14BEME306 , 14BTBT306

ENVIRONMENTAL SCIENCE AND ENGINEERING 3 0 0 3 100

INTENDED OUTCOMES:

- To give a comprehensive insight into natural resources, ecosystem and biodiversity.
- To educate the ways and means to protect the environment from various types of pollution.

UNIT - I PLANET EARTH

Environmental segments- Biosphere, Lithosphere, Atmosphere: Structure of atmosphere-Troposphere, Stratosphere and Ionosphere. Air pollution - Sources, effects and control. Gaseous and particulate air pollutants, Green house effect and global warming, Effect on climates. Ozone depletion-mechanism, substitutes for CFC's- Photo chemical smog-mechanism, Acid rain and its effects.

UNIT - II HYDROSPHERE

Water-Sources, Ground water and surface water-Water shed and its management-Water conservation-Rain water harvesting. Water Pollution-Water quality-Point and Non-point sources, Classification-Oxygen demanding waste (BOD, COD-Definition and experimental determination of BOD only), Bioamplification, waste water treatment-Preliminary, secondary, Disaster management-Floods, earthquake, cyclones and Tsunami.

UNIT - III LITHOSPHERE

Land - weathering and erosion - types of weathering - types of soil - soil erosion - land slides - deserts - types - desertification - land degradation. Soil Pollution-Effects on modern Agriculture on soil-pesticide-over fertilization- solid waste-sources and disposal by sanitary land filling. Hazardous waste- definition-Types, Chemical waste-sources and effects, Bioclinical waste-Sources and disposal method, Nuclear waste-disposal methods.

UNIT - IV BIOSPHERE

Ecosystem-Components-functions-Ecological pyramids-energy flow- Bio Geochemical cycling-marine ecosystem-Terrestrial eco system- Biodiversity-Hot spot, Endemic, Endangered, Extinct species-Factors affecting Biodiversity--conservation of biodiversity.

UNIT - V ALTERNATE ENERGY SOURCES

Nuclear energy- Nuclear reactor-Breeder reactor-Wind energy-Wind mill, Solar energy conversion-solar cells, Tidal-Harnessing methods. Geothermal, Hydro electric power, Biogas, Sustainability, Green Technology, Nano technology, Microwave technology- Importance-current scenario in India

TEXT BOOKS:

S.No	Author(s) Name	Title of the book	Publisher	Year of Publication
1.	Ravikrishnan, A	Environmental Science	Sri Krishna Hi tech Publishing Company Private Ltd., Chennai	2008
2.	Anubha kaushik C.P. kaushik	Environmental Science and Engineering	New Age International (p) Ltd., New Delhi.	2008

REFERENCES:

S.No	Author(s) Name	Title of the book	Publisher	Year of Publication
1.	Linda D. Williams	Environmental Science Demystified	Tata Mc Graw -Hill Publishing Company Limited, New Delhi.	2005
2.	Tyler Miller G. Jr	Environmental Science	Thomson & Thomson Publishers, New Delhi.	2004
3.	William P.Cunningham	Principles of Environmental Science	Tata Mc Graw -Hill Publishing Company, New Delhi.	2007
4.	Bharucha Erach	Environmental Science Demystified	Mapin Publishing Private Limited, Ahmadabad	2005
5.	Trivedi, R.K. and Goel, P.K	Introduction to Air Pollution	Techno-Science Publications.	2003

WEBSITES:

1.www.clemson.edu/ces/eees
2.www.ees.lanl.gov/ees11/geophysics/other/mars/marsworkshop.html
3.www.newagepublishers.com/samplechapter/001281.pdf
4.www.unesco.org/ext/field/beijing/scienceb.htm,www.infinitepower.org/education.htm

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COIMBATORE – 641021

ENVIRONMENTAL SCIENCE AND ENGINEERING

LECTURE PLAN

UNIT-I
PLANET EARTH

S.No	Topics	Hours
1.	General awareness about environment, Scope and importance of environmental studies	1
2.	Introduction - Planet Earth-Environmental segments-Biosphere, Hydrosphere, Lithosphere	1
3.	Atmosphere: Structure of atmosphere-Troposphere, Stratosphere and Ionosphere.	1
4.	Air pollution – Gaseous and particulate air pollutants, pollution sources-Effects and control measures of air pollution	1
5.	Tutorial	1
6.	Green house effect and global warming – climate change	1
7.	Ozone and ozone depletion – Mechanism, substitutes for CFC's	1
8.	Photochemical smog mechanism, Acid rain and its effects	1
9.	Tutorial	1
	Total hours	7+2

UNIT-II
HYDROSPHERE

S.No	Topics	Hours
1.	Water – hydrological cycle – ground water and surface water	1
2.	Water shed and its management	1
3.	Water conservation-Rain water harvesting	1
4.	Water pollution-Water quality-point and Nonpoint sources, classification.	1
5.	Tutorial	1
6.	Oxygen demanding waste , BOD, COD- Definition and experimental determination of BOD ,Bioamplification	1
7.	Waste water treatment methods.	1
8.	Disaster management-Floods, earthquake, cyclones and tsunami.	1
9.	Tutorial	1
	Total hours	7+2

UNIT-III
LITHOSPHERE

S.No	Topics	Hours
1.	Land – weathering and erosion – types of weathering	1
2.	Soil– types of soil, soil erosion	1
3.	Landslides Deserts- types– desertification – land degradation	1
4.	Soil Pollution-Effects of modern Agriculture on soil-pesticide-over fertilization	1
5.	Tutorial	1
6.	Solid waste-sources and disposal by sanitary land filling	1
7.	Hazardous waste- definition, Types, Chemical waste, Bioclinical waste	1
8.	Radioactive waste -Sources, effects and disposal methods.	1
9.	Tutorial	1
	Total hours	7+2

UNIT-IV
BIOSPHERE

S.No	Topics	Hours
1.	Ecosystem-components and functions	1
2.	Ecological pyramids -Energy flow	1
3.	Biogeochemical cycles	1
4.	Marine ecosystem, Terrestrial ecosystem	1
5.	Tutorial	1
6.	Biodiversity-Hot spots, Threats to biodiversity- Factors affecting biodiversity	1
7.	Endemic, Endangered, Extinct species	1
8.	Conservation of biodiversity	
9.	Tutorial	1
	Total hours	7+2

UNIT-V
ALTERNATE ENERGY SOURCES

S.No	Topics	Hours
1.	Nuclear Energy-Nuclear reactor, Breedor reactor	1
2.	Wind Energy, Solar Energy	1
3.	Tidal –harnessing methods, Geothermal Energy	1
4.	Hydro Electric power, biogas	1

5.	Tutorial	1
6.	Sustainability, Green Technology	1
7.	Nano technology	1
8.	Microwave Technology Importance-current scenario in India	1
9.	Tutorial	1
	Total hours	7+2

TOTAL HOURS: 45(Lecture hours: 35+ Tutorial hours: 10)

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2.	Tyler Miller G. Jr	Environmental Science	Thomson & Thomson Publishers, New Delhi.	2004
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4.	Bharucha Erach	Environmental Science Demystified	Mapin Publishing Private Limited, Ahmadabad	2005
5.	Trivedi, R.K. and Goel, P.K	Introduction to Air Pollution	Techno-Science Publications.	2003

WEBSITES:

www. nineplanets.org
www.hydrosphere.net
www.cotf.edu/ete/ess/ESSspheres.
www.biospheresmart.org
www.sciencedaily.com/news/earth_climate/renewable_energy
www.routledge.com/sustainability

JOURNALS:

Journal of Earth Science & Climatic Change
Journal of Climatology & Weather Forecasting
Journal of Applied Water Engineering and Research
International Journal of Waste Resources
Journal of Pollution Effects & Control
Journal of Biodiversity & Endangered Species
Journal of Ecosystem & Ecography
Journal of Fundamentals of Renewable Energy and Applications

UNIT – I

PLANET EARTH

Introduction

Environment is a French word meaning surrounding.

All biological and non biological things surrounding an organism are called an environment.

Environment

It is also defined as the sum of total of water, air and land, interrelationship among themselves and also with the human beings, other living organisms and property.

Environmental Science

It is the study of environment, it's biotic and abiotic and their inter relationship.

Environmental Engineering

It is the application of engineering principles to the protection and enhancement of the quality of the environment and to the enhancement and protection of public health and welfare.

Environmental education

It is the process of educating the people for preserving quality environment.

SCOPE OF ENVIRONMENTAL STUDIES

1. This study crates awareness among the people to know about various renewable and non renewable resources of a region. The endowment or potential, pattern of utilization and the balance of various resources available for future use in the state or a country are analyzed in the study.

2. It provides the knowledge about ecological system causes, effects and relationships between the components.

3. It provides necessary information about biodiversity richness and the potential dangers to the species of plants, animals and microorganism in the environment

4. This study enables one to understand the causes and consequences of natural and man induced disasters, pollutions and measures to minimize theses effects.

5. It enables one to evaluate alternative responses to environmental issues before deciding an alternative course of action.

6. This study enables environmentally literate citizens to make appropriate judgment and decisions for the protection and improvement of the earth.

7. This study exposes the problems of over pollution, health, hygiene etc and the role of arts, science and technology in eliminating the evils from the society.

8. This study tries to identify and develop appropriate and indigenous eco friendly skills and technologies to various environmental issues.

IMPORTANCE OF ENVIRONMENTAL STUDY

1. World population is increasing at an alarming rate especially in developing countries.

2. The natural resources endowment in the earth are limited.

3. The methods and techniques of exploiting natural resources and advanced.

4. The resources are over-exploited and there is no foresight of leaving the resources of the future generations.

5. The unplanned exploitation of natural resources lead to pollution of all types and at all levels.

6. The pollution and degraded environment seriously affect the health of all living things on earth, including man.

7. The people should take a combined responsibility for the deteriorating environment and begin to take appropriate actions to save the earth.

8. Education and training are needed to save the biodiversity and species extinction.

9. The urban areas, coupled with industries, are the major sources of pollution.

10. The number and area of the protected are should be increased so as to protect the wild life.

NEED FOR PUBLIC AWARENESS

1. Individuals of school, colleges, industries, service centers, village, urban centers etc. should realize the importance of day to day environmental issues.

2. The individuals should practice environmental conservation principles and create awareness among family members.

3. The individuals could expose the problems by writing in the newspapers/discuss about the environmental evils in forums and make the people to become aware of the same.

4. There is a need to meet the people and discuss again and again, so that the problem is alive till it is eliminated.

Types of environment

1. Natural environment
2. Man made environment

Natural environment

All natural things, biotic and abiotic are collectively called natural environment.
(e.g) soil, water, tree and air.

Manmade environment

Created by man

Powerful engineering agent

Man modifies the environment using modern technologies according to his necessity.

Component of environment

Consist of 3 components:

1. Abiotic (or) non living
2. Biotic (or) living
3. Energy component

Abiotic component

3 categories atmosphere, lithosphere, hydrosphere

Atmosphere

The air that covers the earth is known as atmosphere. It is 500 km from earth. It is essential for all living organisms. 78% N_2, 21% O_2 and 1% other gases.

Structure of atmosphere:

Region	Altitude in Km	Temperature in ^{o}C	Chemical species
Troposphere	0 -15	15 to -56	N_2,H_2O,CO_2,O_2
Stratosphere	18 – 50	-56 to -2	Ozone
Mesosphere	50 – 85	-2 to -92	NO^+,O_2^+
Thermosphere	85 - 500	-92 to 1200	NO^+,O^+,O_2^+

Troposphere (1 to 15 km)

75% atmospheric air

contain moisture

Stratosphere (18 to 50 km)

consists of large amount of O_3

free from moisture and clouds

prevents UV radiation from sun

Mesosphere (50 to 85 km)

less ozone

more nitrogen oxide

Function of atmosphere

1. It maintains heat balance on the earth by absorbing the IR radiations.
2. Gases present in atmosphere are essential for sustaining life.

Oxygen – supports life

Carbon dioxide – essential for photosynthesis of plants

Nitrogen – essential nutrient for plant growth.

Lithosphere

It consists of soil and rock components of earth.

Function

Home for human beings and wild life.

Store house of minerals and organic matter.

Hydrosphere

The aquatic envelope of the earth. It includes oceans, lakes, streams, river and water vapour. In the hydrosphere 97% of water is not suitable for drinking and only3% is fresh water.

Functions of hydrosphere

Drinking purpose

Irrigation

Power production

Industries and transport

Biotic or living component

(e.g.) Animals, plants and micro organisms.

Biosphere

Interaction of biological environment with physical environment is called biosphere.

Energy component

Flow energy across biotic and abiotic components. It plays an important role in living organisms. (e.g.) solar energy, nuclear energy, geo thermal energy etc.

AIR POLLUTION

Air pollution is defined as the presence of one (or) more contaminants like dust, smoke, mist and odour in the atmosphere which causes damage to plants, animals and human beings.

Composition of air: N- 78%, O_2 – 21%, Argon <1%, CO_2, 0637%, Tracer of O_3, He, NH_3.

SOURCES

(i) National Source: Volcanic eruption, forest fires, biological decay, radioactive materials.
(ii)Man-made: Thermal power plants, Automobile emission, forest fires , fuel burning, agricultural activities.

