chimney.	

Fog	Aerosol consisting of water droplets	
Smog	Term used to describe a mixture of smoke and fog.	

Effects of air pollution on living organisms:

- Our respiratory system has a number of mechanisms that help in protecting us from air pollution.
- The hair in our nose filters out large particles. The sticky mucus in the lining of the upper respiratory tract captures smaller particles and dissolves some gaseous pollutants.
- Prolonged smoking or exposure to air pollutants can overload or breakdown these natural defenses causing or contributing to diseases such as lung cancer, asthma, chronic bronchitis and emphysema.
- Elderly people, infants, pregnant women and people with heart disease, asthma or other respiratory diseases are especially vulnerable to air pollution.
- Sulfur dioxide irritates the respiratory tissues, chronic exposure to it causes a condition similar to bronchitis.
- Nitrogen oxides, especially NO2, can irritate the lungs, aggravate asthma or chronic bronchitis and also increase our susceptibility to respiratory infections, like influenza or common colds.
- Suspended particles in the air aggravate our respiratory tract, leading to bronchitis and asthma. Prolonged exposure to these particles damages lung tissue and contributes to the development of chronic respiratory diseases and cancer.

Effects on plants:

- When some gaseous pollutants enter the leaf pores they damage the leaves of crop plants.
- Chronic exposure of the leaves to air pollutants can break down the waxy coating that helps prevent excessive water loss and leads to damage from diseases, pests, drought and frost.
- At higher concentrations of sulfur dioxide, most of the flower buds become stiff and hard. They eventually fall off from the plants, as they are unable to flower.
- Prolonged exposure to high levels of several air pollutants from iron smelters, coal-burning power plants and industrial units, as well as from vehicles, can damage trees and other plants.

Effects on human health:

- Human respiratory system has a number of mechanisms for protection from air pollution.
- Suspended particulates can cause damage to lung tissues and diseases like asthma, bronchitis and cancer especially when they

bring with them cancer causing or toxic pollutants attached on their surface.

- Sulphur dioxide causes constriction of respiratory passage and can cause bronchitis like conditions.
- Oxides of nitrogen especially NO2 can irritate the lungs and cause conditions like chronic bronchitis and emphysema.
- Carbon monoxide reaches lungs and combines with haemoglobin of blood to form carboxyhaemoglobin.

Effects of air pollution on materials:

- Every year, air pollutants cause damage worth billions of rupees.
- Air pollutants break down the exterior paint on cars and houses.
- All over the world, air pollutants have discolored irreplaceable monuments, historic buildings, marble statues, and other heritage and beauty sites.

Control measures for air pollution:

- Building higher smoke-stacks facilitates the discharge of pollutants as far away from the ground as possible. Industries should be carefully located so as to minimize the effects of pollution after considering the topography and the wind directions.
- Using low sulphur coal in industries.
- Removing NOx during the combustion process.
- Using non-conventional sources of energy.
- Using biological filters and bio-scrubbers
- Planting more trees.

Reduction of air pollution at source:

Gaseous pollutants:

Gaseous pollutants can be reduced by physical adsorption on porous solid materials like activated charcoal, silica gel, fuller's earth, etc. Effluent gases can be absorbed in liquid absorbent, e.g. SO_2 absorbed in ammonia solution.

Particulate Matter :

Many devices are available now-a-days, choice of which depends on characteristics of particulate, flow rate, collection efficiency, costs, etc.

Cyclones: The cyclone is very efficient for larger particles. However, smaller particles which pose human health are not removed efficiently. Therefore, cyclones are employed before the use of other costly devices.

Bag house filters: The device is efficient for removal of very small particles and is preferred in various types of industries. The bag house filters are expensive and cannot be operated for moist gases.

Wet scrubbers: The scrubbers are very useful for removal of toxic and acidic gases also.

Electrostatic precipitators: Electrostatic precipitators utilize electric energy and can efficiently remove even submicroscopic particles.

WATER POLLUTION

Introduction: water is the essential element that makes life on Earth possible. Although 71% of the Earth's surface is covered by water, only a tiny fraction of this water is available to us as freshwater. About 97% of the total water available on Earth is found in the oceans and is too salty for drinking or irrigation. The remaining 3% is fresh water. Of this, 2.977% is locked in ice caps or glaciers. Thus, only 0.003% of the Earth's total volume is eater is easily available to us as soil moisture, groundwater, water vapor and the water in lakes, streams, rivers and wetlands.

It is an alteration of physical, chemical and biological characteristics of water that makes unsuitable for designated use.

Point sources & non point sources of pollution: When a source of pollution can be readily identified because it has a definite source and place where it enters the water it is said to come from a point source, e.g., municipal and industrial discharge pipes. When a source of pollution cannot be readily identified, such as agricultural runoff, acid rain, etc., they are said to be non-point sources of pollution.

Causes of water pollution:

- There are several classes of common water pollutants. These are disease-causing agents (pathogens), which include bacteria, viruses, protozoa and parasitic worms that enter water from domestic sewage and untreated human and animal wastes. Human wastes contain concentrated populations of coli form bacteria such as Escherichia coli.
- Another category of water pollutants are oxygen-depleting wastes. These are organic wastes that can be decomposed by aerobic bacteria; large populations of bacteria use up the oxygen present in the water in order to degrade these wastes. In this process, this degrades the water quality the amounts of

biological oxygen demand (BOD). The amount of BOD in the water is an indicator of the level of pollution.

- The third class of pollutants is inorganic plant nutrients. These are water-soluble nitrates and phosphates that cause the excessive growth of algae and other aquatic plants. This excessive growth due to added nutrients is called eutrophication.
- A forth class of water pollutants is water-soluble inorganic chemicals, which are acids, salts and compounds of toxic metals such as mercury and lead. High levels of these chemicals can make the water unfit to drink, harm fish and other aquatic life, reduce crop yields, and accelerate the corrosion of equipment that is in contact with this water.
- Another class of water pollution is a variety of organic chemicals, which include oil, gasoline, plastics, pesticides, cleaning solvents, detergents and many other chemicals. These are harmful to aquatic life and human health. They enter the water directly from industrial activity disposal of chemical wastes.
- The sediment of suspended matter is another class of water pollutants. These are insoluble particles of soil and other solids that become suspended in water. This occurs when the soil is eroded from the land. High levels of soil particles suspended in water interfere with the penetration of sunlight. This reduces the photosynthetic activity of aquatic plants and algae, disrupting the ecological balance of the aquatic bodies.
- Water-soluble radioactive isotopes are yet another source of water pollution. These can be concentrated in various tissues and organs as they pass through food chains and food webs. The ionizing radiation emitted by such isotopes can cause birth defects, cancer and genetic damage.

Ground water pollution:

- Ground water forms about 6.2% of the total water available on planet earth and is about 30 times more than surface water (streams, lakes, and estuaries).
- Ground water seems to be less prone to pollution as the soil mantle through which water passes helps to retain various contaminants due to its cation exchange capacity.
- However, there are a number of potential sources of ground water pollution. Septic tanks, industry (textile, chemical, and tanneries), deep well injection etc. are mainly responsible for ground water pollution, which is irreversible.
- Ground water pollution with arsenic, fluoride and nitrate are posing serious health hazards.

Surface water pollution: The major sources of surface water pollution are:

Sewage: pouring the drains and sewers in fresh water bodies causes water pollution. The problem is severe in cities.

Industrial effluents: Industrial wastes containing toxic chemicals, acids, alkalis, metallic salts, phenols, cyanides, ammonia, radioactive substances, etc are sources of water pollution. They also cause thermal pollution of water.

Synthetic detergents: are used in washing and cleaning produce foam and pollute water.

Agrochemicals: like fertilizers (containing nitrates and phosphates) and pesticides (insecticides, fungicides, herbicides etc.) washed by rain-water and surface run-off pollute water.

Oil: Oil spillage into sea-water during drilling and shipment pollute it.

Waste heat: It from industrial discharges increases the temperature of water bodies and affects distribution and survival of sensitive species.

Effects of water pollution:

1. Lower DO may be harmful to animals especially fish population. Oxygen depletion (deoxygenating) helps in increase of phosphates from bottom sediments and causes eutrophication.
2. **Nitrogen and phosphorous compounds:** Addition of compounds containing nitrogen and phosphorus help in the growth of algae and other plants which when die and decay consume oxygen of water. Under anaerobic conditions foul smelling gases are produced. Excess growth or decomposition of plant material will change the concentration of CO_2 which will change many physico-chemical characteristics of water.
3. **pathogens:** Many wastewaters especially sewage contain many pathogenic and non-pathogenic micro-organisms and many viruses. Water borne diseases like cholera, dysentery, typhoid, jaundice etc. are spread by water contaminated with sewage.
4. **Toxic compounds**: Pollutants such as heavy metals, pesticides, cyanides and many other organic and inorganic compounds are harmful to aquatic organisms.
5. Nitrate when present in excess in drinking water causes blue baby syndrome or methaemoglobinemia. The disease develops when a part of hemoglobin is converted into non-functional oxidized form.
6. Excess use of fluoride in drinking water causes defects in teeth and bones called fluorosis.
7. Pesticides in drinking water ultimately reach humans and are known to cause various health problems. DDT, aldrin, dieldrin etc. have therefore, been banned.

Control of water pollution:

1. Judicious use of agrochemicals like pesticides and fertilizers which will reduce their run-off and leaching. Avoid use of these on sloped lands.
2. Use of nitrogen fixing plants to supplement the use of fertilizers.

3. Adopting integrated pest management to reduce reliance on pesticides.
4. Separate drainage of sewage and rain water should be provided to prevent overflow of sewage with rainwater.
5. Planting trees would reduce pollution by sediments and will also prevent soil erosion.
6. Waste waters should be properly treated by primary and secondary treatments to reduce the BOD, COD levels up to the permissible levels for discharge.
7. Proper chlorination should be done to prevent the formation of chlorinated hydrocarbons or disinfection should be done by ozone or ultraviolet radiations.

NOISE POLLUTION

Noise is undesirable and unwanted sound. The unpleasant and unwanted sound is called Noise. Sound is measured in a unit called the 'decibel' (dB).

Sources of noise pollution

There are several sources of noise pollution that contribute to both indoor and outdoor noise pollution. Noise emanating from factories, vehicles, and playing of loud speakers can contribute to outdoor noise pollution, while loudly played radio or music system can contribute to indoor noise pollution. Firecrackers generate much higher noise than the prescribed levels. The Noise can be affect human ear because of its loudness and frequency.