CLASSIFICATION OF AIR POLLUTANTS

It is classified into two types (i) Primary Pollutants, and (ii) secondary Pollutants
Primary Pollutants: Pollutants emitted directly into the atmospheres in harmful form.
E.g.: CO, NO, SO_2 etc.
Secondary Pollutants: Some of primary pollutants react with one another (or) with basic Components of air to form new pollutants. **E.g.:** NO/NO_2 Moist HNO_3/NO_3 etc.
Indoor Air Pollutants: These are primary air pollutants important indoor air pollutant is radon gas.
Sources of I.A. Pollutants: Radon gas in emitted by the building materials like bricks, concrete, tiles which are derived from soil containing radium.Burning fuel in the kitchens, cigarette smoke liberates pollutants like CO, SO_2.
Common Air pollutants sources and their effects
CO – formed by the incomplete combustion of carbon containing fuels.
$2C + O_2$ ----------> 2CO
Human Sources – Cigarette smoking, burning fossil fuels. 77% CO comes from motor vehicle exhaust.
Health Effect- Reacts with hemoglobin and reduces the ability of to carry O_2 to body cells and tissues, which causes headaches and anemia.
NO_2 – It gives photochemical smog. In atmosphere it reacts with moisture to form HNO_3. NO_2 + Moisture ------> HNO_3
Human sources: Fossil fuel burning in motor vehicles and power industrial plants.
Effect Health, Lung irritation and damage
Environment effect: HNO_3 corrode metals and eat away stone on buildings, statues, NO_2 damages fabrics.

SO_2- Formed mostly by the combustion of sulphur containing fossil fuels like coal and oil. It is converted to H_2SO4 in the atmosphere. It is major component of acid deposition.

Human Source- Coal burning in power plants and industrial process.

Health effects- Breathing problems.

Environment effect – Reduce visibility, H_2SO_4 damages trees, soil and aquatic life.

Suspended particulate Matter (SPM) -It includes varieties of particles and droplets.

Human Sources – Burning coal in power and industrial plants. Burning diesel and other fuels in vehicle, agriculture, unpaved roads construction.

Health Effect – Nose and throat irritation, lung damage, asthma, reproductive problems and cancer.

Environment effect – Reduce visibility, acid deposition & H_2SO_4 droplets damage trees.

O_3- Highly reactive irritating gas in the troposphere. It is major component of photo chemical smog.

Human Source- Chemical reactions with volatile organic compounds and nitrogen oxides.

Environment effect – Moderates the climate.

Photochemical smog: Any chemical reaction activated by light is called photochemical reaction. Photochemical smog is a mixture of more than 100 primary and secondary pollutants formed under the influence of sunlight. Its formation begins inside automobile engines and the boilers in coal burning power and industrial plants.

Health Effect – Breathing problems, cough, ENT irritation, heart diseases etc.

Environment effect – Smog can reduce visibility.

Lead – Solid toxic metal and its components emitted into the atmosphere as a particulate matters.

Human Source- Paint, lead manufacture, storage batteries, leaded petrol.

Health Effect – Mental retardness (in children) digestive and other health problems. Some lead containing chemicals causes cancer in test animals.

Environment effect – Can harm wild life.

Control measures of air Pollution

Controlling at the sources

1. Use only unleaded petrol
2. Use fuels that have low sulphurs and ash containing.
3. Plant trees along busy streets because they remove particulates and CO and absorb noise
4. Industries and waste disposal should be outside the city area.
5. Use catalytic converters to control the emission of CO and hydrocarbon.

Control Measures in industries

1. Emission rates should be restricted to permissible levels in all industries.
2. Air pollution control equipment should be incorporated in plant layout
3. Monitering of the atmosphere for the pollutants should be carried out continuously to know the emission levels.
4. Scrubber, cyclone separator, bag house filter and electrostatic precipitators must be used in manufacturing process to retain harmful materials that must be disposed of safely.
5. The disposal of the collected air pollutants are equally important for controlling air pollution.
6. The Nongovernmental organizations, in India and abroad, are doing tremendous efforts in conserving the environment.

Types of public participation

1. Pressure group
2. Watch dog
3. Advisory council
4. Enforcing the environmental laws.

Green house effect

The **greenhouse effect** is a process by which thermal radiation from a planetary surface is absorbed by atmospheric greenhouse gases, and is re-radiated in all directions. Since part of this re-radiation is back towards the surface and the lower atmosphere, it results in an elevation of the average surface temperature above what it would be in the absence of the gases.

Solar radiation at the frequencies of visible light largely passes through the atmosphere to warm the planetary surface, which then emits this energy at the lower frequencies of infrared thermal

radiation. Infrared radiation is absorbed by greenhouse gases, which in turn re-radiate much of the energy to the surface and lower atmosphere. The mechanism is named after the effect of solar radiation passing through glass and warming a greenhouse, but the way it retains heat is fundamentally different as a greenhouse works by reducing airflow, isolating the warm air inside the structure so that heat is not lost by convection.

If an ideal thermally conductive blackbody was the same distance from the Sun as the Earth is, it would have a temperature of about 5.3 °C. However, since the Earth reflects about 30% of the incoming sunlight, this idealized planet's effective temperature (the temperature of a blackbody that would emit the same amount of radiation) would be about −18 °C. The surface temperature of this hypothetical planet is 33 °C below Earth's actual surface temperature of approximately 14 °C The mechanism that produces this difference between the actual surface temperature and the effective temperature is due to the atmosphere and is known as the greenhouse effect.

Earth's natural greenhouse effect makes life as we know it possible. However, human activities, primarily the burning of fossil fuels and clearing of forests, have intensified the natural greenhouse effect, causing global warming.

GLOBAL WARMING:

Green house gases in the atmosphere are transparent to light but absorb IR radiation. These gases allow sunlight to penetrate the atmosphere and are absorbed by the earth surface.This sunlight is radiated back as IR which is absorbed by gases. As a result the earth surface and lower atmosphere becomes warm. This is called global warming.

EFFECTS OF GLOBAL WARMING

1.Sea level increases as result of melting and thermal expansion of ocean.

2. High CO_2 level in the atmosphere have a long term negative effect on crop production and forest growth.

3. Global rainfall pattern will change .Drought and floods will become more common. Raising temperature will increase domestic water demand.

4. Many plants and animal species will have a problem of adapting. Many will be at the risk of extinction, more towering verities will thrive.

5. As the earth becomes warmer the floods and drought becomes more frequent. There would be increase in water-borne diseases.

MEASURES TO CHECK GLOBAL WARMING

1. CO_2 emission can be cut by reducing the use of fossil fuel.
2. Plant more trees.
3. Shifting from coal to natural gas.
4. Stabilize population growth.
5. Remove efficiently CO_2 from smoke stocks.
6. Removal atmospheric CO_2 by utilizing photo synthetic algae.

CLIMATE

It is the average weather of an area. It is the general weather condition, seasonal variations of the region. The average of such conditions for a long period is called climate.

Causes of climate changes:

1. Presence of green house gases in the atmosphere increases the global temperature.
2. Depletion of ozone layer increases the global temperature.

Effects of climate change:

1. Small climate changes disturbs agriculture which leads to migration of animals and human.
2. Climate change may upset hydrological cycle which results in floods and droughts in different parts of the world.
3. Global pattern of winds and oceans currents also gets disturbed by climate change.

OZONE LAYER DEPLETION

Ozone gas is present in the atmosphere. It is highly concentrated at the stratosphere Between10to 50 Km above the sea level and is called as ozone layer.

Importance: O_3 protects us from damaging UV radiation of the sun.It filters UV- B radiation. Now a day's certain parts of O_3 layer is becoming thinner and O_3 holes are formed. Because of this more UV –B radiation reaches the earth's surface . UV –B radiation affects DNA molecules, causes damages to the outer cell of plants and animals.

It causes skin cancer and eye disease in human beings.

Formation of O 3 : It is formed in the atmosphere by photochemical reaction

$O_2 + hv$ ----------) $O^* + O^*$

The atomic oxygen reacts with molecular O_2 to form O_3

$O^* + O_2 + M$ ----------) $O_3 + M$

Where M = third body like nitrogen.

Causes of O_3 layer depletion : Refrigerators , air conditioners , aerosol sprays and cleaning solvents release CFC s into the atmosphere. CFCs releases chlorine which breaks O_3 to O_2

$Cl + O_3$ ----------) $ClO + O_2$ (g)

$ClO + O^*$ ----------) $Cl + O_2$

Each chlorine atom is capable of breaking several O_3 molecules. It is a chain reaction.

1% loss of O_3 results in 2% increase in UV rays reaching the earth surface.

Ozone depletion chemicals CFC, HCFC, BFC. Sometimes atmospheric sulfur dioxide

Is converted in to H_2SO_4 which increases the rate of O_3 layer depletion.

Effects ozone layer depletion:

Effects on human beings

1. UV rays cause skin cancer.

2. Increases the rate of non melanin skin cancer in fair colored people.

.Prolonged expose to UV rays leads to actinia Katatities (slow blindness) and cataracts.

Effects on aquatic system:

1. UV rays affects phytoplankton, fish, larval crabs.

2. Phytoplankton consumes large amounts of CO_2 .Decrease in phytoplankton results in

More amount of CO_2 in atmosphere. This contributes to global warming.

3. Ozone Depleting chemicals can cause global warming.

Control measures: Manufacturing and using of O_3 depleting chemicals should be stopped. Use of methyl bromide .which is a crop fumigant should be controlled.

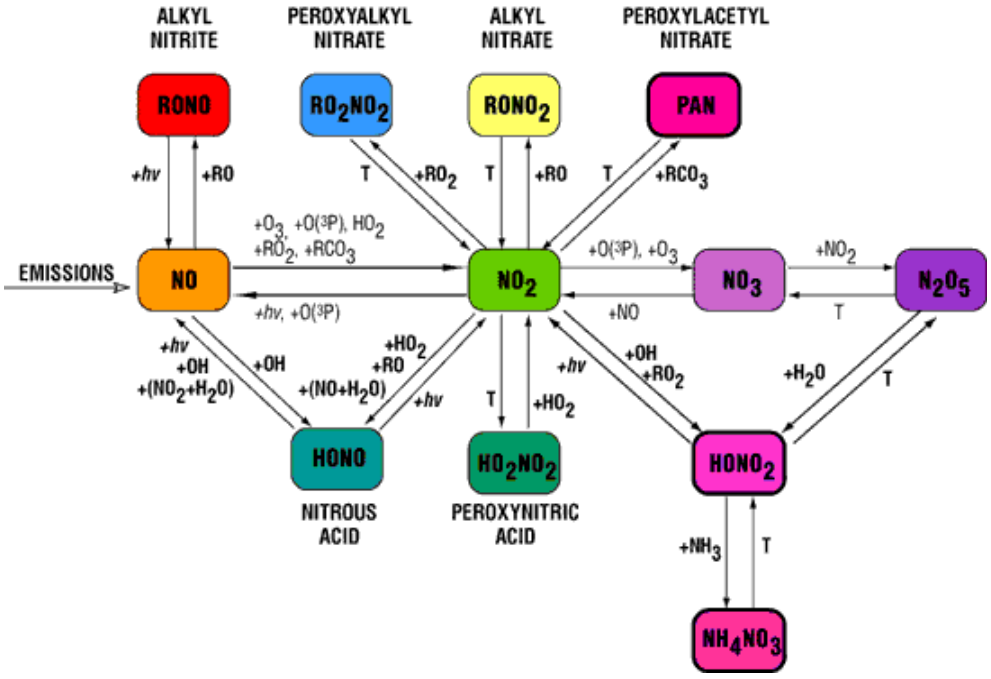
Replacing CFC s by other materials which are less damage

PHOTOCHEMICAL SMOG

To fully appreciate photochemical smog formation, one must first recognize that nitrogen is transformed between many different substances in the atmosphere. Automobile exhausts release nitrous oxide (NO) along with small amounts of nitrogen dioxide (NO_2). These two substances form the starting materials for a vast array of chemical reactions that lead to products with higher oxidation states. In a straight forward process, nitrogen oxide (NO) is converted to nitrogen dioxide (NO_2), nitrogen dioxide is transformed to nitrogen trioxide (NO_3), and nitrogen trioxide in transformed into dinitrogen pentoxide (N_2O_5). Each of these four simple nitrogen oxides then

reacts through a photochemical process, or direct physical contact, with atmospheric substances to form and an impressive list of biological irritants. The list of irritants includes: (1) alkyl nitrite; (2) peroxyalkyl nitrate; (3) alkyl nitrate; (4) peroxyacetyl nitrate; (5) nitrous acid; (6) peroxynitric acid; (7) nitric acid, and; (8) ammonium nitrate. These chemical transformations are shown graphically in the figure.

Chemical Transformations of Nitrogen Oxides in the Troposphere.



The substances that react with nitrogen oxides to form oxidants (the final product of photochemical smog) are trace hydrocarbons (from incomplete combustion) and the hydroxyl radical. The necessary ingredients for photochemical smog formation are (1) nitrogen oxides, (2) sunlight, and (3) hydrocarbons. Photochemical smog formation proceeds through a sequence of reactions, all involving a free radical mechanism. Free radicals are generated by photo dissociation of nitrogen dioxide, a process that generates ozone and oxygen atoms. Oxygen atoms react with water to form hydroxyl radicals, which in turn react with hydrocarbons to form

hydrocarbon radicals. Oxidation of hydrocarbons by the hydroxyl radical leads to the formation of aldehydes. The aldehydes are oxidized further to form aldehyde peroxides and aldehyde peroxyacids. These final substances are the compounds that are so irritating to sensitive biological tissues and cause most of the health problems associates with photochemical smog.