Area Code	Category Area	Noise Level in dB	
		Day	Night
(A)	Industrial	75	70
(B)	Commercial	65	55
(C)	Residential	55	45
(D)	Silence Zone	50	40

"Silence Zone in an area comprising not less that 100 meters around hospitals, educational institutions, courts, religious places or any other area which is declared as such by the competent authority.

Effects of noise pollution on physical Health –

- The degree of hearing loss depends on the duration as well as the intensity of the noise.
- Cardiovascular health – Excessive sound levels can cause harmful effects on the circulatory system by raising blood pressure and altering pulse rates as well as increased incidence of coronary artery disease.

Effects of noise pollution on mental health –

- Noise can also cause emotional or psychological effects such as irritability, anxiety and stress.
- Lack of concentration and mental fatigue are significant health effects of noise.
- The inherent unpleasantness of sound causes annoyance.
- Increases the rate of accidents in industries.
- It can lead to lowered worker efficiency and productivity and higher accident rates on the job.

Control of noise pollution

There are 4 ways in which noise can be controlled: - reduce noise at source, block the path of noise, increase the path-length and protect the recipient. The best control method is to reduce noise levels at the source.

1. In industries noise reduction can be done by using rigid sealed enclosures around machinery lined with acoustic absorbing material. Using special spring mounts or absorbent mount and pads contribute to reduce noise pollution at source.
2. Regular and thorough maintenance of operating machinery. Noise levels at construction sites can be controlled using proper construction planning and scheduling techniques.
3. Poorly-maintained vehicles can add to noise levels. A smooth flow of traffic cause less noise. Proper highway planning and design are essential for controlling traffic noise. The path of traffic noise can also be blocked by constructing vertical barriers alongside the highway.
4. Planting trees also act as effective noise barriers.
5. Highly- absorptive interior finish material for walls, ceilings and floors can greatly decrease indoor noise levels.
6. Increasing the path-length between the source and the recipient offers a passive means of control.
7. The use of earplugs and earmuffs can protect individuals from excessive noise levels.

SOIL POLLUTION

Soil is one of the most significant ecological factors, which is derived from the transformation of surface rocks. Plants depend for their nutrients water and mineral supply on soil.

Soil pollution is the addition of some chemical substances in an indefinite proportional to the soil system thereby changing the fertility of soil. Any substance capable of changing the productive capacity of soil is termed as soil pollutant. The polluted soil produces inferior quality of crop and reduces quantity.

Causes of soil degradation:

1. Industrial wastes: Disposal of industrial wastes is the major problem responsible for soil pollution. The industrial pollutants are mainly discharged from, paper and pulp mills, chemical industries, tanneries etc.,
2. Urban Wastes: It comprises both commercial and domestic wastes containing of dried sludge of sewage. Urban solid wastes are referred as refuse solid wastes and refuse in urban areas contribute to soil pollution.
3. Chemicals like fertilizers, pesticides, bactericides applied to plants and soils.
4. Radioactive wastes discharged from industrial, research centers and hospitals.
5. Soil gets polluted by the removal of its upper fertile layer.
6. Soil is also polluted by soil erosion, due to deforestation, overgrazing, unplanned irrigation and defective agricultural practice.
7. Pollutants present in air and fallout from smoke stacks of chemicals works also pollute the soil.

Effects of soil pollution:

1. Sewage and industrial effluents which pollute the soil ultimately affect human health.
2. Sewage sludge has many types of pathogenic bacteria, viruses and intestinal worms which may cause various types of diseases.
3. Radioisotopes which attach the clay become a source of radiations in the environment.
4. Nitrogen and phosphorus from the fertilizers inn soil reach nearby water bodies with agricultural run-off and cause eutrophication.
5. Chemicals or their degradation products from soil may percolate and contaminate ground water resources.

Control of soil pollution:

1. The hazards due to pesticide pollution may be somewhat reduced with the application of organic matter in the soil. Sometimes chemical degradation of DDT, endrin, heptachlor, Malathion, diazion

and atrazine reduced the intensity of toxicity of those pesticides. In the addition bio-degradation by soil micro-organisms is the most important method by which pesticides are removed from soils.

2. The phytotoxic effect of heavy metals in soil especially Cd can be controlled by exchange reactions, chelation by organics, absorption by colloidal oxides and hydroxides of iron and manganese etc., besides this soil contamination due to inorganic pollutants may be alleviated by the elimination of soil application and recycling of toxins in soils.
3. If sewage-sludge is treated in a sludge treatment plant before its use to the soil application, then on its application, crop yields increase through the improvement of soil physical properties. Sludge-borne organic contaminants with agricultural pesticides.
4. However, the beneficial effects of sludge organic matter and nutrients in improving soil fertility and productivity have been extensively reported and are universally recognized.
5. The incorporation or injection of sludge protects the natural ecosystems by preventing environmental problems caused by run-off and volatilization.

RADIOACTIVE POLLUTION

Radioactive substances are present in nature. They undergo natural radioactive decay in which unstable isotopes spontaneously give out fast moving particles, high energy radiations or both, at a fixed rate until a new stable isotope is formed.

Alpha particles can be interrupted by a sheet of paper while beta particles can be blocked by a piece of wood or a few millimeters of aluminium sheet. The gamma rays can pass through paper and wood but can be stopped by concrete wall, lead slabs or water.

Sources of radiation

Various sources of radioactivity can be grouped into

A. Natural sources include cosmic rays from outer space, radioactive radon-222, soil, rocks, air, water and food, which contain one or more radioactive substances.

B. Anthropogenic sources include nuclear power plants, nuclear accidents, x-rays, diagnostic kits, test laboratories etc. where radioactive substances are used.

Effects of Radiations

Ionisation radiations can affect living organisms by causing harmful changes in the body cells and also changes at genetic level.

A. Genetic damage is caused by radiations, which induce mutations in the DNA, thereby affecting genes and chromosomes. The damage is often seen in the offsprings and may be transmitted upto several generations.

B. Somatic damage includes burns, miscarriages, eye cataract and cancer of bone, thyroid, breast, lungs and skin.

Control of nuclear pollution

- Siting of nuclear power plants should be carefully done after studying long term and short term effects.
- Proper disposal of wastes from laboratory involving the use of radioisotopes should be done.

UNIT-IV

Assignment cum Tutorial questions

SECTION-A

Objective Questions

1) BOD of the drinking water should not exceed_____
2) During clearance of any developmental project, the minimum distance required for site selection from eco-sensitive zone is _____
3) Individual organism respond to environmental change through short term adjustments by_____
4) Which of the mineral causes fluoride pollution in the groundwater_____
5) Identify the air pollutant in urban areas which irritates eyes and also respiratory tract of human beings_____
6) Blue baby syndrome is caused by the presence of _____
7) Minamata disease occurred due to consumption of fish contaminated with _____
8) Microbial indicator of water contamination is _____
9) Tajmahal is threatened due to the effect of _____
10) The permissible limit of day time industrial noise as recommended by WHO is_____
11) In the recently launched Air Quality Index in India, which of the following Pollutant is not included [ ]
    A) CO B) Fine particulate matter C) O3 D) CFCs
12) Which of the following air pollutants are released by thermal power plants [ ]
    I) Oxides of nitrogen II) Oxides of sulphur
    III) Ammonia IV) Carbonmonoxide
    A) I, III and IV only B) II and III only
    C) I, II and IV Only D) I,II,III and IV
13) When DDT enters the human body, it is, [ ]
    A) Water soluble and easily excreted in urine
    B) Stored in the bones
    C) Fat soluble and stored in fat tissues
    D) Processed by enzymes and becomes a different compound which is toxic
14) Priority air pollutants included in the air quality index for urban areas in India are [ ]
    i. CO,NOX,PM10 and PM 2.5,O3,Ammonia and Pb
    ii. CO,N0x,Sox and Pb
    iii. NO_X , SO_X, O_3, and Pb
    iv. Pm_{10}, and $Pm_{2.5}$,NO_X, SO_X,O_3, And Pb
15) Cement dust is characterized by very fine particulates, which of the following air pollution control devices is appropriate for removing them from hot exhaust gases emanating from cement kiln [ ]

A) Bag house B) Cyclones
C) Venturi scrubber D) Electrostatic precipitator

16) Natural sources of radioactivity include [ ]
A) Cosmic rays b) Radon C) Rocks D) All of the above

17) Which of the following methods related to fly ash utilization has future eco-friendly and economic benefits? [ ]
I) Direct application cropland
II) Converting to Bricks
III) Using a road-sub-base material

Codes:

A) I and II only B) II and III only C) I and III only D) I, II and III

18) Mutations in the DNA caused by radiation is called [ ]
A) Genetic damage B) Somatic damage
C) Both D) None of the above

19) A wetland ecosystem has a very high Biological Oxygen Demand (BOD). Which of the following statement about such a wetland is correct? [ ]
A) It has high level of microbial pollution
B) It has a very low effect of microbial pollution
C) There is no microbial pollution
D) It is highly turbid

20) Radioactive strontium affects bones by depositing in the bones instead of [ ]
A)Phosphorus B) Calcium C) Iron D) Fat

21) Match the List-1 and List-11 .Identify the correct answer from the codes given below: [ ]

List-1 (Process/Event)	List-11 (Consequences/Links)
a. Assimilative capacity	I. DO, BOD, Coliform
b. Critical water parameter	II. Cadmium
c. Itai-Itai disease	III. Blue baby syndrome
d. Excess nitrates in water	IV. Waste discharge

	a	b	c	d
A	I	II	III	IV
B	IV	I	II	III
C	II	I	III	IV
D	II	III	I	IV

22) Which of the following statements are correct? [ ]
I. DDT is non-biodegradable pollutant
II. Industries are sources of primary pollutants.
III. PAN is primary pollutant.
Choose the correct answer.
A. I and II only B) I only C) I and III only D) I,II and III

23) Match the List-1 and List-11 .Identify the correct answer from the codes given below: [ ]

List-I	List-II
a. Cyclone separator	I. Larger particles
b. Baghouse filter	II. Very small particles
c. Wet scrubber	III. Toxic gases
d. Electrostatic precipitator	IV. Microscopic particles

Codes

	a	b	c	d
A	I	II	III	IV
B	IV	I	II	III
C	II	I	III	IV
D	II	III	I	IV

24) Which of the following statements are correct? [ ]

I. Photochemical smog is secondary pollutant.
II. Industrial effluents are sources of surface water pollution.
III. More BOD values of any water sample are associated with poor water quality.
IV. Radioactive iodine accumulates in thyroid gland and causes cancer.

Choose the correct answer:

A) I and II only B) I, II and III only
C) I and III only D) I,II,III and IV

25) Which of the following have more penetration power? [ ]

A) Alpha particles B) Beta particles
C) Gamma particles D) None of the above

SECTION-B

Descriptive questions

1. Define pollution.
2. List out types of pollutants.
3. What is pollutant?
4. Define air pollution.
5. What is biological magnification?
6. Write permissible levels of noise.
7. What are causes of noise pollution?
8. List out effects of soil pollution.
9. Write control measures of air pollution.
10. Define nuclear hazard.
11. Distinguish between primary and secondary pollutants.
12. What are somatic damages of radiation?
13. Define water pollution.
14. What is pathogen?
15. What is biodegradable pollutant?

Essay questions:

1) Identify causes and effects of air pollution.
2) Write control measures of air pollution
3) Illustrate effects of water pollution.
4) Describe causes of soil pollution.
5) Write control measures of water pollution.
6) Describe control measures of noise pollution.
7) Classify pollutants.
8) List out sources of noise pollution.
9) Define air pollution. Write causes, effects and control measures of air pollution.
10) Describe causes, effects and control measures of water pollution.
11) Analyze effects of radiations.
12) Analyze effects, control measures of soil pollution
13) Write a detailed note on radioactive pollution.

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UNIT-5
ENVIRONMENTAL MANAGEMENT

Objectives:

- To familiarize knowledge on environmental impact assessment.
- To impart basic understanding of environmental legislation.

Syllabus:

UNIT V : Environmental Management

a) Environmental Impact Assessment
b) Environmental Impact Statement
c) Environmental Management Plan
d) Environmental Audit
e) Ecotourism
f) Green Building
g) Green Development Mechanism
h) Wild life (protection) Act,1972
i) Water (prevention and control of pollution) Act,1974
j) Forest (conservation) Act,1980
k) Air (prevention and control of pollution) Act,1981
l) Environment (protection) Act, 1986

Prescribed text books:

- Environmental studies:Anubha Kaushik, C.P.kaushik
- Environmental studies:R.Rajagopalan
- Environmental studies:Erach barucha

Outcomes:

Students will be able to:

- apply the knowledge of EIA on development activities.
- list out main categories of Environmental Audit.
- apply the knowledge of green development mechanism for sustainable development.
- design environmental management plan to establish industries.
- Interpret the use of ecotourism for economic development of a country.
- explain salient features of environmental protection act, wildlife act, air act, water act and forest conservation act.

LEARNING MATERIAL
ENVIRONMENTAL IMPACT ASSESSMENT

Environmental Impact Assessment is a procedure to plan some development activity with well defined environmental goals so that damage due to the activity both during developmental stage and production stage have minimum impact on the natural system and the population in the area.

IMPACT ASSESSMENT AND ITS SIGNIFICANCE

The changes caused by a development project on the landscape and ecology of the area and on the quality of water and air along with that on various socio-economic aspects of human life is defined as impact.

Impacts could be categorized in different manners:

(A)Positive and negative impacts

Some of the development actions have beneficial impacts while others have deteriorative or adverse effects. Accordingly they are designed as positive and negative impacts.

(B)Reversible and irreversible impacts

Some of the impacts caused by the development projects are for a short – term and could be reversed over a period of time by adopting appropriate control or remedial measures.

However, if a development activity involves destruction of a forest and loss of habitat of some endangered or endemic species, it is an irreversible impact. Therefore, irreversible impacts should be very carefully assessed.

(C) Light, moderate and severe impacts

The magnitude of the impacts caused by a development projects needs to be assessed. It could be light, moderate or severe. The magnitude of such impacts could be represented in different ways:

i. By putting round symbols varing in size:
   - Small
   - Medium
   - Severe

ii. By assigning numerical values:
   +/-1 Small positive or negative impact
   +/-3 Medium positive or negative impact
   +/-5 Severe positive or negative impact

In different systems, different numerical scales could be taken. In the above example, a scale of 1 to 5 has been taken, where 1 is very little impact and 5 represents severe impact.

ENVIRONMENTAL IMPACT ASSESSMENT

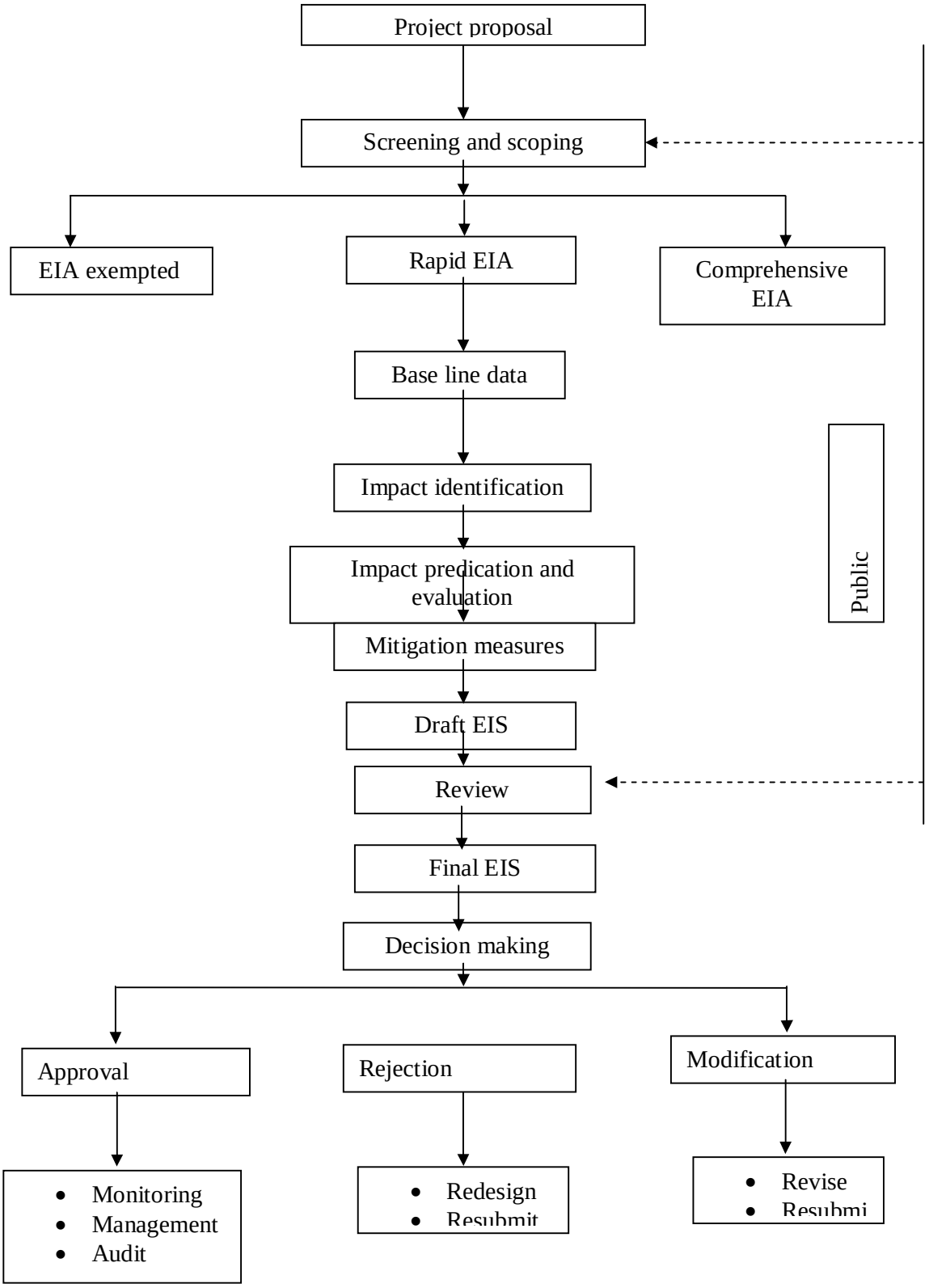
Environmental Impact Assessment is a procedure to plan some development activity with well defined environmental goals so that damage due to the activity both during developmental stage and production stage have minimum impact on the natural system and the population in the area.

The National Environmental Policy Act (NEPA) U.S.A. in 1969 first of all provided the guidelines for environmental impact assessment through Council for Environment Quality (CEQ).

In India, the gazette notification of EIA was issued in 1994 vide which the Ministry of Environment and Forest provided guidelines for project proponents to have EIA and prepare an Environmental Impact Statement prior to clearance of the project.

EIA Methodology

The basic steps followed in EIA are screening, scoping, base line data, impact identification, prediction, evaluation, mitigation, EIS preparation, review and environment audit, involving public participation at various stages, as shown in Flow charts.


Project proposal
Screening and scoping
EIA exempted
Rapid EIA
Comprehensive EIA
Base line data
Impact identification
Impact predication and evaluation
Mitigation measures
Draft EIS
Review
Final EIS
Decision making
Approval
Rejection
Modification
Monitoring
Management
Audit
Redesign
Resubmit
Revise
Resubmi
Public

ENVIRONMENTAL IMPACT STATEMENT

The EIS is prepared by the project proponents at the time of submission of the proposal, which is known as the draft EIS. After evaluation and review by the Impact Assessment Agency, the final EIS is prepared.

Objectives

- Effect on land including land degradation and subsistence.
- Deforestation and compensatory afforestation.
- Air pollution and dispersion along with possible health effects.
- Water pollution including surface water and ground water pollution.
- Noise pollution due to the projects.
- Loss of flora and fauna due to the project during construction.
- Socio economic impacts including displacement of native people, cultural loss and health aspects.
- Risk analysis and disaster management plan.
- Recycling and reduction of waste.
- Efficient use of inputs including energy and matter.

ENVIRONMENTAL MANAGEMENT PLAN

After impact prediction and evaluation an EMP is prepared so as to minimize the negative impacts, increase the positive impacts and restore the damages done o different environmental components. A comprehensive list of measures to be taken is included in the EMP which includes mitigation measures and future guidelines for maintenance of a good quality environment, as discussed below:

- There are technical solutions to many of the adverse impacts caused by various development activities.
- In order to prevent or avoid damage to the environment by a development activity, the harmful or hazardous substances produced should be handled properly and removed from that site to some safe area where they could be properly disposed of.
- The control the damage due to various emissions coming from development projects like industries, power plants or highway projects with stone- crushing units various control methods are available.
- To convert the harmful substances produced by various industrial projects, into less harmful nature or to reduce their concentrations to safe permissible limits , treatment methods are available.
- Trees and shrubs are known to act as sinks of many toxic gases and particulates.