Generalized Reaction Scheme for Photochemical Smog Formation

eq. 1 $NO_2 + h\nu \longrightarrow NO + O$

eq. 2 $O + O_2 + M \longrightarrow O_3 + M$ *Make O_3 and O*

eq. 3 $NO + O_3 \longrightarrow NO_2 + O_2$

This is a cyclic process that needs light and nitrogen oxides to generate oxygen atoms. Once formed, the oxygen atoms react with water to form hydroxyl radicals. The hydroxyl radicals then react with hydrocarbons according to equations 5 through 8 to form peroxyacyl nitrates (or PAN).

eq. 4 $O^{\bullet} + H_2O \rightarrow 2\ OH^{\bullet}$

then

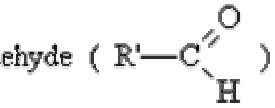
eq. 5
$$\begin{cases} RH + OH^{\bullet} \rightarrow H_2O + R^{\bullet} \\ R^{\bullet} + O_2 \rightarrow RO_2^{\bullet} \text{ very fast} \end{cases}$$

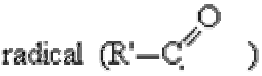
eq. 6
$$\begin{cases} RO_2^{\bullet} + NO \rightarrow NO_2 + RO^{\bullet} \\ RO^{\bullet} + O_2 \rightarrow R'CHO + HO_2^{\bullet} \text{ very fast} \end{cases}$$

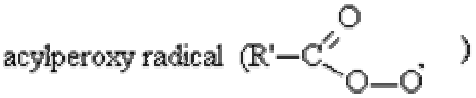
eq. 7
$$\begin{cases} R'CHO + OH^{\bullet} \rightarrow R'CO^{\bullet} + H_2O \\ R'CO^{\bullet} + O_2 \rightarrow R'C(O)\,O_2^{\bullet} \text{ very fast} \end{cases}$$

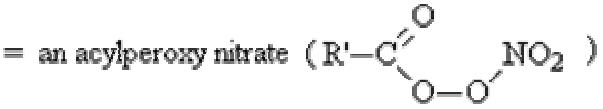
eq. 8 $R'C(O)O_2^{\bullet} + NO_2 \longrightarrow R'C(O)_2NO_2$

RH = any hydrocarbon (i.e., $CH_3CH_2CH_3$ or CH_3CH_3)

R'CHO = an aldehyde ()

R'CO· = an acyl radical ()

$R'C(O)O_2^{\cdot}$ = an acylperoxy radical ()

$R'C(O)O_2NO_2$ = an acylperoxy nitrate ()

When R' is a methyl group (CH_3—) this substance is called Peroxyacyl nitrate, or PAN

In summary, this is what happens in photochemical smog formation

1) Nitrogen oxides generate oxygen atoms

2) Oxygen atoms form hydroxyl radicals

3) Hydroxyl radicals generate hydrocarbon radicals

4) Hydrocarbon radicals form hydrocarbon peroxides

5) Hydrocarbon peroxides form aldehydes

6) Aldehydes form aldehyde peroxides

7) Aldehyde peroxides form peroxyacylnitrates

ACID RAIN

Normal rain water is always slightly acidic (pH 5-5.6) because of CO_2 present in the atmosphere gets dissolved in it. Because presence of SO_2 and NO_2 gases as pollutants in the atmosphere. The pH of the rain is further lowered. This type of precipitation of water is called acid rain.

Formation

Acid rain means the presence of excessive acids in the rain water. The thermal power plants industries and vehicles release NO_2 and SO_2 in to the atmosphere due to the burning of coal and

oil. These gases reacts with water vapour in the atmosphere and from acids like HNO_3, H_2SO_4.These acids descends on to the earth as acid rain through rain water.

$SOx + H_2O \rightarrow H_2SO_4$

$NOy + H_2O \rightarrow HNO_3$

EFFECTS

Effect on human being

Human nervous system respiratory system and digestive system are affected by acid rain. It cause premature death from heart and lung disorder like asthma, bronchitis.

On building

At present Taj Mahal in Agra is suffering due to SO_2 and H_2SO_4 fumes from Madura refinery.

Acid rain corrodes houses, monuments, statues, bridges and fences.

Acid rain causes corrosion of metals.

Terrestrial and lake Ecosystem.

Reduce the rate of photosynthesis and growth in terrestrial vegetation.

Acid rain retards the growth of crops like beans potatoes, carrot ,spinach. Acid rain reduces fish population, black flies, mosquitoes, deer flies occurs largely which causes number of complications in ponds rivers and lakes.

Activity of bacteria and other microscopic animals is reduced in acidic water. The dead materials are not rapidly decomposed. Hence the nutrients like N, P are locked up in dead matter.

Control of acid rain:

Emission of NO_2 and SO_2 from industries from power plants should be reduced by using pollution control equipments.

Liming of lakes and soils should be done to correct the adverse effect of acid rain.

In thermal points low sulphur content coal should be used.

UNIT-II

HYDROSPHERE

Water resources:

Water is essential component of all living things. 80% of earth surface is covered with water. All organisms are made up of mostly by water.

(e.g.) Tree 60% by weight of water

Animals50 – 65% by weight of water

Water exists in three phases solid, liquid and gases. It is circulated in the hydrological cycle.

Hydrological cycle

- Water from various water bodies
- Evaporated by solar energy
- Enters in to the atmosphere as clouds
- Falls again on earth as rain or snow
- Ultimately returns to the ocean.
- This process is called hydrological cycle.

Distribution of water resources

Fresh water resources

Surface water under ground water

Standing water bodies flowing water bodies

1. Lakes 2. Streams

3. Reservoirs 4. Rivers

5. Estuaries

Surface water

Water stored on the surface of earth.

Standing water bodies

Lakes

Oligotrophic lakes:

These lakes are deep and clear. The nutrients amount is deficient. Biological reactions are less.

Eutrophic lakes:

More nutrients and more turbid. It supports more life.

Dystrophic lakes:

Shallow coloured lakes and low pH.

Reservoirs:

Generally larger than lakes.

Estuaries:

These are deltas formed at the mouth of rivers, where they join the ocean. The mixing of fresh and salt water gives estuaries.

Flowing water bodies:

Water flows in streams and rivers. It carries sedimentary materials and dissolved minerals.

Under ground water

Water available deep in the ground due to percolation of surface water. It is the major source. It is very pure and used for almost all purposes in the world.

Aquifer:

Layers of highly permeable rock containing water is called an aquifer. Layer of sand and gravels are good aquifers. Clay and crystalline rocks are not good aquifers.

Types of aquifiers

1.Unconfined aquifiers-which are overlayed by permeable earth materials and they are recharged by water steeping down from above in the form of rainfall and snow melts.

2. Confined aquifiers-which are sandwhiched between two impermeable layers of rocks or sediments and recharged only in those areas where the aquifiers intersects the land surface.

Effects of over utilization ground water:

1. Decrease of ground water:

Increased usage decreases the ground water.

Insufficient rain fall

Building construction activities sealing the permeability of the soil.

2. Ground subsidence:

Ground water withdrawal is greater than its recharge rate, the sediments in the aquifers get compacted. As a result shrinkage of land surface takes place.

Problems:

a. Structural damages in the buildings

b. Fracture in pipes.

c. Reversing the flow of canals.

3. Lowering of water table:

Over utilisation of ground water in arid and semi arid regions for agriculture disturbs the state of equilibrium of the hydrological cycle.

Problem:

a. lowering of water table

b. decrease the number of aquifers

c. Change the speed and direction of water.

4. **Intrusion of salt water:**

In coastal area over exploitation of ground water leads to the intrusion of salt water from sea. Therefore that water cannot be used for drinking and agriculture.

Over utilisation of water causes earth quakes, land slides and famine

Drying up of wells:

Due to over utilisation, ground water level decreases much faster than can be regenerated. It leads to drying up of dug well and bore wells.

5. Pollution of water:

Near the agricultural land ground water decreases therefore water containing nitrogen enters into the ground and pollute the ground water.

Problem:

Water which contains excess nitrate content is not suitable for drinking.

Water resource management

S.No	Organisation	Source
1	Central water commission	Surface water
2	Central ground water board	Ground water
3	Indian meteorological department	Precipitation
4	Central pollution control board	Water quality
5	Ministry of agriculture	Water for irrigation

6	Ministry of environment and forest	Environmental impact assessment
7	Central public health and env.engg	Water supply, sanitation and sewage disposal
8	Department of power	Hydro electric power
9	Department of forest	Watershed management

Watershed management techniques

Trenches (pits) were dug at equal intervals to improve ground water storage.

Earthern dam or stone embankment must be constructed to check run off water.

Farm pond can be built to improve water storage capacity of the catchment's area

Maintenance of watershed

Water harvesting: Proper storage of water in water shed can be used in dry season

In low rainfall areas.

Afforestation and agro-forestry help to prevent soil erosion and retention of moisture

In watershed areas

Reducing soil erosion : Terracing , contour cropping minimse soil erosion and run off on the slopes of water sheds

Scientific mining and quarrying minimse the destructive effect of mining in water shed areas

Public participation is essential for water shed manasement.People should be motivated for maintaining water harvesting structures implemented by the government.

Livestock population should be reduced in surrounding villages of water shed.

WATER CONSERVATION –Rain water harvesting

In the present scenario management and distribution of water has become centralized. People depend on government system, which has resulted in disruption of community participation in water management and collapse of traditional water harvesting system. As the water crisis continues to become severe, there is a dire need of reform in water management system and revival of traditional systems. Scientific and technological studies needs to be carried out to assess present status so as to suggest suitable mitigative measures for the revival to traditional system/wisdom. Revival process should necessarily be backed by people's initiative and active public participation. Living creatures of the universe are made of five basic elements, viz., Earth, Water, Fire, Air and Sky, Obviously, water is one of the most important elements and no creature

can survive without it. Despite having a great regard for water, we seem to have failed to address this sector seriously. Human being could not save and conserve water and it sources, probably because of its availability in abundance. But this irresponsible attitude resulted in deterioration of water bodies with respect to quantity and quality both. Now, situation has arrived when even a single drop of water matters. However. “Better late than never", we have not realized the seriousness of this issue and initiated efforts to overcome those problems.

Why harvest rainwater?

This is perhaps one of the most frequently asked question, as to why one should harvest rainwater. There are many reasons but following are some of the important ones.

- To arrest ground water decline and augment ground water table
- To beneficiate water quality in aquifers
- To conserve surface water runoff during monsoon
- To reduce soil erosion
- To inculcate a culture of water conservation

How to harvest rainwater

Broadly there are two ways of harvesting rainwater:

(i) Surface runoff harvesting

(ii) Roof top rainwater harvesting

Surface runoff harvesting:

In urban area rainwater flows away as surface runoff. This runoff could be caught and used for recharging aquifers by adopting appropriate methods.

Roof top rainwater harvesting (RTRWH):

It is a system of catching rainwater where it falls. In rooftop harvesting, the roof becomes the catchments, and the rainwater is collected from the roof of the house/building. It can either be stored in a tank or diverted to artificial recharge system. This method is less

expensive and very effective and if implemented properly helps in augmenting the ground water level of the area.

Components of the roof top rainwater harvesting system

The illustrative design of the basic components of roof top rainwater harvesting system is given in the following typical schematic diagram

The system mainly constitutes of following sub components:

- Catchment
- Transportation
- First flush
- Filter

The surface that receives rainfall directly is the catchment of rainwater harvesting system. It may be terrace, courtyard, or paved or unpaved open ground. The terrace may be flat RCC/stone roof or sloping roof. Therefore the catchment is the area, which actually contributes rainwater to the harvesting system.

Transportation

Rainwater from rooftop should be carried through down take water pipes or drains to storage/harvesting system. Water pipes should be UV resistant (ISI HDPE/PVC pipes) of required capacity. Water from sloping roofs could be caught through gutters and down take pipe. At terraces, mouth of the each drain should have wire mesh to restrict floating material.

First Flush

First flush is a device used to flush off the water received in first shower. The first shower of rains needs to be flushed-off to avoid contaminating storable/rechargeable water by the probable contaminants of the atmosphere and the catchment roof. It will also help in cleaning of silt and

other material deposited on roof during dry seasons Provisions of first rain separator should be made at outlet of each drainpipe

Filter

There is always some skepticism regarding Roof Top Rainwater Harvesting since doubts are raised that rainwater may contaminate groundwater. There is remote possibility of this fear coming true if proper filter mechanism is not adopted. Secondly all care must be taken to see that underground sewer drains are not punctured and no leakage is taking place in close vicinity. Filters are used fro treatment of water to effectively remove turbidity, colour and microorganisms. After first flushing of rainfall, water should pass through filters. There are different types of filters in practice, but basic function is to purifywater.

Sand Gravel Filter

These are commonly used filters, constructed by brick masonry and filleted by pebbles, gravel, and sand as shown in the figure. Each layer should be separated by wire mesh**.**

Charcoal Filter

Charcoal filter can be made in-situ or in a drum. Pebbles, gravel, sand and charcoal as shown in the figure should fill the drum or chamber. Each layer should be separated by wire mesh. Thin layer of charcoal is used to absorb odor if any.

PVC- Pipe filter

This filter can be made by PVC pipe of 1 to 1.20 m length; Diameter of pipe depends on the area of roof. Six inches dia. pipe is enough for a 1500 Sq. Ft. roof and 8 inches dia. pipe should be used for roofs more then 1500 Sq. Ft. Pipe is divided into three compartments by wire mesh. Each component should be filled with gravel and sand alternatively as shown in the figure. A layer of charcoal could also be inserted between two layers. Both ends of filter should have reduce of required size to connect inlet and outlet. This filter could be placed horizontally or vertically in the system.

Sponge Filter

It is a simple filter made from PVC drum having a layer of sponge in the middle of drum. It is the easiest and cheapest form filter, suitable for residential units.