ENVIRONMENTAL AUDIT

International Chambers of Commerce (ICC) in 1989 has defined environmental auditing as a management tool comprising a systematic, documented periodic and objective evaluation of how well environmental organization, management and equipment are performing, with the aim to help safeguard the environment by:

- Facilitating management control of environmental practices, and
- Assessing compliance with company policies which would include meeting regulatory requirements.

To ensure that an audit is effective, a number of key steps must be included.

a) **Criteria :** An essential step in establishing an audit programme is to decide the criteria against which the audit will be conducted and to ensure that management throughout the organization knows what these criteria are. Typically criteria used for audits are:

- Company policies and procedures on environmental matters.
- Applicable legislation and regulations.
- Good environmental management practice.

b) **Pre-audit steps:** These include the administrative issues associated with planning the audit, selecting the personnel for the audit team, preparing the audit protocol used by the organization and obtaining background information about the facility.

c) **Onsite steps :** These include

- Understanding the internal controls
- Assessing strengths and weaknesses of internal controls
- Gathering audit evidence
- Recording audit findings
- Evaluating and reporting the audit findings

d) **Post-audit steps:** After onsite work , a draft report is prepared, which is reviewed by the plant management to confirm its accuracy. It is then distributed to senior management according to the requirement of the company.

ECOTOURISM

The concept of ecotourism developed a few decades ago is essentially visits of tourists to the unpolluted areas rich in biodiversity for recreation and boosting the economy of the region.

The term " ecotourism" was coined by Ceballos- Lascurin in 1983 to describe a new form of nature travel. Thereafter, many definitions of ecotourism have

been given. According to The International Ecotourism Society, ecotourism is defined as " responsible travel to natural areas that conserves the environment and improves the well – being of local people.
The major advantages are as under:

- Funds generated by ecotourism should be used to fund the local communities in their efforts to preserve nature and earth' s natural resources, wild life and local species.
- In this way the resources would last longer and with the growing economy of the region local people would have access to education and can lead respectful life.

GREEN BUILDING

Introduction:

It is also known as green construction (or) sustainable building

- It is the practice of creating structures using processes that are environmentally responsible & resource efficient throughout a building's life cycle.
    - Sitting to design
    - Construction
    - Operation
    - Maintenance
    - Renovation
    - Deconstruction
- Design concerns of economy
    - Utility
    - Durability &
    - Comfort

CDM

Defined in Article – 21 of the protocol

- Emission reduction
- Emission limitation

Under Kyoto protocol to implement an emission – reduction project in developing countries.

That project can earn sealed **(CER)** Certificate Emission Reduction equivalent to one tonne of Co2.

CER is a standardized emissions offset instrumentation

- The mechanism stimulates sustainable development & emission reductions. From a National point of view CDM holds the potential to lead to significant investment Job creation.

Desertification & deforestation, poverty alleviation to achieve sustainable development like entities aiming to combat CDM might be a way to fiancé their activities & advance their aims by environmental NGO's.

Clean Development Mechanism Project Involve:

Rural electrification project using solar panels (or) the installation of more energy efficient boilers.

Benefits of CDM:

- Stimulate Sustainable development
- Emission reduction

Operating details of CDM:

- The projects must qualify through a rigorous & public registration & issuance process.
- Approval is given by the designated National Authorities. Operational since the beginning of 2006
- The mechanism has already registered more than 1,650 projects & is anticipated to produce
- CER's amounting to more than 2.9 billion tonnes of Co2 equivalent in the first commitment period of the Kyoto Protocol 2008-2012

ENVIRONMENTAL LEGISLATION

India is the first country in the world to have made provisions for the protection and conservation of environment in its constitution. On 5th June, 1972, environment was first discussed as an item of international agenda in the U.N. Conference on Human Environment in Stockholm and thereafter 5th June is celebrated all over the world as World Environment Day. Soon after the Stockholm Conference our country took substantive legislative steps for environmental protection. The Wildlife (Protection) Act was passed in 1972, followed by the Water (Prevention and Control of Pollution) Act 1974, the

Forest (Conservation) Act, 1980, Air (Prevention and Control of Pollution) Act, 1981 and subsequently the Environment (Protection) Act, 1986.

Constitutional Provisions

The provisions for environmental protection in the constitution were made within four years of Stockholm Conference, in 1976, through the 42nd amendment as follows:

Article 48-A of the constitution provides: .The state shall endeavour to protect and improve the environment and to safeguard forests and wildlife of the country..

Article 51A (g) provides: .It shall be the duty of every citizen of India to protect and improve the natural environment including forests, lakes, rivers and wildlife and to have compassion for living creatures.

.Some of the important Acts passed by the Government of India are discussed here.

WILDLIFE (PROTECTION) ACT, 1972

(i) It defines the wild-life related terminology.

(ii) It provides for the appointment of wildlife advisory Board, Wildlife warden, their powers, duties etc.

(iii) Under the Act, comprehensive listing of endangered wild life species was done for the first time and prohibition of hunting of the endangered species was mentioned.

(iv) Protection to some endangered plants like Cycus beddome ,Blue Vanda, Ladies Slipper Orchid, Pitcher plant etc. is also provided under the Act.

(v) The Act provides for setting up of National Parks, Wildlife Sanctuaries etc.

(vi) The Act provides for the constitution of Central Zoo Authority.

(vii) There is provision for trade and commerce in some wildlife species with license for sale, possession, transfer etc.

(viii) The Act imposes a ban on the trade or commerce in scheduled animals.

(ix) It provides for legal powers to officers and punishment to offenders.

(x) It provides for captive breeding programme for endangered species. Several Conservation Projects for individual endangered species like lion (1972) Tiger (1973), Crocodile (1974) and Brown antlered Deer (1981) were started under this Act. The Act is adopted by all states in India except J & K, which has it own Act. Some of the major drawbacks of the Act include mild penalty to offenders, illegal wild life trade in J & K, personal ownership certificate

for animal articles like tiger and leopard skins, no coverage of foreign endangered wildlife, pitiable condition of wildlife in mobile zoos and little emphasis on protection of plant genetic resources.

FOREST (CONSERVATION) ACT, 1980

This act deals with the conservation of forests and related aspects. Except

J & K, the act is adopted all over India. The Act covers under it alltypes of forests including reserved forests, protected forests or any forested land irrespective of its ownership.

The salient features of the Act are as follows:

(i) The State Govt. has been empowered under this Act to use the forests only for forestry purposes. If at all it wants to use it in any other way, it has to take prior approval of central Government, after which it can pass orders for declaring some part of reserve forest for non-forest purposes (e.g mining) or for clearing some naturally growing trees and replacing them by economically important trees (reforestation).

(ii) It makes provision for conservation of all types of forests and for this purpose there is an Advisory committee which recommends funding for it to the Central Government.

(iii) Any illegal non-forest activity within a forest area can be immediately

Stopped under this Act.

Non-forest activities include clearing of forest land for cultivation of any type of plants/crops or any other purpose (except re-afforestation). However, some construction work in the forest for wildlife or forest management is exempted from non-forest activity (e.g. fencing, making water-holes, trench, pipelines, check posts, wireless communication etc.)

WATER (PREVENTION AND CONTROL OF POLLUTION) ACT, 1974

It provides for maintaining and restoring the wholesomeness of water By preventing and controlling its pollution. Pollution is defined as such Contamination of water or such alteration of the physical, chemical or biological properties of water, or such discharge as is likely to cause a nuisance or render the water harmful or injurious to public health and safety or harmful

For any other use or to aquatic plants and other organisms or animal life.

The salient features and provisions of the Act are summed up asfollows:

(i) It provides for maintenance and restoration of quality of all types of surface and ground water.

(ii) It provides for the establishment of Central and State Boards for pollution control.

(iii) It confers them with powers and functions to control pollution. The Central and State Pollution Control Boards are widely represented and are given comprehensive powers to advise, coordinate and provide technical assistance for prevention and control of pollution of water.

(iv) The Act has provisions for funds, budgets, accounts and audit of the Central and State Pollution Control Boards.

(v) The Act makes provisions for various penalties for the defaulters and procedure for the same. The main regulatory bodies are the Pollution Control Boards, which have been, conferred the following duties and powers:

Central Pollution Control Board (CPCB):

1.It advises the central govt. in matters related to prevention and control of water pollution.

2. Coordinates the activities of State Pollution Control Boards and provides them technical assistance and guidance.

3.Organizes training programs for prevention and control of pollution.

4. Organizes comprehensive programs on pollution related issues through mass media.

5. Collects, compiles and publishes technical and statistical data related to pollution.

6. Prepares manuals for treatment and disposal of sewage and trade effluents.

7. Lays down standards for water quality parameters.

8. Plans nation-wide programs for prevention, control or abatement of pollution.

9. Establishes and recognizes laboratories for analysis of water, sewage or trade effluent sample. The State Pollution Control Boards also have similar functions

to be executed at state level and are governed by the directions of CPCB.

10. The Board advises the state govt. with respect to the location of any industry that might pollute a stream or a well.

11. It lays down standards for effluents and is empowered to take samples from any stream, well or trade effluent or sewage passing through an industry.

12. The State Board is empowered to take legal samples of trade effluent in accordance with the procedure laid down in the Act. The sample taken in the presence of the occupier or his agent is divided into two parts, sealed, signed by both parties and sent for analysis to some recognized lab. If the samples

do not conform to the prescribed water quality standards (crossing maximum permissible limits), then .consent. is refused to the unit.

13. Every industry has to obtain consent from the Board (granted for a fixed duration) by applying on a prescribed Proforma providing all technical details, along with a prescribed fee following which analysis of the effluent is carried out.

14. The Board suggests efficient methods for utilization, treatment and disposal of trade effluents.

THE AIR (PREVENTION AND CONTROL OF POLLUTION)ACT, 1981

Salient features of the act are as follows:

(i) The Act provides for prevention, control and abatement of air pollution.

(ii) In the Act, air pollution has been defined as the presence of any solid, liquid or gaseous substance (including noise) in the atmosphere in such concentration as may be or tend to be harmful to human beings or any other living creatures or plants or property or environment.

(iii) Noise pollution has been inserted as pollution in the Act in 1987.

(iv) Pollution control boards at the central or state level have the regulatory authority to implement the Air Act. Just parallel to the functions related to Water (Prevention and Control of Pollution) Act, the boards perform similar functions related to improvement of air quality. The boards have to check whether or not the industry strictly follows the norms or standards laid down by the Board under section 17, regarding the discharge of emission of any air pollutant. Based upon analysis report consent is granted or refused to the industry.

(v) Just like the Water Act, the Air Act has provisions for defining the constitution, powers and function of Pollution Control Boards, funds, accounts, audit, penalties and procedures.

(vi) Section 20 of the Act has provision for ensuring emission standards from automobiles. Based upon it, the state govt. is empowered to issue instructions

to the authority incharge of registration of motor vehicles (under Motor Vehicles Act, 1939) that is bound to comply with such instructions.

(vii) As per Section 19, in consultation with the State Pollution Control Board, the state government may declare an area within the state as .air pollution control area. and can prohibit the use of any fuel other than approved fuel in the area causing air pollution. No person shall, without prior consent of State Board operate or establish any industrial unit in the .air pollution control area.The Water and Air Acts have also made special provisions for appeals. Under Section 28 of Water Act and Section 31 of Air Act, a provision for appeals has been made. An Appellate Authority consisting of a single person or three persons appointed by the Head of the State, Governor is constituted to hear such appeals as filed by some aggrieved party (industry) due to some order made by the State Board within 30 days of passing the orders. The Appellate Authority after giving the appellant and the State Board an opportunity of being heard, disposes off the appeal as expeditiously as possible.

THE ENVIRONMENT (PROTECTION) ACT, 1986

The Act came into force on Nov. 19, 1986, the birth anniversary of our Late Prime Minister Indira Gandhi, who was a pioneer of environmental Protection issues in our country. The Act extends to whole of India. Some terms related to environment have been described as follows in the Act:

(i) Environment includes water, air and land and the inter-relationships that exist among and between them and human beings, all other living organisms and property.

(ii) Environmental pollution means the presence of any solid, liquid or gaseous substance present in such concentration, as may be, or tend to be, injurious to environment.

(iii) Hazardous Substance means any substance or preparation which by its physico-chemical properties or handling is liable to cause harm to human beings, other living organisms, property or environment.

The Act has given powers to the Central Government to take measures to protect and improve environment while the state governments coordinate the actions.

The most important functions of Central Govt. under this Act include setting up of:

(a) The standards of quality of air, water or soil for various areas and purposes.

(b) The maximum permissible limits of concentration of various environmental pollutants (including noise) for different areas.

(c) The procedures and safeguards for the handling of hazardous substances.

(d) The prohibition and restrictions on the handling of hazardous substances in different areas.

(e) The prohibition and restriction on the location of industries and to carry on process and operations in different areas.

(f) The procedures and safeguards for the prevention of accidents which may cause environmental pollution and providing for remedial measures for such accidents.

UNIT-V

Assignment cum Tutorial questions

SECTION-A

Objective Questions

1. The World Environment Day is celebrated on **……**
2. **. ……..**Act provides for setting up of National Parks and wildlife sanctuaries
3. Environmental Protection Act came into force on ……1986, the birth anniversary of Smt. Indira Gandhi.
4. For CDM approval is given by _____.
5. The CDM has already registered more than _____ number of projects.
6. During clearance of any developmental project, the minimum distance required for site selection from eco-sensitive zone is _____.
7. Noise has been included as pollution in the Air (Prevention and control of pollution) Act, 1981 in the year----------.
8. The term ecotourism was coined by----------
9. When EIA is done based on a single season data, it is called----------.
10. Comparison of the impacts predicted in EIS before the project and actual impacts after implementation of the project is done in----------.
11. Which article in constitution recognizes environmental protection as one of the fundamental duties of every citizen of India **[ ]**
    (a) Article 42 (b) Article 48A (c) Article 51A(g) (d) Article 52
12. As per the Forest Act, cultivation of which of the following is a non-forest activity [ ]
    (a) Tea (b) Rubber (c) Mulberry (d) All the above
13. EIA of port and harbor projects involve impact assessment on[ ]

    I) Biological environment II) Air environment
    III) Soil environment IV) Social environment

    Choose the correct answer:
    a) I only b) II only c) III only d) I,II and IV only
14. "Public hearing" is not mandatory for project like [ ]
    a) Building construction project b) Mining project
    c) Oil refinery project d) River valley project

15. Arrange the functions associated with EIA in a sequential manner
I) Identification II)Prediction III) Defining the scope IV) Impact evaluation and analysis [ ]

a) III,I,II,IV b) III,II,I,IV c)III,IV,I,II d) III,I,IV,II

Section B

Subjective questions

Short answer questions

1. Define EIA.
2. What is EIS?
3. Differentiate between EIS and EMP.
4. What is environmental audit?
5. Define ecotourism.
6. Write objectives of green building.
7. Define CDM.
8. What are non forestry activities?
9. What do you know about environmental legislation?
10. What are reversible impacts?

Long answer questions

1. Discuss the salient features of (a) Wildlife (protection) Act,1972 (b) Forest (Conservation Act),1980.
2. How do you define pollution as per water (prevention and Control of Pollution) Act,1974? What are the salient features of the Act?
3. Who has the authority to declare an area as “air pollution control area” in a state under the Air (Prevention and Control of Pollution) Act,1981? When was noise inserted in this act?
4. Why do we refer to Environmental Protection Act, 1986 as an Umbrella Act? Discuss the major Environmental Protection Rules, 1986.
5. What are the major limitations to successful implementation of our environmental legislation?
6. Write significance of EIA.
7. Explain methodology of EIA.
8. Describe objectives of EIS.
9. Interpret measures of EMP.
10. Discuss the concept of ecotourism, its principles and merits.

UNIT – VI

WASTE MANAGEMENT

OBJECTIVES:

- To acquire a comprehensive knowledge in liquid and solid waste management practices.
- To understand the treatment of wastewater & solid waste management.

UNIT VI : Waste Management

- Liquid waste – Industrial waste water treatment - Municipal water treatment – Drinking water treatment
- Solid waste – Municipal solid waste- Biomedical waste – Hazardous waste –E-waste.

Learning Outcomes:

Students will be able to

- understand the technical issues of waste and management of solid waste.
- develop an overall treatment strategy for industrial waste as well as commercial waste stream.
- classify hazardous wastes.
- identify effects of E-waste.
- categorize drinking water treatment methods.
- distinguish between liquid waste and solid waste treatment methods.

INDUSTRIAL WASTE WATER TREATMENT

The composition of municipal waste water varies from place to place. Sometimes industrial wastes also mix with sewage. The type of treatment of waste water depends upon its characteristics and the desired quality of water after treatment. The waste water treatment plants are generally for primary, secondary or advanced treatment.

The purpose of waste water treatment is to remove or reduce organic & inorganic substances, nutrients, toxic substances, kill pathogenic organisms, etc. so that the quality of discharged water is improved to meet the permissible level of water to be discharged in, some water body or Land or Agricultural fields. Treatment of water thus aims at reduction of BOD and COD Eutrophication etc of receiving water bodies prevention of biomagnifications of toxic substances in food chain and prevention of disease due to pathogenic organisms present in the waste water.

(1) PRIMARY TREATMENT:

It is a physical process for removal of debris and large particles with the help of screen. The waste water after **screening is** passed through **grit** chamber where sand, grit and other solids settle down. About 35% of BOD and 60% of suspended solids are removed during primary treatment.

(2) SECONDARY TREATMENT:

It is a biological process which involves microorganisms. It removes upto 90% BOD and 90% of Suspended solids and Biodegradable oxygen demanding wastes are stabilized. Following are the various approaches adopted in secondary treatment.

TRICKLING FILTERS

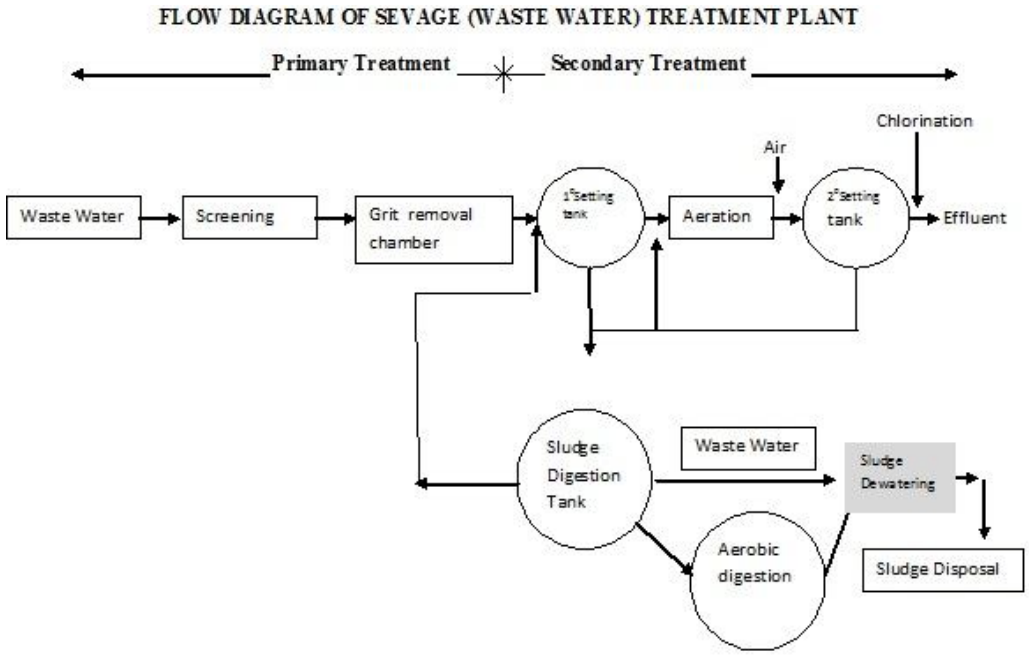
ROTATING BIOLOGICAL CONTACTOR

UPFLOW ANAEROBIC SLUDGE BLANKET REACTOR (UASB)

ADVANCED SEWAGE TREATMENT:

After the primary & secondary treatment many undesirable substances still remain in the effluent.

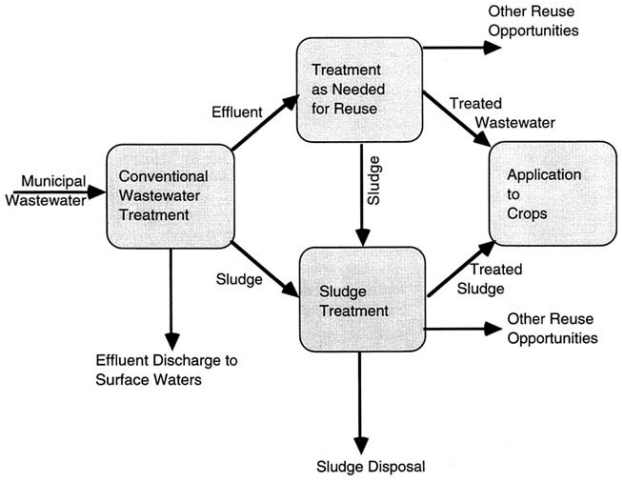
Sewage= waste matter such as faeces or dirty water Sludge=ooze dirt Floc=individual particles of clay



MUNICIPAL WASTEWATER TREATMENT

At municipal wastewater treatment plants in the United States, raw municipal wastewater undergoes preliminary, primary, secondary, and in some cases, additional treatment to yield treated effluent and a concentrated stream of solids in liquid, called sludge. The sludge is treated as required for utilization or disposal, and additional treatment of effluent may be needed to accommodate specific water reuse opportunities.