Some important Methods of Roof Top Rainwater Harvesting

Storage of Direct use

In this method rain water collected from the roof of the building is diverted to a storage tank. The storage tank has to be designed according to the water requirements, rainfall and catchment availability. Each drainpipe should have mesh filter at mouth and first flush device followed by filtration system before connecting to the storage tank. It is advisable that each tank should have excess water over flow system. Excess water could be diverted to recharge system. Water from storage tank can be used for secondary purposes such as washing and gardening etc. This is the most cost effective way of rainwater harvesting. The main advantage of collecting and using the rainwater during rainy season is not only to save water from conventional sources, but also to save energy incurred on transportation and distribution of water at the doorstep. This also conserve groundwater, if it is being extracted to meet the demand when rains are on.

Recharging ground water aquifers

Ground water aquifers can be recharged by various kinds of structures to ensure percolation of rainwater in the ground instead of draining away from the surface. Commonly used recharging methods are:-

a) Recharging of bore wells

b) Recharging of dug wells.

c) Recharge pits

d) Recharge Trenches

e) Soak ways or Recharge Shafts

f) Percolation Tanks

Recharging of bore wells

Rainwater collected from rooftop of the building is diverted through drainpipes to settlement or filtration tank. After settlement filtered water is diverted to bore wells to recharge deep aquifers. Abandoned bore wells can also be used for recharge.

Optimum capacity of settlement tank/filtration tank can be designed on the basis of area of catchement, intensity of rainfall and recharge rate as discussed in design parameters. While recharging, entry of floating matter and silt should be restricted because it may clog the recharge structure. "first one or two shower should be flushed out through rain separator to avoid contamination. This is very important, and all care should be taken to ensure that this has been done

WATER POLLUTION

The alternation in physical, chemical & biological characteristics of water which causes Harmful effects on humans and aquatic life.
The major pollutants are sewage, effluents, bacteria.
Infections Agents: Bacteria, viruses, protozoa, parasitic worms
Human Source- Human and animal works
Health Effect – Variety of diseases.

Point vs. Non-point Source Pollution

Point source pollution is pollution that comes from a single source, such as a factory or wastewater treatment plant. The Clean Water Act put restrictions on how much and what kind of pollutants industries can dispose of in rivers and lakes. While this has not eliminated industrial or domestic waste from
entering our waters completely, it has reduced what once was our biggest source of water pollution.

Many people incorrectly believe waste that is dumped into the storm sewer is treated at a waste water treatment plant. In fact, Denver has separate storm and sanitary sewer systems.

Sanitary sewers collect wastewater from homes and businesses and treat it before discharging it into the river. Storm sewers, on the other hand, are a direct connection to the city's waterways. Anything dumped into a storm grate or gutter discharges - untreated - to a stream or lake at an outfall**.** Each outfall is considered to be a point source.

Denver's Waste water Management is responsible for administering the city's municipal storm water discharge permit, which sets goals for the reduction of pollutants discharging from storm water. The Wastewater Management Division has instituted a series of programs to help reduce the discharge of pollutants from storm water outfalls. These programs include reducing polluted runoff from municipal facilities and city streets, placing screens over storm water outfalls, reducing pesticide and fertilizer use by city agencies and the public, and reducing polluted runoff from municipal and private construction sites.

Non-point source pollution does not have one specific source, such as a factory. Non-point source pollution comes from the cumulative effect of a region's residents going about their everyday activities, such as fertilizing a lawn or driving a car.

One type of non-point source pollution is fertilizer. Fertilizer contains nitrogen compounds called nitrates. When fertilizer is applied excessively or just prior to a rainstorm, it washes off the lawn and into the gutter, where it makes its way through the storm sewer system and into a river or lake. Once in the water, these nitrates have the same effect on algae as they do on lawns - they make it grow! Overgrown algae can have devastating effects on a lake or stream, consuming all the oxygen and suffocating fish and other aquatic wildlife. This is called eutrophicationIncreased awareness of alternative practices such as xeriscaping and using native grasses can help cut down on fertilizer use.

Other types of non-point source pollutants include pesticides, pet waste, motor oil, and household hazardous wastes. Again, any of these pollutants which get either washed or dumped into the storm sewer flow directly to a stream or lake without treatment.

Oxygen demanding wastes: Organic wastes, such as animal manure & Plant debris that are decomposed by aerobic bacteria.

Human Source- Sewage, animal feedlots, paper mills, food processing facilities.

Health Effect – Depletion of dissolved O_2 in water. This causes death of aquatic life.

Inorganic Chemical water soluble chemicals like acids. Compounds of toxic metals like Lead, arsenic and selenium. Salts like NaCl in sea water and fluorides found in some soils

Human Source- Industrial effluents, street wash, household waste.

Health Effect – Causes skin caner & neck damage. Damage nervous system, liver & Kidney. harm fish and other aquatic life

Organic Chemical Plastics, pesticides, detergents

Human Source- Industrial effluents, household waste.

Health Effect – Damages nervous system, causes some cancers

Plant Nutrients- Water soluble compounds containing Nitrates, (NO_4) phosphates (PO_4) and NH_4^+ions

Human Source- Sewage, manure, runs off of agriculture, urban fertilizer.

Health Effect – Drinking water with high levels of nitrate lowers the O_2 carrying capacity of Blood and kills urban children and infants

Sediment – Soil, silt

Human Source- Land Erosion

Health Effect – Clouds water and reduces photosynthesis. Disturbs aquatic food web carry Pesticides, bacteria and other harmful substances.

Radio active materials – Radio isotopes of I2, radon, uranium and thorium

Human Source- I-131, CO-60, Fe-55 Nuclear power plants, mining and processing of thorium.

Health Effect – Genetic mutation, birth defects and certain cancers.

Thermal Pollution Excessive heat

Human Source- Water cooling of electric power plants and some types of industrial plants. Hence the temperature of water increases. The rise in temperature decreases the dissolved O_2 and affects the aquatic organisms.

Controlling of water pollution:

1. All domestic and municipal effluents be drained to water bodies only after treatment
2. Use of pesticides in agriculture should be limited. Only standard quality pesticides should be used.

3. Chemicals like potassium permanganate should be sprayed regularly to protect water from micro organisms.

4. Radio active substances can be removed by Ion-exchange method.

5. Plants, trees and forests control pollution and they act as natural air conditions.

6. Bacteria are killed by passing chlorine gas into water bodies.

7. Highly qualified and experienced persons should be consulted from time to time for effective control of water pollution.

8. Inorganic wastes can be treated chemically.

9. Acids and bases are removed by neutralization

10. Sewage is treated by biochemical oxidation. The chemicals retards the growth of plants and retard reproduction process.

Oxygen demanding waste

Organic matter which reaches water bodies are decomposed by microorganisms present in water for the decomposition to take place oxygen dissolved in water is consumed.

Biochemical oxygen demand

Biochemical oxygen demand is a measure of oxygen that is needed by the microorganisms to decompose the organic and inorganic pollutants in polluted water. The microorganisms transformed the pollutants into nonhazardous products ($CO_2$and H_2O).

Determination of BOD

For determination BOD the water samples is saturated with oxygen and then incubated at constant temperature for five days. During this time the microorganisms in polluted water oxidized the pollutants completely. After five days the remaining amount of dissolved oxygen is determined and the BOD is calculated as follows

BOD= Saturated value of dissolvedoxygen per litre at 20^oC - Amount of dissolved oxygen per litre at 20^oCafter five days

Chemical oxygen demand

Chemical oxygen demand is a measure of oxygen required to degrade or breakdown of organic matter. In COD the degradation is effected by chemical oxidizing agent by potassium dichromate**.**

Bioamplification

The organ mercurial (ex. methyl mercury chloride) is incorporated in the food chain. Being soluble in the tissue of simple organisms, these penetrate inside the bodies of simple organisms. The complex species which feed on simple organisms accumulate the organomercurials in their system .This process is called bioamplification.

WASTE WATER TREATMENT

Sewage treatment is the process of removing contaminants from wastewater and household sewage, both runoff (effluents), domestic, commercial and institutional. It includes physical, chemical, and biological processes to remove physical, chemical and biological contaminants. Its objective is to produce an environmentally safe fluid waste stream (or treated effluent) and a solid waste (or treated sludge) suitable for disposal or reuse (usually as farm fertilizer). Using advanced technology it is now possible to re-use sewage effluent for drinking water, although Singapore is the only country to implement such technology on a production scale in its production of NEWater.

Sewage can be treated close to where it is created, a decentralized system (in septic tanks, biofilters or aerobic treatment systems), or be collected and transported by a network of pipes and pump stations to a municipal treatment plant, a centralized system (see sewerage and pipes and infrastructure). Sewage collection and treatment is typically subject to local, state and federal regulations and standards. Industrial sources of sewage often require specialized treatment processes.

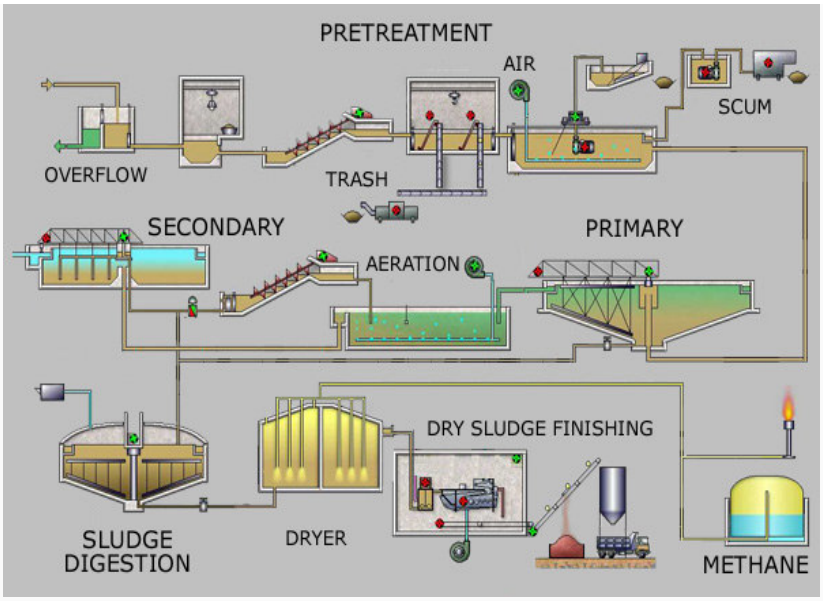
Sewage treatment generally involves three stages, called primary, secondary and tertiary treatment.

- ***Primary treatment*** consists of temporarily holding the sewage in a quiescent basin where heavy solids can settle to the bottom while oil, grease and lighter solids float to the surface. The settled and floating materials are removed and the remaining liquid may be discharged or subjected to secondary treatment.
- ***Secondary treatment*** removes dissolved and suspended biological matter. Secondary treatment is typically performed by indigenous, water-borne micro-organisms in a managed

habitat. Secondary treatment may require a separation process to remove the micro-organisms from the treated water prior to discharge or tertiary treatment.

Tertiary treatment is sometimes defined as anything more than primary and secondary treatment in order to allow rejection into a highly sensitive or fragile ecosystem (estuaries, low-flow rivers, coral reefs,). Treated water is sometimes disinfected chemically or physically (for example, by lagoons and microfiltration) prior to discharge into a stream, river, bay, lagoon or wetland, or it can be used for the irrigation of a golf course, green way or park. If it is sufficiently clean, it can also be used for groundwater recharge or agricultural purposes.

Process flow diagram for a typical large-scale treatment plant



Noise Pollution

It may be defined as unwanted sound which gets dumped

In to the atmosphere without regarding to it' adverse effects.

Causes:

Industrial noise

Most affonding noise sources are compressors, generators power looms, grinding mills, furnaces. These are used in many industrial processes and installed partially in closed and open sheds.

Domestic noise

Transistors radio, TV, other musical instruments, Air conditioners, washing machines. They affect users as well as the neighbors.

Traffic noise

Continuous movement of vehicles causes traffic noise. It affects not only those who are moving but also those who live near the roads, railwaylinks, and airports

Effects of noise pollution

1. Physiological effects

Headache increase in the rate of heart beat, pain in heart, emotional disturbances, hearing loss.

2. Annoyance

A noise is said be annoying if the exposed individual or groups of individuals reduce the noise avoid or leave the noisy area if possible. Both loudness and annoyance increase with increasing sound levels

3. Recently it has been reported that the blood also thickened by excessive noise

4. Impulsive noise also causes psychological and pathological disorders.

5. Ultrasonic sound can affect digestive respiratory cardiovascular system and semi circular canals of internal ear.

6. It causes muscle to contract leading to nervous breakdown,tension etc.

Control measures:

Source Control

1. Modification of source such as acoustic treatment to machine surface designed changes limiting the operational timings.

2. Oiling: Proper oiling will reduce the noise from the machine.

3. Transmission path intervention:

Containing the source inside a sound insulating enclosure, construction of noise barrier or provision of sound absorbing material along the path.

4. Planting of trees:

Planting of trees like neem, tamarind, coconut etc near schools hospitals reduce the noise to the extent of 8 to 10 db.

5. Selection of machinery:

Careful selection of machine tools and equipments to be used may help to lower the noise levels in machine shop.

UNIT-III
LITHOSPHERE

WEATHERING

Weathering breaks rocks into smaller pieces. It is the effect of rainfall and temperature on rocks. Weathering occurs **in situ**. This means the rocks stay in the same place and are not moved. This is different from **erosion**. Erosion is when rocks are moved around or hit by something moving so that they break into smaller pieces

Key words: In situ staying in the same place; Disintegration breaking into smaller pieces; **Decomposition** changing the chemicals which make up a rock

Types of weathering

Rocks can be weathered in three ways:

1. **Physical (or mechanical) weathering** causes rocks to **disintegrate**. This means the rocks fall apart into smaller pieces.
2. **Chemical weathering** causes rocks to **decompose**. This means the minerals that make up the rock are changed by a chemical reaction.