This briefly reviews typical amounts and properties of treated effluent and sludge, then examines processes used in conventional wastewater treatment (defined as preliminary, primary, and secondary treatment), processes intended specifically to accommodate wastewater application to crops, and typical sludge treatment processes.



Conventional municipal wastewater treatment processes were developed to produce effluents suitable for discharge to surface waters. The processes are intended primarily to remove BOD and suspended solids, but wastewater constituents associated with particles are also removed. Thus, substantial removal of trace contaminants may occur in conventional treatment even though the treatment processes were not designed for trace metal or toxic chemical removal.

When required by receiving water conditions or effluent reuse practices, advanced, or tertiary, wastewater treatment processes may be used in addition to conventional municipal wastewater treatment processes. Destruction of pathogenic organisms and increased removal of suspended solids or nutrients are some of the goals of tertiary treatment.

With the exception of compounds biologically degraded or volatilized during wastewater treatment, substances removed from wastewaters are contained in the residues, or sludges, produced. A wide variety of sludge treatment processes are used to prepare municipal wastewater treatment sludges for use or disposal. The objectives of most municipal sludge treatment processes are to reduce the water content of sludges, to avoid complications from decomposition of the biologically degradable fraction of sludges, and to reduce the levels of pathogenic organisms in sludges.

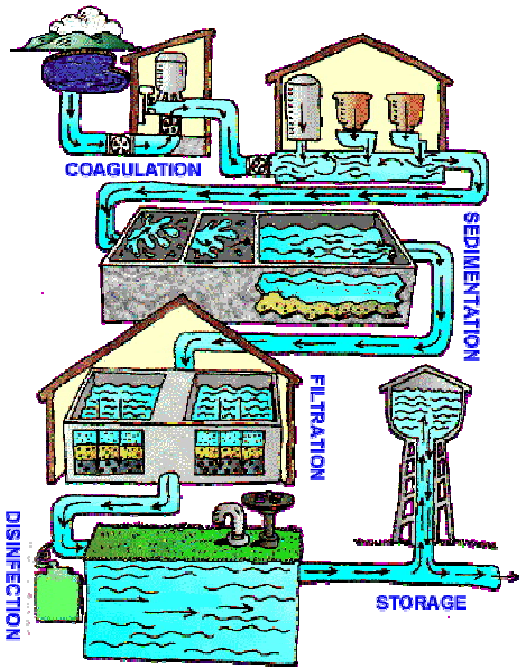
Economically viable technology for selective removal of trace elements and toxic organic compounds from sludges does not exist. Amounts of these constituents in municipal sludges can currently be controlled only by regulating the quality of wastewater entering municipal waste-water collection systems. Industrial wastewater pretreatment programs have been demonstrated to

substantially improve the quality of sludge from municipal wastewater treatment. Modification of industrial processes, control of corrosivity of water in water supply systems, and changes in the formulation of disposable consumer products are other measures needed to control wastewater and, hence, sludge quality.

DRINKING WATER TREATMENT

Drinking water supplies in the United States are among the safest in the world. However, even in the U.S., drinking water sources can become contaminated, causing sickness and disease from waterborne germs, such as Cryptosporidium, E. coli, Hepatitis A, Giardia intestinalis, and other pathogens.

Drinking water sources are subject to contamination and require appropriate treatment to remove disease-causing agents. Public drinking water systems use various methods of water treatment to provide safe drinking water for their communities. Today, the most common steps in water treatment used by community water systems (mainly surface water treatment) include:



Coagulation and Flocculation

Coagulation and flocculation are often the first steps in water treatment. Chemicals with a positive charge are added to the water. The positive charge of these chemicals neutralizes the negative charge of dirt and other dissolved particles in the water. When this occurs, the particles bind with the chemicals and form larger particles, called floc.

Sedimentation

During sedimentation, floc settles to the bottom of the water supply, due to its weight. This settling process is called sedimentation.

Filtration

Once the floc has settled to the bottom of the water supply, the clear water on top will pass through filters of varying compositions (sand, gravel, and charcoal) and pore sizes, in order to remove dissolved particles, such as dust, parasites, bacteria, viruses, and chemicals.

Disinfection

After the water has been filtered, a disinfectant (for example, chlorine, chloramine) may be added in order to kill any remaining parasites, bacteria, and viruses, and to protect the water from germs when it is piped to homes and businesses.

MUNICIPAL SOLID WASTE MANAGEMENT

Definition:

Rejected and refuse material from commercial and as well as industrial activities is known as solid waste.

SOURCES AND CLASSIFICATION OF SOLID WASTES:

Solid wastes can be classified into the following:

- Garbage or food-wastes:
  These are meat, fruit or vegetable residues which decompose rapidly (putrescible) especially in warm weather.
  Ex: vegetable and fruit peels, leftovers, meat, bones, spoiled food items.
- Rubbish : These do not decompose rapidly.
  (i)combustible:
  Ex: paper, cardboard, textiles, wood items, rubber, leather, plastic containers.
  (ii) Non-combustible:
  Ex: crockery, metals, aluminium cans, tin cans etc., empty glass bottles.
- **A**gricultural wastes: These include crop residues from agricultural fields, farm manure etc.,
  Ex: jute, cotton, rubber, tea, coffee, coconut, sugarcane wastes, rice straw, cattle-shed wastes.
- Industrial wastes: These arise from industrial activites.
  Ex: flyash, sewage, chemicals, sludge, paints, toxic metals etc.
- Hazardous wastes: Those wastes which adversely affect human, plant or animal life.
  Ex: radioactive wastes, toxic chemicals, flammable wastes, explosives, hazardous biological wastes from hospitals or research institutions.
- Pathological waste: Waste from dead animals, slaughter house etc.,
  Ex: carcass of animals, slaughter house wastes like blood, pieces of meat, hair, fat, bone chippings, hides, skin excretions etc.,
- Demolition and construction wastes: Demolition, construction and repair of residential. Commercial and industrial buildings generate plenty of solid wastes.
  Ex: stones, bricks, concrete, dust, plaster, electrical, plumbing and sanitary parts.

- Aquatic weeds: these are a menace because of their profile growth. They increase water borne diseases, hinder traffic and fishing and cause Eutrophication.
- Miscellaneous wastes: wastes not included in any of the above categories.
  Ex: street sweepings, roadside litter, dead stray animals, abandoned vehicles etc.,

CAUSES OF SOLID WASTE POLLUTION:

The reasons for the rapid growth in the quantity of solid wastes are over population, affluence and technology.

(A) OVERPOPULATION: As a number of people producing a pollutant increase pollution will naturally increase.

(B) AFFLUENCE: Production or per capita consumption.

(C) amount of pollution produced per unit of economic good.

EFFECTS OF SOLID WASTE POLLUTION:

(A)HEALTH HAZARDS:

Improper of handling of solid wastes is a health hazard especially for the worker who comes in direct contact with the waste.

Disease transmission may take place by infection through open sores or vectors like rats and insects which invade refuse dumps for food.

Rats spread many diseases like plague, salmonellosis, endemic typhus, trichinosis etc.,through direct bite.

Flies breed on refuse dumps, human faces etc and spreads many diseases like bacillary dysentery, diarrhoea and amoebic dysentry in humans.

Improper disposal of hazardous wastes results in contamination of crops or water supplies pose a serious health hazard for humans like large scale of epidemic of cholera, gastro-intestinal diseases, jaundice, hepatitis etc., Contamination of soil and water bodies by the leachate from decomposed and purified garbage dumps. Chocking of drains and gully pits by the solid wastes result in water logging especially during the rainy season. This water logging results in breeding of mosquitoes in the stagnant water.

(b) ENVIRONMENTAL IMPACTS:

Scavengers, stray animals, roadside garbage dumps and litter causing much aesthetic damage to the environment. Burning of these wastes produce smoke and causes air pollution. Noxious fumes given off by the burning of plastic containers.

CONTROL MEASURES OF URBAN AND INDUSTRIAL WASTE:

The main objective of solid waste management is to minimize these adverse effects before it becomes too difficult to rectify in the future. It involves many activities like:

(a) Collection of solid waste
(b) Disposal of solid wastes.
(c) Waste utilization.

(1) COLLECTION OF SOLID WASTES:

It all activites like gathering and hauling of the wastes collected to the location from where the collection vehicle will ultimately transport it to the site of disposal. There are three basic methods of collection:

(a) Community storage point:

The municipal refuse is taken to fixed storage bins and stored till the waste collection agency collects.

(a)

(b)

(c)

(b) Kerbside collection:

In advance of the collection time, the refuse is brought in containers and placed on the footway from where it its collected by the waste collection agency.

(c) Block collection:

Individuals bring the waste in containers and hand over to the collection staff who empties it into the waiting vehicle and return the container to the individuals.

WASTE SEPERATION TECHNOLOGY:

This technology is to remove volatile chemicals like alcohol, sodium, spirit, and perfume.

It is of four types:

(1) Air stripping:
Technology which have tendency to vaporize conveniently can be forced out of liquid when air passes through them.

(2) Steam stripping:
In this technology heated air is used to raised the temperature of the liquid to force out volatile chemicals which ordinary air may not force out.

(3) Carbon absorption:
Carbon absorption tanks contain specifically activated particles of carbon. These particles of carbon trap hazardous chemicals which are in liquid and gaseous waste. They catch hazardous particles just as a fine mesh catches grains of sand contaminated carbon is disposed of, cleaned or reused.

(4) Precipitation:

It involves adding and mixing special materials to a liquid waste. settleable floc can be separated as sludge and the one that remains suspended can be filtered out.

(11) DISPOSAL OF SOLID WASTES:

Before the solid waste is ultimately disposed of it is processed in order to improve the efficiency of solid waste disposal system and to recover usable resources out of the solid wastes.

The processing techniques are:

(1) SALVAGE OR MANUAL COMPONENT SEPARATION:

Manually sorted out or salvaged either for recycling or for resale.

Ex: cardboard, newsprint, high quality paper, glass, metals, wood and aluminium cans etc.,

(2) COMPACTION OR MECHANICAL VOLUME REDUCTION:

After separation of reusable or disposable articles, compacters are used to compress the waste materials directly into large containers or to form bales that can be then placed in large containers.

(3) INCINERATION OR THERMAL VOLUME REDUCTION:

Burning of waste at very high temperatures.

Ex: high combustible wastes like plastics, rubber, wood scrap, floor sweepings etc.,

(4) OPEN DUMPING:

It in done in low lying areas and outskirts of the towns and cities.

(5) SANITARY LANDFILLING OR CONTROLLED TIPPING:

Sanitary land filling involves the disposal of municipal wastes on or in the upper layers of the earth's mantle especially in degraded areas in need of restoration.

In land filling, the solid wastes are compacted and spread in thin layers.Each layer being uniformly covered by a layer of soil. The final layer is covered by afinal cover of about one meter of earth to prevent rodents from burrowing into the refuse and scattering. This is a biological method of waste treatment and bacterial refuse digestion results in decomposition products like CO2,CH4, NH3,H2S and H2O which can be harnessed as renewable sources of energy.

This prevention can be taken by using a plastic membrane or watertight membrane on the base.

(6) PYROLYSIS OR DESTRUCTIVE DISTILLATION:

In this disposal method the solid wastes are heated under anaerobic conditions (i.e, burning without oxygen). Pyrolysis is a highly endothermic process and that is why it is also called destructive distillation.

(7) LANDFARMING:

In this waste disposal method the biodegradable industrial wastes and organic wastes are either applied on top of the land or injected below the soil surface with suitable equipment where the undergo bacterial and chemical decomposition.

(8) COMPOSTING OR BIODEGRADATION:

Bacterial decomposition of the organic components of the municipal solid wasters result in formation of humus or compost and the process is known as composting.

In this process a compost pile is constructed by making alternate layers of organic matter and soil (source of micro organisms), some fertilizer and water is periodically added to the compost pile to stimulate microbial (bacterial and fungi) action and to maintain the necessary moisture content (55%)

(III) WASTE UTILISATION:

Resource recovery or waste utilization is achieved by **<u>three</u>** techniques:

(1)REUSE:

Given material has multiple uses.

(2) RECLAMATION:

Component of the waste is recovered for use in a manner different from its original use.

(3) RECYCLING:

Isolating the material from which a given product was made and reintroducing into the production cycle for production of the same product.

<u>BIOMEDICAL WASTE MANAGEMENT</u>

Definition:

Solid, semisolid (or) liquid waste including containers that are generated during diagnosis treatment immunization products &testing of body parts.

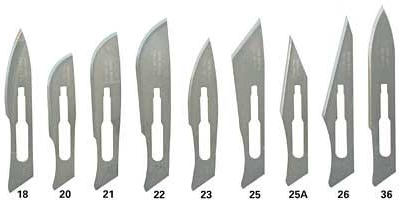
GENERATION:

Operation theaters, Injection rooms, ICU-Intensive Care Units, Dressing rooms, Dialysis rooms Laboratory, Labor room

TYPES OF BIOMEDICAL WASTE:

- **In general these wastes include**
  - Needles
  - Scalpel blades
  - Syringes
  - Contaminated gloves

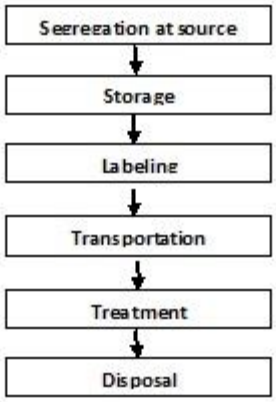
- Dishes used for microbiological cultures
- Human anatomical waste
- Blood soaked items such as gauze pads & other absorbents.
- Wastes generated in the health center that are known to have been in contact with an infectious agent.



Scalpel blades

BIOMEDICAL WASTE MANAGEMENT:

Management of biomedical waste is important because of its infectious nature;



These are the different stages of biomedical waste management

a) <u>Segregation at source:</u>

The first step in biomedical waste management is segregation of wastes. only a small fraction of waste generated by health care institutions is actually infectious/hazardous. It is estimated that about 80-85% non-infectious 10% infectious 5% hazardous.

b) <u>STORAGE OF BIOMEDICAL WASTES:</u>

Storage of biomedical waste is the process of holding the biomedical waste temporarily at any location prior to transportation treatment (&) disposal the containers used for storage must be rigid, leak proof , impervious to moisture and sufficiently strong to prevent tearing/bursting under normal conditions of use & handling.

Colour adopted for different types of BMWs:

S. No.	Colour	Type of container	Waste category
1.	Yellow	Plastic Bags	Cat 1,2,3 &6
2.	Red	Disinfected container/ plastic bag	Cat 3,6,&7
3.	Blue/White Translucent	Puncture proof container plastic bag	Cat 4 &7
4.	Black	Plastic bag	Cat 5,9 &10

c) **<u>labeling</u>**:

In biomedical waste management it is essential to affix (or) otherwise imprint a water-resistant label on the outside of each container indicating contents of the container before the transportation process.

The label must be three inches by five inches & it shall be non-washable & Shall be prominently visible.

Each label over the container must specifically contain the universal biohazard symbol (or) the words medical waste (or) infectious waste.

Schedule III: Label for Bio-Medical Waste Containers/Bags

THE LABEL MUST CONTAIN THE FOLLOWING DETAILS:

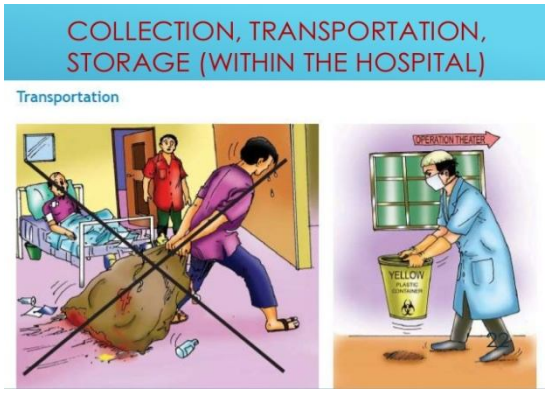
(a) Type of waste
(b) The site of generation
(c) The generator's name & address.

<u>d)Transporting biomedical waste:</u>

- Specially designed vehicles are to be used in transporting the untreated biomedical wastes.
- Such vehicles shall be dedicated for transportation of biomedical waste only.
- Depending upon the volume of wastes to be transported the vehicle may be

Three wheeler
Light motor vehicle
Heavy duty vehicle

- Separate cabins shall be provided for staff/driver and the container.
- No untreated biomedical waste shall be stored beyond a period of 48 hours.



e) Treatment of biomedical wastes:

The different types of treatments given for the processing of biomedical wastes are:

- Incineration
- Autoclaving
- Microwaving
- Hydroclaving
- Chemical disinfection
- Shredding

Incineration:

Incineration is a controlled combustion process where the waste is completely oxidized & harmful micro organisms present in it are destroyed under high temperature.

Autoclaving:

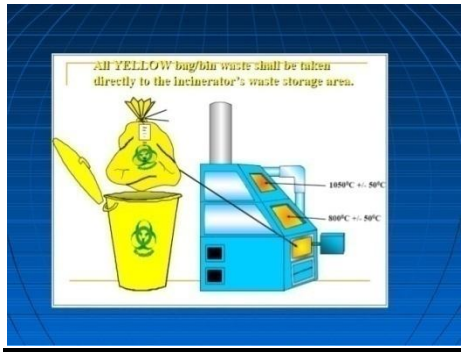
It is a low heat thermal process. In this process for sufficient duration, the low-heat steam is allowed to have direct contact with waste in a controlled manner to disinfect the wastes.

Microwaving:

It is an inter-molecular heating process with electromagnetic radiation between 300 to 3,00,000 MHz. The heat occurs inside the waste material inside the steam. Microwave treatment shall not be used of cytotoxic, hazardous/radioactive wastes, contaminated animal carcasses, body parts & large metal items.

Hydroclaving:

It is similar to that of autoclaving. The only differences is that the waste is subjected to indirect heating by applying steam in the outer jacket. The waste is continuously tumbled in the chamber during the process.



Chemical disinfection:

It is done using atleast 1% hypochlorite solution (or) any other equivalent chemical reagent. This type of treatment is an option for the treatment of certain categories of biomedical waste.

Shredding:

It is a process by which the wastes are reshaped or cut into smaller pieces so as to make the wastes unrecognizable. It helps in prevention of reuse of biomedical wastes.

Disposal of biomedical waste:

- Biomedical waste should be disposed frequently to reduce accumulation these materials in work areas.
- Liquid wastes like blood, urine may be disposed of through the sanitary sewer in that area.
- Use of sanitary sewer reduce the chance for leaks or spills during transport.
- Also it reduces the cost of disposal. Biological waste disposal can be poured down the drain (sanitary sewer) under running water.
- Non – infectious human or animal blood & blood fluids do not need to be disinfected before being poured down the drain.
- The sink should be rinsed well & disinfected if necessary, after the disposal procedure.

Different modes of disposal of Biomedical Wastes

Waste category	Type of waste	Type of Treatment	Modes of Disposal
Category – 1	Human anatomical waste	Incineration	Deep burial
Category – 2	Animal waste	Incineration	Deep burial
Category – 3	Microbiology/Biotechnological waste	Autoclaving/microwaving	incineration
Category – 4	Waste sharps	Autoclaving/microwaving/chemical disinfection	Shredding
Category – 5	Discarded medicine & cytotoxic drug	Incineration	Secured land filling
Category – 6	Soiled wastes	Autoclaving/microwaving/incineration	Shredding
Category – 7	Solid wastes	Autoclaving/microwaving/chemical disinfection	Land fill
Category – 8	Liquid wastes	Chemical	Discharge into disinfection drains municipal land fill
Category – 9	Incineration Ash	Chemical	Discharge into disinfection drains municipal land fill
Category – 10	Chemical wastes	Chemical disinfection	Secured landfills for solids & discharge into drains for liquids

HAZARDOUS WASTE MANAGEMENT

DEFINITION:

Wastes that creates danger to the living community, immediately (or) over a period of time are called as Hazardous wastes.

It can be available in the form of Solids, Sludge (or) Gases.

Safe collection, handling & disposal of these wastes are very important, great care and caution should be taken for these processes.

CHARACTERISTICS OF HARZARDOUS WASTES:

The hazardous wastes have the following characteristics:

(A) TOXITY:

It can be toxic to living things when ingested (or) absorbed. The toxicity of hazardous waste will produce metabolic absorbed. The toxicity of hazardous waste will produce metabolic disorders, poisoning, cancer & mutations in the receptor.