Biological weathering is when plants cause rocks to break up.

1. **Physical weathering**

Physical weathering causes rocks to **disintegrate in situ**. This means the rocks break up. They form smaller pieces of rock with sharp edges. Physical weathering happens when there are changes in temperature over a short period of time. The temperature needs to be **fluctuating**.

Two types of physical weathering are **freeze-thaw weathering** and **exfoliation**.

a. **Freeze-thaw weathering**

Freezing is when water becomes ice. This happens at a temperature of 0°C. Water expands when it becomes ice, taking up more space. **Thawing** is when ice turns to water. This happens when the temperature rises above 0°C. **Freeze-thaw weathering** occurs when the

temperature keeps fluctuating above and below 0°C. When the temperature drops below 0°C water in a crack in a rock will freeze. The ice thaws during the day when the temperatures rise. The water freezes when the temperature drops again at night and the ice widens the crack even more. This is freeze-thaw weathering.

b. Exfoliation

Exfoliation is when pieces of the outer layer of rock break away. Exfoliation happens in places where there is a very big difference in temperature between the night and day. This is most common in deserts. During the day in deserts the temperature may rise to over 40°C. At night the temperature may drop to below 5°C. During the day the heat causes the outer layers of the rocks to expand. At night the cold temperature causes the outer layers of the rocks to get smaller and they contract. This makes it weaker until it breaks up.

2. Chemical weathering

The **composition** of a rock is the chemicals or minerals that it is made from. Chemical weathering causes rocks to **decompose**. This means the composition of the rocks is changed, because chemical reactions have occurred. Chemical weathering usually needs water from rainfall, and warm temperatures.

Carbonation and **oxidation** are types of chemical weathering.

a. Carbonation

Carbonation is the chemical weathering of **chalk** and **limestone** rocks by rainfall. Chalk and limestone are made of **calcium carbonate**. When rain falls on chalk and limestone a chemical reaction occurs. The air contains gases such as **water vapour** and **carbon dioxide**. Water vapour reacts with carbon dioxide to form **carbonic acid**. All rainfall contains carbonic acid. This reacts with the calcium carbonate. The mineral changes and becomes **soluble** in water. This means the rock **dissolves** in rainwater and is washed away. Carbonation is when chalk and limestone are dissolved in rainwater.

b. Oxidation

Oxidation is a chemical reaction between some minerals in rocks and the **oxygen** in the air. Oxidation changes iron minerals in rocks from a light grey colour to a brown-red colour. This is called **rusting**. The change in colour shows the change in the composition of the rock. This chemical reaction causes the rock to break up.

Biological weathering

Biological weathering is when plants cause rocks to break up. The **roots** of plants cause rocks to disintegrate. Plant roots grow down through soil and rocks to find water and minerals. The roots can grow through cracks in rocks to find **groundwater**. As the roots grow the cracks are made wider and eventually the rock breaks up. Dead plants can cause chemical weathering. The plants produce acids when they rot. These acids may cause a chemical reaction in the rocks.

Climate and rate of weathering

Climate is the average rainfall and temperature of a place over a long period of time.

The **rate** of weathering is the speed of weathering. Heat causes chemical reactions to occur faster. Most chemical weathering needs rainfall. Chemical weathering occurs fastest where it is warm and there is a lot of rainfall. This means chemical weathering will occur quickly in warm, wet places such as rainforests in the **tropics**. In cool, wet places chemical weathering will occur slowly, for instance in Britain and New Zealand. Physical weathering occurs fastest in places where temperatures rapidly fluctuate over a short time. Rainfall is not always necessary. Freeze-thaw weathering occurs most rapidly where temperatures fluctuate just above and below 0°C over a short time. Rainwater is needed. Exfoliation happens most rapidly where there are large changes in temperature between night and day. It does not need rainfall.

Rock type and mineral composition

Certain rock types are made up of different minerals. This is the **mineral composition** of the rock. Certain rock types are more affected by certain types of weathering. Limestone is composed of calcium carbonate. This means that it can be weathered by carbonation. However granite is not affected by carbonation as it does not contain calcium carbonate. Rocks containing iron minerals will be weathered by oxidation.

Rock type and lines of weakness

Lines of weakness are cracks in rocks which are attacked by weathering. Water and air can enter these cracks and break down the rock by physical or chemical weathering. A rock with lots of lines of weakness will be more easily weathered. Chalk and limestone are **sedimentary** rocks. They are formed in layers. Each layer is separated by a **bedding plane**. These are horizontal lines of weakness in the rock. There are also vertical lines of weakness called **joints**. Rain water flows through limestone through the joints and bedding planes. The rock is weathered

by carbonation.Limestone **caves** are formed by carbonation. **Granite** is an **igneous** rock. It is formed when **magma** slowly cools as it rises towards the surface of the earth. As it cools horizontal bedding planes and vertical joints form. These are lines of weakness in the rock. Granite isweathered to form **tors**.

Key words :

Climate the average rainfall and temperature of a place over a long period of time

Mineral composition the different minerals (chemicals) which make up a rock

Sedimentary rock rocks formed by layers of sediment under water

Igneous rock rock formed by magma or lava cooling

SOIL

Soil is comprised of minerals, soil organic matter (SOM), water, and air. The composition and proportion of these components greatly influence soil physical properties, including texture, structure, and porosity, the fraction of pore space in a soil. In turn, these properties affect air and water movement in the soil, and thus the soil's ability to function. Although SOM comprises a relatively small portion of soil, typically only 1–4% in Montana and Wyoming agricultural soils, it plays a key role in many soil processes.

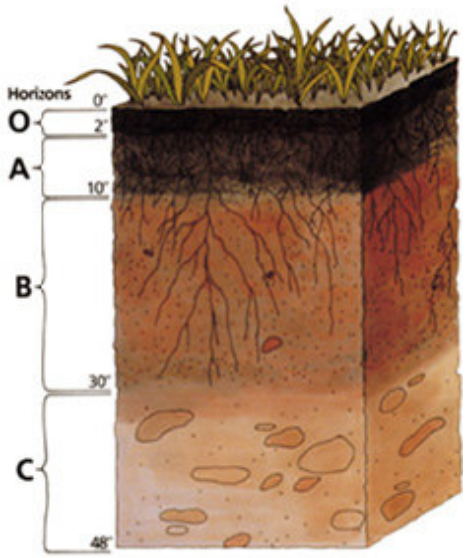
Soil Horizons

If you were to begin digging into a mature soil, you would notice that the color, texture, and other properties of the soil changed as you went deeper. If you were to dig deep enough, you would see that the soil appeared to be in very distinct layers. These layers, known as soil horizons, occur because of the different chemical and biological processes that take place in these zones.

Depending upon the type of soil, there can be up to 5 different horizons. These are denoted by the letters O, A, B, C, and E. Not all soils will have these horizons, with some immature soils having none. Most soils have at least three of these (A, B, and C).

If it is present, the top horizon will by the O layer, which is comprised of organic matter. This layer is normally found in forest soils, where dead leaves and other detritus can build up on a yearly basis. Below the O layer will be the A horizon, which is where the organic material is mixed in with the inorganic material. This layer is usually darker in color, and if present, means that the soil will generally be fertile for plant life. In a forest environment, there will sometimes by an E horizon below the A that is a result of water becoming acidic as it passes through the O

and A horizons and then leaching minerals out of the soil. Below this horizon if it is present, or below the A if it is not, is the B layer, which is where the minerals and clay grains accumulate. In some regions, this layer can be very thick and tightly pored, resulting in hardpan that can very effectively impede the flow of water through it. Below the B horizon is the C, which contains the parent inorganic material for the soil. It is little affected from the original soil before it matured.



Types of soil

Alfisols are a well-developed, highly fertile soil that forms in forests. These soils have undergone some leaching (water stripping some chemicals from the soil as it percolates through it), leaving them with a subsurface layer of clay. This clay allows these soils to remain moist, which helps to keep them fertile. They are usually found in temperate zones, which makes them ideal for farming.

Andisols are formed from the ash and ejecta from volcanoes. These soils are very high in glass grains and materials with pores. This latter property means that these soils have a high ability to hold water.

Aridisols, as the name implies, are soils that form in regions that are dry for long periods of the year. These soils have a high calcium carbonate concentration, with layers of clay, silica, salt, and gypsum in the subsurface regions.

Entisols are characterized by being fairly new soils, which means that they have not had much time to develop any horizons or substrata. They are usually found on rocky hillsides, but

they can also be found on river deltas and shorelines. Essentially, all soils that do not fit into one of the other 11 orders is classified as an entisol. The greatest concentration of these soils is found in the Rocky Mountain and High Plains regions.

Gelisols form in locations that have permafrost within 2 meters of the surface. This means that they are limited to regions near the Poles, or in high, mountainous zones. Because organic matter does not decompose at a fast rate in such areas, gelisols contain a lot of carbon material.

Histosols are soils that contain at least 20-30% organic material and are more than 40 centimeters thick. They are found in locations where the presence of water prevents organic matter from decomposing quickly. This means that histosols are commonly found in low-lying swampy regions.

Inceptisols are slightly more mature versions of entisols. They have begun to develop soil horizons, but have none of the features found in the 10 other orders. As with entisols, they are found mostly in mountainous or hilly regions, such as in the Rocky and Appalachian Mountains.

Mollisols are found in grassland areas and have a relatively rich, dark-colored surface zone as a result of the organic matter from the being added from the grass. The fertile nature of these soils makes them excellent media for growing grain crops. The Great Plains region of the World, is an example of this type of soil.

Oxisols are the heavily oxidized soils found in tropical and subtropical rainforest. These soils have undergone heavy amounts of weathering and are very low in fertility outside of the very thin layer of organic material on the surface. Because water has leached most of the other minerals out of the soil, oxisols are very high in concentrations of aluminum and iron and are mined extensively in countries where rainforest are being chopped down.

Spodosols are highly acidic soils that form in coniferous forests. Water leaching through these soils becomes acidic, which causes heavy weathering of the lower horizons in the soil. Much like the oxisols, this leads to high concentrations of aluminum and iron in the subsurface horizons. These soils have a very low fertility for any kind of crop other than trees that favor acidity like pines.

Ultisols are very similar to spodosols in that they are highly leached, acidic soils in forest environments. They are characterized by a subsurface clay layer that is high in iron, and are found in temperate and subtropical zones that receive a fair amount of rain.

Vertisols are clay-rich soils that experience swelling and shrinking depending upon the water content. These soils are an engineering nightmare, as the total volume of the soil changes depending water.

Land slides:

A landslide is a sudden collapse of large mass of hill side.

Types:

Shallow disrupted land slide and decoherent landslide.

Factors causing landslides:

Caused by rain forces increasing top material weight, lubricating the material layer or making slope top steep.

Gravity-gravity works more effectively on steeper slopes

Weather:

Most slides occur during or after heavy rains.

Effects:

Flow deposit blocks the road and diverts the passage.

Causes of erosion of the soil.

Prevention:

Revegitate the area to prevent the surface erosion .Inspect and repair all drainage system. Collect runoff from roofs and improved areas and convey water from the steep slopes in a well designed pipe system.

Case Study: Landslide In UP 20th August 1998.

Malpa Village Pithoragrah district of UP on 18th August 1998 had a land slide. At least 180 people including 60 kailash Manasorovar pilgrims and 8 Indo-Tibet border Police personnel were killed.

The state government has announced a grant of 237,905 dollars for relief and rescue operation.

Tsunami

It is a Japanese word which means harbour wave.□Tsu□ means harbour and ―nami□ stands for wave.

Tsunami is large waves of water generated when the sea flow is deformed by seismic activity, vertically displacing the overlying water in the ocean.

Phenomenon:

Tsunami is not a singular wave but a series of waves like a ordinary waves one can see on a beach. Ordinary eaves have the wavelength of 100 mts. Tsunami have a wavelength of 500 kms and there could be as much as a hairs gap between eaves. The speed of Tsunami waves across deep sea is 1000 km/hr.The energy lost by tsunami waves is inversely proportional to the wavelength. Tsunami was extremely fast moving and high volume of water. The waves are several hundreds of kms of waves and traveling 1000 km/hr.

Effects:

Tsunami attacks mostly the coastal lines damaging property and life. Kills lot of human being and livestock also spread lot of waterborne disease.

Management:

Earthquake under the sea are monitored by sensors on the floor of sea. The sensors send information of floating buoys on the surface whenever they detect the change in the pressure of the sea. The information is relied to satellite which passes it to the earth station. All member nations waning system are warned of the approaching danger .Finally the country make the people alert to make all necessary precautions.

Case study:

Tsunami in India:

Tsunami was formed on 26th December 2004 in Bay of Bengal and in the Indian Ocean. The tidal waves occurred due to massive earthquake under the ocean floor of Indonesian coast. The magnitude of earthquake is 8.9 on Richter scale and striked northern Sumithra and Indonesia at 6.25a.m.Tsunami travels at a speed of jet engine (700-800 km/hr) and hit Tamilnadu and Srilanka coast about 2-3 hrs after the earthquake.Nagapatinam was worst hitted by Tsunami in India. About 6000 people were dead and huge property loss.

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DESERTS

The concept of dryness is relative; it refers to any situation in which a water deficiency exists. Dry regions encompass about 30 percent of Earth's land surface. Deserts number 25% of the Earth's land surface.

•Two climatic "types"are commonly recognized:

•**desert**, which is arid, and

•**steppe**(a marginal and more humid variant of desert), which is semiarid.