(B) REACTIVITY:

These wastes strongly react with water. They are capable of reacting with other chemical. These are unstable under normal conditions.

(C) IGNITABILITY:

It catches fire easily.

(D) RADIOACTIVITY:

It may release ionizing radiation.

E) CORROSIVITY:

It can be corrosive & weans away other materials. The PH value of these may be less than 2 or more than 12.5.

SOURCES OF HAZARDOUS WASTES:

Industries, hospitals and biological research centers are the principal sources.

Following are some of the sources of hazardous wastes;

1) Automobile industries
2) chemical industries
3) coal industries
4) electroplating
5) leather
6) metallurgical
7) paints & related industries
8) petroleum
9) textile
10) hospital & research laboratories.

CLASSIFICATION OF HAZARDOUS WASTES:

The hazardous wastes are classified mainly into **five** categories.

a) radioactive substances
b) chemicals

c) biological wastes
d) flammable wastes
e) explosives

A)RADIOACTIVE SUBSTANCES:

The substances that are emitting ionizing radiation are being defined as radioactive substances.

These are hazardous because prolonged exposure to radiation results in damage to the living organisms.

SOURCES OF RADIOACTIVE POLLUTION

NATURAL SOURCES	**MAN-MADE SOURCES**
1) COSMIC RAYS FROM OUTER SPACE	1)NUCLEAR WEAPONS
2) NATURALLY OCCURING ISTOPES	2)ATOMIC REACTORS & NUCLEAR FUEL
	3) RADIOACTIVE ISOTOPES
	4) MINING & REFINING OF RADIOACTIVE ELEMENTS (Ur ,Pl & Th)

2) CHEMICALS:

The extensive use of chemicals for industrial & agricultural purposes is the source of chemical pollution.

SOURCES: detergents, fertilizers, pesticides, toxic metals in industrial wastes, soil based technology etc.,

various types of industries like petroleum, steel, fertilizers & non-ferrous metal industries are producing common pollutants like cadmium, mercury, chromium, lead,arsenic, barium etc.,

3) BIOLOGICAL WASTES:

These types of wastes are also generated as a byproduct of industrial biological conversion processes.

SOURCES:

HOSPITALS

BIOLOGICAL RESEARCH STATIONS.

These type of wastes have the ability to produce toxins & infect other living organisms.malignant tissues taken during surgery. Hypodermic needles, bandages, expired medicines are included in this group.

4)FLAMMABLE WASTES:

These wastes may be in liquid, gaseous (or), solid form, but most often they are liquids.

ex: organic solvents, oils, plasticizers & organic sludge, most of the flammable hazardous wastes are also indentified as hazardous chemical wastes.

5)EXPLOSIVES:

These wastes are resulting from weapons manufacturing. Some of the industrial gases are also included in this group. these wastes may exist in solids, liquid (or) gaseous form.

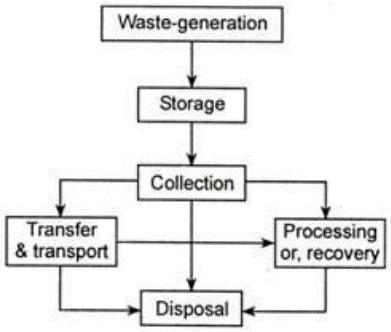
COMMON HAZARDOUS WASTES:

- Cyanide & fluoride waste
- alkaline & acidic sludge containing heavy metals
- metal finishing waste
- waste containing chromium, lead, zinc, barium, mercury.
- dye & spent chemicals
- phenolic wastes
- discarded containers

MANAGEMENT OF HAZARDOUS WASTES:

The steps to be followed in the management of hazardous wastes after its generation are

- storage
- collection & transportation
- treatment
- disposal



Stages of hazardous waste management:

1)STORAGE OF HAZARDOUS WASTES:

Storage of hazardous waste is an interim measure, generally the storage of hazardous waste is carried out temporarily prior to the treatment process or unit its disposal.

2) COLLECTION & TRANSPORTATION OF HAZARDOUS WASTES:

Collection of hazardous wastes for delivery from the onsite places to the treatment (or) disposal units is normally done by the waste generator (or) a specialized hauler.

Loading of collection vehicles can be done in any of the following two ways:

1) Sealed drums (or) Sealed container which stored the hazardous wastes are loaded to the collection vehicle by either manually (or) mechanically

2) The wastes stored in tanks are either drained (or) pumped into collection vehicle.

TREATMENT OF HAZARDOUS WASTES:

It has two purposes:

(I) To recover useful materials from the waste.
(II) To prepare the wastes for disposal.

Some wastes require less treatment while the others require more intensive treatment methods for its disposal liquid & semi liquid radioactive wastes are treated by solidification process such as vitrification & calcining.

In vitrification process by adding molten glass particles the high level liquid wastes are converted into insoluble form.

Compaction (or) incineration process are used to reduce the volume of hazardous & mixed wastes. Mixed wastes pose a significant challenge, because sufficient treatment technologies do not exist for some of these wastes.

DISPOSAL OF HAZARDOUS WASTES:

Disposal is the final step in the waste management process. It is the permanent isolation of the hazardous waste management. The disposal site must be far away from large population centers.

These sites must have dry climate & extremely deep water table. Land-filling is the most common method used in disposal of hazardous wastes. Generally sanitary landfilling method of disposal is adopted for non-hazardous wastes. The disposal site must be far away from large population centers.

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E – Waste

E – Waste which means “Discarded electronic waste”

Definition:

Field of electronics which keeps on changing the configuration & technology & as a result, the older models of electronic devices becomes obsolete in a short span of time.

Example:

- Telecommunication devices
- Reprographic devices
- Security devices
- Automobile devices

It contains toxic metals such as

- Lead
- Beryllium
- Mercury
- Cadmium

- Lead & cadmium in circuit boards
- Leadoxide & cadmium in cathode raytubes monitors
- Mercury in switches & flat screen monitors
- Cadmium in computer batteries
- PCB’s poly Chlorinated Biphemyls in older capacitors & transformers
- Brominated flame standards & retardants on printed circuit boards

- Plastic casings, cables &
- Polyvinyl cable insulation

Management method:

- Product reuse
- Conventional disposal in land fills
- Incineration & recycling

It has to be assessed in the broad frame work of extended procedure responsibility & the precautionary principle.

UNIT – VI

Assignment-cum-tutorial questions

Section A

Objective questions

1. Solid waste comprises of [ ]
   a) Natural wastes & agricultural wastes b) Agricultural & behavioral wastes
   c) Agricultural & industrial wastes d) Agricultural, behavioral and industrial wastes.
2. One among the following in not a hazardous waste [ ]
   a) Cyanide waste b) Mercury, arsenic waste
   c) Sludge from water treatment plant
   d) Sludge from industrial waste contains heavy metals.
3. _____is the most dangerous and long-lasting waste. [ ]
   a) Solid waste b) Biomedical waste c) Hazardous waste d) E-waste
4. Chemical disinfection is a method used to treat _____waste. [ ]
   a) Nuclear waste b) Hospital waste c) Solid waste d) E-waste
5. Reverse osmosis is a type of _____ [ ]
   a) Dead end filtration system b) Cross flow filtration system
   c) Ion exchange method d) Micro filtration
6. Biomedical waste may be disposed off by_____ [ ]
   a) Incineration b) Pyrolysis c) Autoclaving d) Autoclaving & land-filling
7. Which of the following strategies should be given first preference as far as the management of plastic waste is concerned_____ [ ]
   a) Recycle b) Reuse c) Reduce the waste d) Disposal
8. Which of the following statement is correct [ ]
   (a) I&II (b) III&IV (c) Only III (d) Only I
9. High level radioactive waste can be managed in which of the following ways? [ ]
   (I) composting (II) store indefinitely (III) incineration (IV) neutralization
   (a) only I (b) only II (c) only III (d) only IV
10. Disposal of different types of wastes: [ ]

A. Radioactive waste	(I) Recycling
B. Biomedical waste	(II) Land farming
C. Solid waste	(III) Deep geological disposal
D. E-waste	(IV) Microwaving

   A) A-I, B-II, C-III, D- IV B)A- IV,B-II,C-III, D-I
   C) A-III, B-IV, C-II, D-I D) A-III,B-II,C-I,D-IV

11. Storage of different types of waste [ ]

A. Solid waste	I. sealed containers
B. Hazardous waste	II. Large containers
C. Biomedical waste	III. Puncture-resistant containers
D. E- waste	IV. Tins

   A) A-IV, B-III, C-I, D- II (B)A- I,B-II,C-III, D- IV (C) A-II, B-I, C-III, D-IV
   D) A-III, B-IV, C-I, D-II
12. The process of converting electricity (energy) from waste is called_____..
13. Used batteries, mobile phones, calculators & other such stuff are better known as _____.
14. The common convention of solid waste into manure & biogas using bacteria & fungi is called_____.
15. Hospital waste has to be disposed off by _____.
16. Industries generating hazardous wastes are classified as _____ color.
17. Carbon emission trading is a form of emissions trading that specifically targets_____.

18. One carbon credit =_____.
19. For CDM approval is given by _____.
20. The CDM has already registered more than _____ number of projects.

Section B

Subjective questions

Short answer questions

1) Define waste? Why does it require management?
2) Define composting and vermicomposting.
3) What solid waste?
4) What is biomedical waste?
5) What is hazardous waste?
6) What is E-waste?
7) Define carbon trading?
8) Define carbon credits?
9) What is incineration?
10) What do you mean by 3R's principle?

Long answer questions

1. Describe industrial waste water treatment.
2. Define & describe
    - Composting
    - Mechanical composting
    - Land fill method
    - Pyrolysis
    - Incineration
3. What are the wastes that are classified as hazardous wastes?
4. What is the way out of waste problem?
5. How do you categorize the biomedical wastes?
6. What are the effects of plastic waste?
7. Discuss the concept of Green Building & its design consideration?
8. Write a story on Clean Development Mechanism (CDM)
9. What are the various methods of biomedical waste management?
10. How is vermicomposting better than conventional composting used for biodegradable solid waste?
11. What are the problems occurring due to the disposal of untreated or improperly treated municipal waste waters?
12. Explain clearly about stages of biomedical waste?
13. How do you classify hazardous wastes?
14. What are the technologies for processing of MSW?
15. Given the risks of accidents and the problem of storing deadly waste for thousands of years, should we persist with nuclear power? Is it really clean as its proponents say?