•**Low-latitude deserts**coincide with the zones of subtropical highs in lower latitudes.

•On the other hand, **middle-latitude deserts**exist principally because of their positions in the deep interiors of large landmasses far removed from the ocean.

Types of Deserts

Sand desert --- a wavy sand sea

Stony desert --- gravel surfaces

Rock desert --- bare rock surfaces with huge pavement that kept clear of sand or gravel by wind

Plateau desert --- rocky plateaux , deeply eroded wadis, buttes or inselbergs

Mountain desert --- bare and arid arrays of jagged rock peaks

Deserts can be grouped into five (5) categories based on geographic location

1.Sub-tropical deserts: usually in areas 20-30 degrees North and South of the equator. Example: Sahara

2.Continental Interiors: located so far from a water source that sheer geographic limits the amount of moisture. Example: Gobi

3.Rainshadow Deserts: downwind of a mountain range. Example: Eastern Colorado, east of the Andes Mts. of South America

4.Coastal Deserts: along ocean coastline where chilled air is dry blowing inland. Example: Namibia in Southern Africa

5.Polar Regions: air is so cold that it lacks moisture and therefore very little precipitation falls. Example: Greenland

DESERTFICATION AND LAND DEGRADATION

Desertification is the process of land degradation in arid, semi-arid and dry-subhumid areas.The following are some of the major programs which have been implemented in each of the country's dryland types:

Arid and hyper-arid drylands: flood control, water harvesting, effluent treatment and reuse of treated wastewater for crop irrigation and landscaping; management of natural vegetation and applied agricultural crops including techniques such as drought and salineresistant crops and greenhouse agriculture.

Semi-arid drylands: control of free-ranging livestock herds and afforestation to prevent soil erosion, restoration of aquifer recharge, and development of fish farming with saline groundwater as well as establishment of orchards irrigated by treated wastewater transported from densely populated parts of the country.

Dry sub-humid drylands: remediation of salinized agricultural lands and management of water resources to prevent pollution and promote conservation.

The most salient strategic planning and policies associated with combating desertification can be divided into four general categories as follows:

1. **Development plans** – Approval of the National Master Plan which limits suburban sprawl in the central region and balances and encourages development of the Negev desert region.
2. **Upgraded sustainable water management** – for drylands, based on effluent recycling, desalination, water harvesting techniques and the establishment of watershed management projects.
3. **Afforestation** – adoption of National Master Plan for Forests and Afforestation as a national policy that promotes sustainable forestry through zoning a range of forest types defined by ecological carrying capacity, precipitation levels and landscape values.
4. **Policies to promote sustainable agriculture** – in vulnerable regions based on active erosion control programs, regulation of nomadic grazing, and the promotion of water-saving, salttolerant crops with advanced agricultural techniques.

SOIL POLLUTION

Definition

Soil pollution is defined as the build-up in soils of persistent toxic compounds, chemicals, salts, radioactive materials, or disease causing agents, which have adverse effects on plant growth and animal health.

Soil is the thin layer of organic and inorganic materials that covers the Earth's rocky surface. The organic portion, which is derived from the decayed remains of plants and animals, is concentrated in the dark uppermost topsoil. The inorganic portion made up of rock fragments, was formed over thousands of years by physical and chemical weathering of bedrock. Productive soils are necessary for agriculture to supply the world with sufficient food.

There are many different ways that soil can become polluted, such as:

- Seepage from a landfill
- Discharge of industrial waste into the soil
- Percolation of contaminated water into the soil
- Rupture of underground storage tanks
- Excess application of pesticides, herbicides or fertilizer
- Solid waste seepage

The most common chemicals involved in causing soil pollution are:

- Petroleum hydrocarbons
- Heavy metals
- Pesticides
- Solvents

Types of Soil Pollution

- Agricultural Soil Pollution
    - i) pollution of surface soil
    - ii) pollution of underground soil

- Soil pollution by industrial effluents and solid wastes
    - i) pollution of surface soil
    - ii) disturbances in soil profile

- Pollution due to urban activities
    - i) pollution of surface soil
    - ii) pollution of underground soil

Causes of Soil Pollution

Soil pollution is caused by the presence of man-made chemicals or other alteration in the natural soil environment. This type of contamination typically arises from the rupture of underground storage links, application of pesticides, percolation of contaminated surface water to subsurface strata, oil and fuel dumping, leaching of wastes from landfills or direct discharge of industrial wastes to the soil. The most common chemicals involved are petroleum hydrocarbons, solvents, pesticides, lead and other heavy metals. This occurrence of this phenomenon is correlated with the degree of industrialization and intensities of chemical usage.

A soil pollutant is any factor which deteriorates the quality, texture and mineral content of the soil or which disturbs the biological balance of the organisms in the soil. Pollution in soil has adverse effect on plant growth.

Pollution in soil is associated with

- Indiscriminate use of fertilizers
- Indiscriminate use of pesticides, insecticides and herbicides
- Dumping of large quantities of solid waste
- Deforestation and soil erosion

Indiscriminate use of fertilizers

Soil nutrients are important for plant growth and development. Plants obtain carbon, hydrogen and oxygen from air and water. But other necessary nutrients like nitrogen, phosphorus, potassium, calcium, magnesium, sulfur and more must be obtained from the soil. Farmers generally use fertilizers to correct soil deficiencies. Fertilizers contaminate the soil with impurities, which come from the raw materials used for their manufacture. Mixed fertilizers often contain ammonium nitrate (NH_4NO_3), phosphorus as P2O5, and potassium as K2O. For instance, As, Pb and Cd present in traces in rock phosphate mineral get transferred to super phosphate fertilizer. Since the metals are not degradable, their accumulation in the soil above their toxic levels due to excessive use of phosphate fertilizers, becomes an indestructible poison for crops.

The over use of NPK fertilizers reduce quantity of vegetables and crops grown on soil over the years. It also reduces the protein content of wheat, maize, grams, etc., grown on that soil. The carbohydrate quality of such crops also gets degraded. Excess potassium content in soil decreases Vitamin C and carotene content in vegetables and fruits. The vegetables and fruits grown on overfertilized soil are more prone to attacks by insects and disease.

Indiscriminate use of pesticides, insecticides and herbicides

Plants on which we depend for food are under attack from insects, fungi, bacteria, viruses, rodents and other animals, and must compete with weeds for nutrients. To kill unwanted populations living in or on their crops, farmers use pesticides. The first widespread insecticide use began at the end of World War II and included DDT (dichlorodiphenyltrichloroethane) and

gammaxene. Insects soon became resistant to DDT and as the chemical did not decompose readily, it persisted in the environment. Since it was soluble in fat rather than water, it biomagnified up the food chain and disrupted calcium metabolism in birds, causing eggshells to be thin and fragile. As a result, large birds of prey such as the brown pelican, ospreys, falcons and eagles became endangered. DDT has been now been banned in most western countries. Ironically many of them including USA, still produce DDT for export to other developing nations whose needs outweigh the problems caused by it.

The most important pesticides are DDT, BHC, chlorinated hydrocarbons, organophosphates, aldrin, malathion, dieldrin, furodan, etc. The remnants of such pesticides used on pests may get adsorbed by the soil particles, which then contaminate root crops grown in that soil. The consumption of such crops causes the pesticides remnants to enter human biological systems, affecting them adversely.

An infamous herbicide used as a defoliant in the Vietnam War called Agent Orange (dioxin), was eventually banned. Soldiers' cancer cases, skin conditions and infertility have been linked to exposure to Agent Orange. Pesticides not only bring toxic effect on human and animals but also decrease the fertility of the soil. Some of the pesticides are quite stable and their bio-degradation may take weeks and even months.

Pesticide problems such as resistance, resurgence, and heath effects have caused scientists to seek alternatives. Pheromones and hormones to attract or repel insects and using natural enemies or sterilization by radiation have been suggested.

Dumping of solid wastes

In general, solid waste includes garbage, domestic refuse and discarded solid materials such as those from commercial, industrial and agricultural operations. They contain increasing amounts of paper, cardboards, plastics, glass, old construction material, packaging material and toxic or otherwise hazardous substances. Since a significant amount of urban solid waste tends to be paper and food waste, the majority is recyclable or biodegradable in landfills. Similarly, most agricultural waste is recycled and mining waste is left on site.

The portion of solid waste that is hazardous such as oils, battery metals, heavy metals from smelting industries and organic solvents are the ones we have to pay particular attention to. These can in the long run, get deposited to the soils of the surrounding area and pollute them by altering their chemical and biological properties. They also contaminate drinking water aquifer sources. More than 90% of hazardous waste is produced by chemical, petroleum and metal-related industries and small businesses such as dry cleaners and gas stations contribute as well. Solid Waste disposal was brought to the forefront of public attention by the notorious Love Canal case in USA in 1978. Toxic chemicals leached from oozing storage drums into the soil underneath homes, causing an unusually large number of birth defects, cancers and respiratory, nervous and kidney diseases.

Deforestation

Soil Erosion occurs when the weathered soil particles are dislodged and carried away by wind or water. Deforestation, agricultural development, temperature extremes, precipitation including acid rain, and human activities contribute to this erosion. Humans speed up this process by construction, mining, cutting of timber, over cropping and overgrazing. It results in

floods and cause soil erosion. Forests and grasslands are an excellent binding material that keeps the soil intact and healthy. They support many habitats and ecosystems, which provide innumerable feeding pathways or food chains to all species. Their loss would threaten food chains and the survival of many species. During the past few years quite a lot of vast green land has been converted into deserts. The precious rain forest habitats of South America, tropical Asia and Africa are coming under pressure of population growth and development (especially timber, construction and agriculture). Many scientists believe that a wealth of medicinal substances including a cure for cancer and aids, lie in these forests. Deforestation is slowly destroying the most productive flora and fauna areas in the world, which also form vast tracts of a very valuable sink for CO_2.

Pollution Due to Urbanisation

Pollution of surface soils

Urban activities generate large quantities of city wastes including several Biodegradable

materials (like vegetables, animal wastes, papers, wooden pieces, carcasses, plant twigs, leaves, cloth wastes as well as sweepings) and many non-biodegradable materials (such as plastic bags, plastic bottles, plastic wastes, glass bottles, glass pieces, stone / cement pieces). On a rough estimate Indian cities are producing solid city wastes to the tune of 50,000 - 80,000 metric tons every day.

If left uncollected and decomposed, they are a cause of several problems such as

• Clogging of drains: Causing serious drainage problems including the burst / leakage of drainage lines leading to health problems.

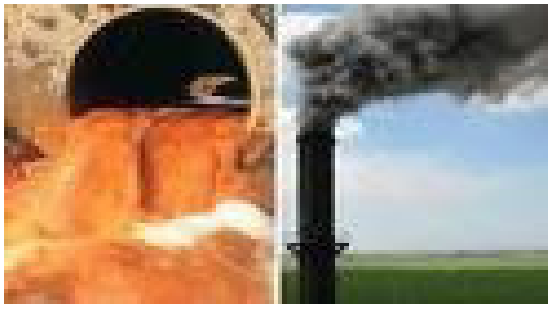
• Barrier to movement of water: Solid wastes have seriously damaged the normal movement of water thus creating problem of inundation, damage to foundation of buildings as well as public health hazards.

• Foul smell: Generated by dumping the wastes at a place.

• Increased microbial activities: Microbial decomposition of organic wastes generate large quantities of methane besides many chemicals to pollute the soil and water flowing on its Surface

• When such solid wastes are hospital wastes they create many health problems: As they may have dangerous pathogen within them besides dangerous medicines, injections.

Pollution of Underground Soil



Underground soil in cities is likely to be polluted by

• Chemicals released by industrial wastes and industrial wastes

• Decomposed and partially decomposed materials of sanitary wastes

Many dangerous chemicals like cadmium, chromium, lead, arsenic, selenium products are likely to be deposited in underground soil. Similarly underground soil polluted by sanitary wastes generate many harmful chemicals. These can damage the normal activities and ecological balance in the underground soil

Causes in brief:

- Polluted water discharged from factories
- Runoff from pollutants (paint, chemicals, rotting organic material) leaching out of landfill
- Oil and petroleum leaks from vehicles washed off the road by the rain into the surrounding habitat
- Chemical fertilizer runoff from farms and crops
- Acid rain (fumes from factories mixing with rain)
- Sewage discharged into rivers instead of being treated properly
- Over application of pesticides and fertilizers
- Purposeful injection into groundwater as a disposal method
- Interconnections between aquifers during drilling (poor technique)
- Septic tank seepage
- Lagoon seepage
- Sanitary/hazardous landfill seepage
- Cemeteries
- Scrap yards (waste oil and chemical drainage)
- Leaks from sanitary sewers

Effects of Soil Pollution

Agricultural

- Reduced soil fertility
- Reduced nitrogen fixation
- Increased erodibility
- Larger loss of soil and nutrients
- Deposition of silt in tanks and reservoirs
- Reduced crop yield
- Imbalance in soil fauna and flora

Industrial

- Dangerous chemicals entering underground water
- Ecological imbalance
- Release of pollutant gases
- Release of radioactive rays causing health problems
- Increased salinity
- Reduced vegetation

Urban

- Clogging of drains
- Inundation of areas
- Public health problems
- Pollution of drinking water sources
- Foul smell and release of gases
- Waste management problems

Environmental Long Term Effects of Soil Pollution

When it comes to the environment itself, the toll of contaminated soil is even more dire. Soil that has been contaminated should no longer be used to grow food, because the chemicals can leech into the food and harm people who eat it.

If contaminated soil is used to grow food, the land will usually produce lower yields than it would if it were not contaminated. This, in turn, can cause even more harm because a lack of plants on the soil will cause more erosion, spreading the contaminants onto land that might not have been tainted before.

In addition, the pollutants will change the makeup of the soil and the types of microorganisms that will live in it. If certain organisms die off in the area, the larger predator animals will also have to move away or die because they've lost their food supply. Thus it's possible for soil pollution to change whole ecosystems.

Effects of soil pollution in brief:

- pollution runs off into rivers and kills the fish, plants and other aquatic life
- crops and fodder grown on polluted soil may pass the pollutants on to the consumers
- polluted soil may no longer grow crops and fodder
- Soil structure is damaged (clay ionic structure impaired)
- corrosion of foundations and pipelines
- impairs soil stability
- may release vapours and hydrocarbon into buildings and cellars
- may create toxic dusts
- may poison children playing in the area

Control of soil pollution

The following steps have been suggested to control soil pollution. To help prevent soil erosion, we can limit construction in sensitive area. In general we would need less fertilizer and fewer pesticides if we could all adopt the three R's: Reduce, Reuse, and Recycle. This would give us less solid waste

Reducing chemical fertilizer and pesticide use

Applying bio-fertilizers and manures can reduce chemical fertilizer and pesticide use.

Biological methods of pest control can also reduce the use of pesticides and thereby minimize soilpollution.

Reusing of materials

Materials such as glass containers, plastic bags, paper, cloth etc. can be reused at domestic levels rather than being disposed, reducing solid waste pollution.

Recycling and recovery of materials

This is a reasonable solution for reducing soil pollution. Materials such as paper, some kinds of plastics and glass can and are being recycled. This decreases the volume of refuse and helps in the conservation of natural resources. For example, recovery of one tonne of paper can save 17 trees.

Reforesting

Control of land loss and soil erosion can be attempted through restoring forest and grass cover to check wastelands, soil erosion and floods. Crop rotation or mixed cropping can improve the fertility of the land.

BIOGEOCHEMICAL CYCLES

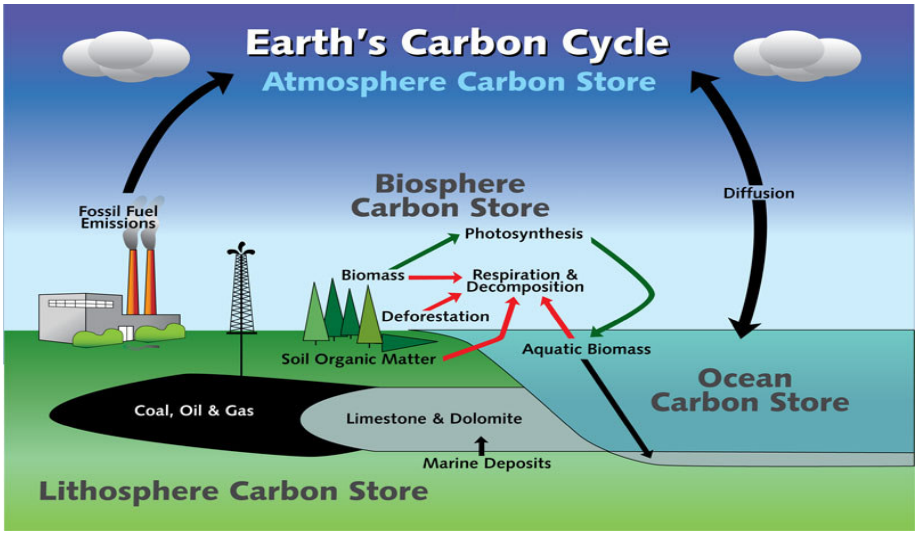
- Major parts of the biosphere are connected by the flow of chemical elements and compounds.
- Exchanges of materials between these different reservoirs
- Between atmosphere and biota/oceans can be rapid
- Between rocks, soils and oceans can be more slow

Major Element Cycles

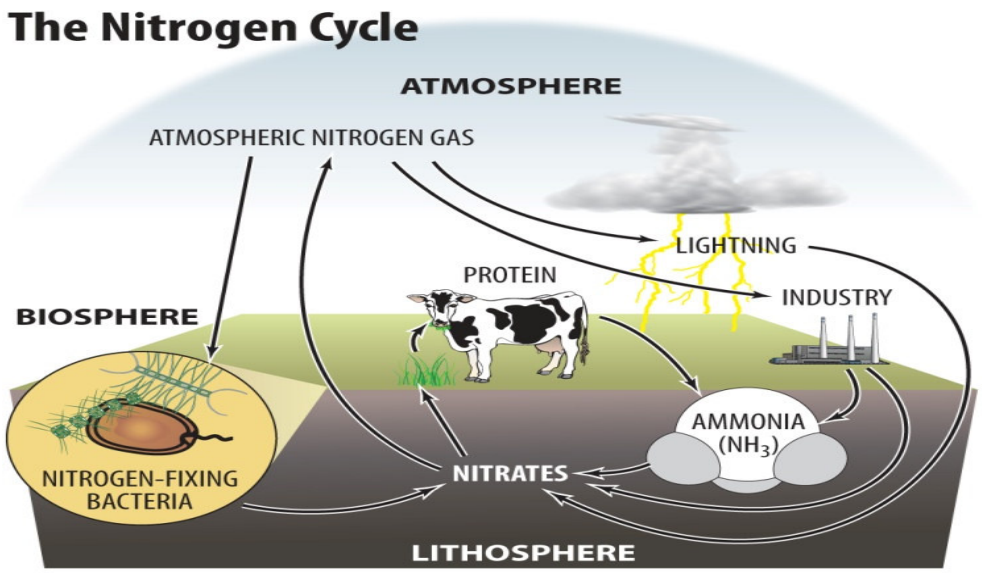
Here we will consider these: C, O, N, P, S, Ca,

- Carbon Cycle
- Nitrogen Cycle
- Oxygen Cycle
- Phosphorus Cycle
- Sulfur Cycle

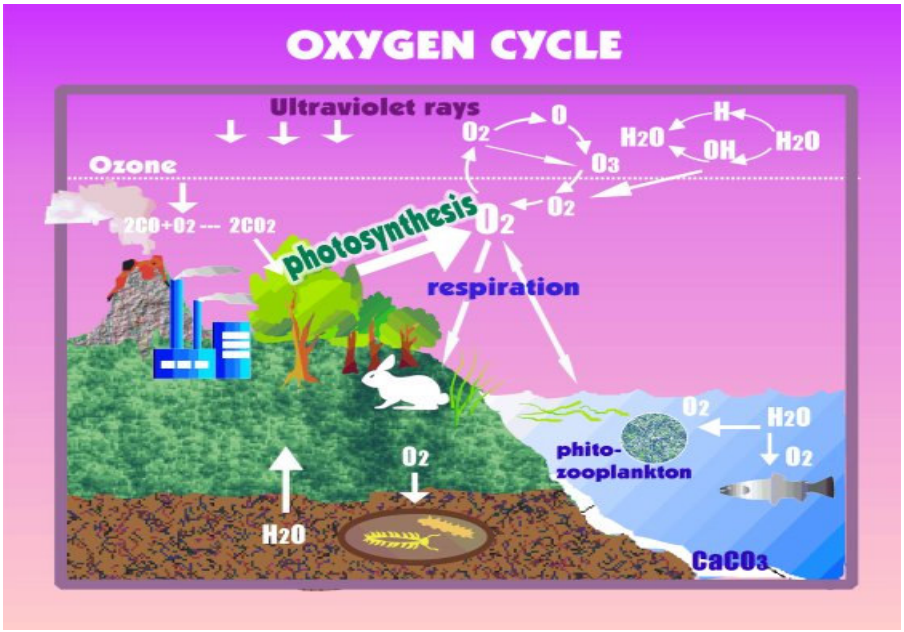
Carbon Cycle:



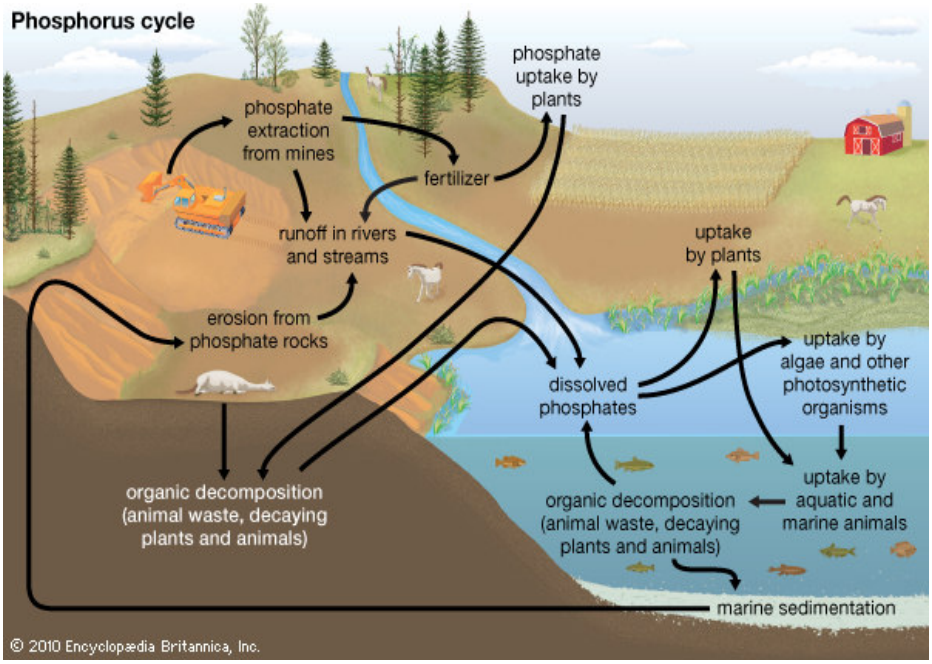
Nitrogen Cycle:



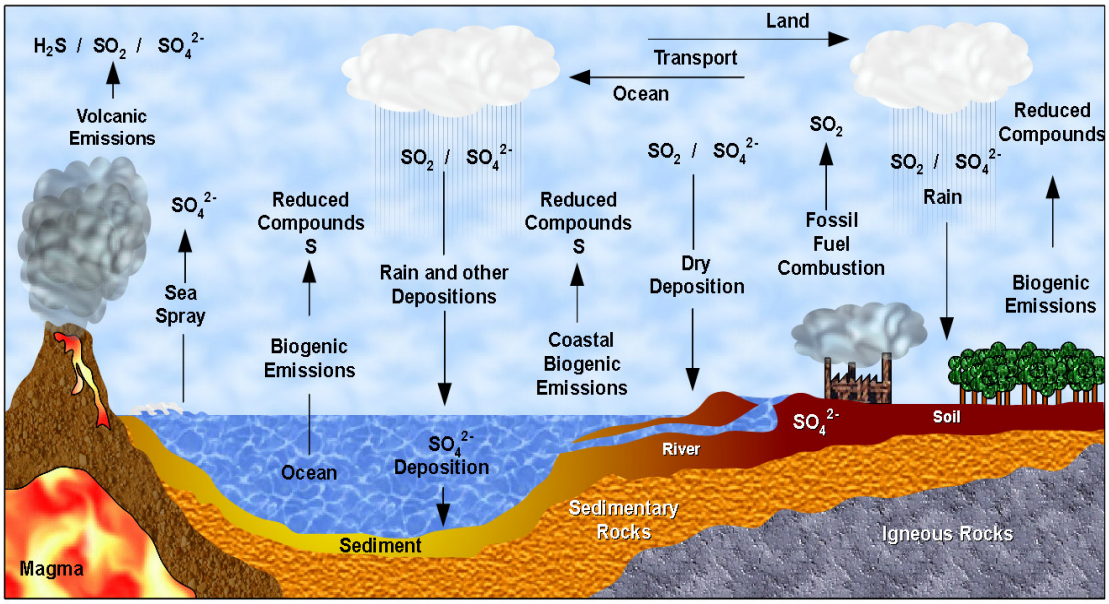
Oxygen Cycle:



Phosphorus Cycle:



Sulphur Cycle:



RADIOACTIVE POLLUTION

Radioactive pollution is the physical pollution of air water and soil by radioactive materials.

Sources:

Natural source:

The important natural source is space which emits cosmic rays. Soil rocks, air radioactive Rd 222also contain one or more radioactive substances.

Man made resources:

Nuclear power plants X-rays, nuclear accidents, nuclear bombs. Mining and refining of plutonium, thorium and preparation of radioactive isotopes.

Effects:

1. Damages to enzymes, DNA, RNA through ionization, cross linkings within and between two affected molecules.

2 .Damage to cell membranes, chromosomes such as fragmentation mitochondria etc.

3.Disruption of central nervous system ,loss of sight, inactivation of bone marrow activity resulting in blood cancer, malignance and ulcerisation in intestinal tract.

4. Death or shortening of life span due to radiation changes in chacteristics due to mutation.

5. Internal bleeding and blood vessel damage may show up as red spots on the skin.

6. Urban children are vulnerable to brain damage or mental retardation if radiation occurs in early pregnancy

Control Measures:

1Nuclear devices should never be exploded in air. If necessary they may be explode under ground.

2. Leakage of radioactive elements from reactors and labs processing or using them should be totally checked.

3. In nuclear and chemical industries the use of radio isotopes may be carried under a jet of soil or water instead of powder or gaseous form.

4. In nuclear mines wet drilling may be employed along with underground drainage.

5. Nuclear medicines and radiation therapy should be applied when absolutely necessary with minimum dose.

6. Minimum number of nuclear installations should be commissioned.

7. In nuclear reactors closed cycled coolant system with gaseous coolants may be used to prevent extraneous activation of products.

SOLID WASTE MANAGEMENT

Management of solid waste is very important to minimize adverse effect of solid waste.

Types of solid waste

Urban waste and industrial waste.

Sources of urban and industrial wastes

Sources of urban waste: domestic waste like food waste, waste paper, glass bottles, polythene bags etc .Commercial waste like packing materials cans, bottles, polythene bags etc Construction wastes like concrete, wood, debris etc .Biomedical waste like Anatomical waste, infectious waste etc

Classification of urban waste:

1. Biodegradable wastes – urban solid waste materials that can be degraded by micro organisms are called biodegradable waste. E.g. food, vegetables, Tea leaves, dried leaves etc.

2. Non biodegradable waste. Urban solid wastes that cannot be degraded by microorganisms are called non biodegradable wastes.

SOURCES OF INDUSTRIAL WASTES

The main source of industrial waste is chemical industries, metal and mineral processing industries. E.g.

1. Nuclear power plants generate radioactive wastes
2. thermal power plants produce fly ash in large quantities
3. Chemical industries produce toxic and hazardous materials.
4. other industries produce packing materials acid, alkalis, scrap metals, rubber, plastic, glass wood etc

EFFECT OF SOLID WASTE

1. Biodegradable materials in the disposed municipal waste undergo decomposition. This produces foul smell and breeds various types of insects which spoil land well.
2. Industrial waste containing toxic metals and hazardous waste affect soil characteristics.
3. Toxic substances name percolate into the ground and contaminates the ground water.

4. Burning of some industrial waste or domestic waste produces furan, dioxins and poly chlorinated biphenyls which are harmful to human beings.

STEPS INVOLVED IN SOLID WASTE MANAGEMENT

Reduce, reuse and recycle: if the usage of raw materials is reduced the generation of waste also gets reduced.

Reuse of waste materials: discarded refillable containers can be reused. Waste generation during manufacture of rubber bands is reduced by making rubber bands from discarded cycle tubes.

Recycling of materials. Recycling is the reprocessing of discarded materials into new useful products. Ex. Old aluminium cans glass bottles are melted into new cans and bottles.

Preparation of cellulose insulations from paper.

Preparation of fuel pallets from kitchen wastes.

METHODS OF DISPOSAL OF MUNICIPAL SOLID WASTES

Land Fill: Solid wastes are placed in sanitary land fill system in alternate layers of 80cm thick refuse covered with selected earth fill of 20cm thickness. After 2 or 3 years solid waste volume shrinks by 25-30% and the land is used for parks, roads and small buildings.

Waste disposal is dumping in sanitary land fill which is employed in Indian cities. This method involves spreading the solid waste on the ground. Compacting it and then covering it with soil at suitable intervals.

Advantages: 1 Simple and economical. Segregation is not required. Natural resources are returned to soil and reclyed .Converts low lying, marshy waste land into usefull areas.

Diadvantages: Large area needed. Bad odour. High transportation cost. Sources of mosquito, flies. Insecticides and pesticides are to be applied at regular intervals. Causes fire hazard due to methane formation in wet weather

INCINERATION

In this method the municipal solid wastes are burnt in a furnace called incinerator. The combustible substances such as rubbish, garbage, and dead organisms and non combustible matter such as glass, metals are separated before feeding into incinerator. The non combustible can be left out for recycling and reuse. The left out ashes and clinkers from the incinerator may be about 10-20 % which is disposed by land fill or some other methods.

The heat produced in the incinerator during burning is used as steam power for generation of electricity through turbines. The wet solid waste is dried in pre heaters and then taken into large incinerating furnaces called destructors which incinerate 100- 150tons per hour. The temperature maintained is about 700 ˚ C and increase to 1000˚ C when electricity is to be generated.

Advantages:

1. Requires little space
2 .Hygienic point of it is safest.
3. Incinerated plants of 300 tons per day capacity generate 3 MW of power.

Disadvantages:

1. Capital and operational cost is high.
2. Needs skilled persons.

3. Formations of smoke, dust and ash causes air pollution.

COMPOSTING

In this method bulk organic waste is converted in to manure by biological action. Compost able waste is dumped in underground trenches in layer of 1.5 meters and is finally covered about 20 cms and left for decomposition. Microorganism like actinomycetes is added for active decomposition.

Within two to three days biological action starts .The organic matter decomposed by actionomycetes and lot of heat is liberated. The temperature of the compost increases by 75˚C and finally the refuse is converted to a brown coloured powder known as humus and is used in agricultural fields. The compost contain N,P and other minerals.

Advantages:

Recycling occurs.

Number of industrial solid wastes can also be treated by this method.

Role of an individual in the prevention of pollution:

A small effort made by each individual at his own place will have pronounced effect at the global level. It is aptly said ―Think globally; Act locally

Each individual change his life style in such a way has to reduce environment pollution.

Individual participation:

Planting more trees.

Use water energy and other resources efficiently.

Purchase recyclable, recycled and environmentally safe products.

Use CFC free refrigerators.

Reduce deforestation.

Increase use of renewable resources.

Remove NOx from motor vehicular exhausts. Use of eco friendly products.

Case studies related to pollution:

Bhopal gas tragedy: In Bhopal M.P on 3rd December 1984 world's worst industrial accident occurred. In occurred at Union Carbide India Ltd this manufactures carbonate pesticides using methyl iso cyanate.

Effects of MIC. Lower concentration of MIC affects lungs, Eyes and causes irritation in the skin. High concentration of MIC removes Oxygen from the lungs and causes death.

Effects in Bhopal: MIC spread over 40square Km in area. 5000 people are killed and 65000 people suffered from disorders in eye, respiratory, gastrointestinal. 1000 become blind.

Taj – Trapezium Case

Tajmahal is the king emperor among world wonders. The chemical and hazardous industries and the refinery at Mathura are major sources of damage to Tajmahal. The SO2 from Mathura refineries combine with Oxygen along with moisture in the atmosphere forms H2SO4 called Acid Rain. This corrodes clean white marble.

Gulf War (Marine Pollution)

The Gulf war between USA and Iraq took place from Jan16th to Feb26th 1991. During the war nearly 700 oil wells of Kuwait fired and the oil spills into the sea. The floating oil covered nearly 80 Km long and 25 Km wide area. The burning the oil produced pollutants like CO2 and SO2 in the Atmosphere.

Effects: 1 million birds were killed due to oils slick. The oil slick in the sea made the desalination plants ineffective

UNIT – IV

BIOSPHERE

ECOSYSTEM:

Living organisms cannot be isolated from their non-living environment because the later provides materials and energy for the survival of the farmer. An ecosystem is therefore defined as a natural functional ecological unit comprising of living organisms and their non-living environment that interact to form a stable self supporting system.

Eg. Pond, lake, desert, grassland, forest, etc.

ENERGY FLOW IN ECOSYSTEM:

Energy is defined as the capacity to do work. For living organisms, it is the basic force responsible for running all the metabolic activities. The flow of energy from producer level to top consumer level is called energy flow.

The flow of energy in an ecosystem is unidirectional. It flows from producer level to consumer level and never in the reverse direction.

The process of energy flow involves transfer of energy from autotrophy to various components of heterotrophy and help in maintaining bio diversity. The main source of energy in the ecosystem is sunlight. About 80% of energy is lost during flow of energy from one tropic level to the next one.

Sun Producer Herbivores Carnivores Top carnivores Decomposers

FOOD CHAIN

Plants by photosynthesis convert solar energy into protoplasm. Small herbivores consume the vegetable matter and convert into animal matter which in turn eaten by large carnivores. This sequence of eaten and being eaten, produces transfer of food energy known as food chain.

Producers Consumer I order Consumer II order Decomposers

(Plants) (Deer) (Tiger, Lion) (Bacteria, fungi)

FOOD WEB: The food relationship between various organisms is being depicted by linking all the possible prey and predators of different food level. In an ecosystem linking of feeding habit relations will provide a food web.

Mouse snake

Grass Rabbit Hawk

Grasshopper Lizard

ECOLOGICAL PYRAMIDS:

The energy biomass and number of organisms gradually decreases from the producer level to the consumer level. The total mass of herbivores in an ecosystem will generally be less than the total mass of plants. Similarly the total mass of carnivores will be less than the total mass of herbivores. The graphical representation of the number, biomass and energy of various energy levels is called ecological pyramid. In any ecological pyramid the producer forms the base and the successive levels form the tires which can make the apex.

Types of ecological pyramids:

a) pyramid of numbers

b) pyramid of biomass

c) pyramid of energy

Eg. Grassland ecosystem – pyramid of number – upright pyramid

MAJOR TYPES OF ECOSYSTEMS

FOREST ECOSYSTEM

Definition

It is a natural ecosystem consisting of dense growth of trees and wild animals

Types: tropical – deciduous, evergreen, wet green

Littoral and swamps

Sub tropical

Characteristics:

Abiotic: soil, sun light, temperature etc

Biotic: forest trees, shrubs and animals

Structure:

Producer: trees and shrubs

Consumer: Primary – elephants, deer etc.

Secondary – snakes, birds, lizards etc

Tertiary – lions, tigers etc

Decomposers: fungi, bacteria

GRASSLAND ECOSYSTEM:

It is dominated by grass few shrubs and trees are also found rainfall average but erratic overgrazing leads to desertification.

Three types – depending on the climate

1. Tropical grass lands found near the boarders of tropical rain forests. Eg. Savannas in Africa. Animals Zebra, giraffes etc. fires are common in dry seasons termite mounds produce methane leads to fire high in photosynthesis deliberate burning leads to release of high CO2 global warming.

2. Temperate grasslands – flat and gentle slopes of hills. Very cold winter and very hot summer dry summer fires do not allow shrubs and trees to grow soil is quite fertile cleaned for agriculture.

3. Polar grasslands found in arctic polar region organism arctic wolf, fox, etc. A thick layer of ice remains frozen under the soil surface throughout the year known as permafrost summer insects and birds appear.

Components:

Structural Components:

Abiotic: soil pH, nutrients, soil moisture, temp, climatic conditions, etc.

Biotic: grass, caterpillar, butterfly, worms, insects, birds, etc.

Functional components:

Ecological pyramid

birds –insects-Worms-grass

Energy flow: Grass- worms- Insects- small birds- huge bird- Decomposition- Sediments

BIODIVERSITY

Biodiversity is the abbreviated word for ―biological diversity (bio-life or living organisms, diversity-variety). Thus biodiversity is the total variety of life on our planet, the total number of races, varieties and species. The sum of total of various types of microbes, plants and animals (producers, consumers and decomposers) in a system.

Biomes can be considered life zones, environment with similar climatic, topographic and soil conditions and roughly comparable biological communities (Eg. Grassland, forest). The biomes shelter an astounding variety of living organisms (from driest desert to dripping rain forest, from highest mountain to deepest ocean trenches, life occurs in a marvelous spectrum of size, shape, colour and inter relationship). The variety of living organisms, the biodiversity, makes the world beautiful.

There are 1.4 million species known presently. But based on new discoveries, by research expeditions, mainly in tropics, taxonomists estimate there are between 3-50 million different species may be alive today. Insects make up more than one half of all known species and may comprise more than 90% of all species on earth.

The concept of biodiversity may be analyzed in 3 different levels. They are

1. ecosystem diversity
2. species diversity
3. genetic diversity

Ecosystem or ecological diversity means the richness and complexity of a biological community, including tropic levels, ecological processes (which capture energy), food webs and material recycling.

Species diversity describes the number of kinds of organisms within individual communities or ecosystems.

Genetic diversity is a measure of the variety of versions of same gene within individual species.

Biodiversity Hotspots:

Most of the world's biodiversity are near the equator especially tropical rain forest and coral reefs. Of all the world's species, only 10-15% live in North America and Europe.

The Malaysian Peninsula, for instance, has at least 8000 species of flowing plants, while Britain, with an area twice as large, has only 1400 species. South America has 200 000 species of plants. Areas isolated by water, desert or mountain can also have high conc. of unique species and biodiversity. New Zealand, South Africa and California are all mid-latitude area isolated by barriers that prevent mixing up of biological communities from other region and produce rich, unusual collection of species.

Significance of Biodiversity:

Biosphere is a life supporting system to the human race. Each species in the biosphere has its own significance.

It is the combination of different organisms that enables the biosphere to sustain human race.

Biodiversity is vital for a healthy biosphere.

Biodiversity is must for the stability and proper functioning of the biosphere.

Besides these biodiversity is so important due to having consumptive use values, productive use values, social values, ethical values and aesthetic values.

Benefits of biodiversity:

We benefit from other organism in many ways. Even insignificant organisms can play irreplaceable roles in ecological systems or the source of genes or drugs that someday become indispensable.

Food: Many wild plant species could make important contributions to human food suppliers either as they are or as a source of material to improve domestic crops. About 80,000 edible plants could be used by human.

Drugs and medicine: Living organisms provides many useful drugs and medicines. The United Nations Development Programme derived from developing world plants, animals and microbes to be more than $30 billion per year.

Eg. For natural medicinal products

Penicillin – fungus is the source – Antibiotic

Quinine – chincona bark - Malaria treatment

Morphine – poppy bark – Analgesic

Twenty years before, once the drugs were not introduced, childhood leukemia was fatal. Now the remission rate for childhood leukemia is 99%.

Ecological benefits:

Human life is inextricably linked to ecological services provided by other organisms. Soil formation, waste disposal, air and water purification, solar energy absorption, nutrient cycling and food production all depend on biodiversity. In many environments, high diversity may help biological communities to withstand environmental stress better and to recover more quickly than those with fewer species.

Threats to biodiversity

Habitat loss

Deforestation activities (cutting trees for timber, removal of medicinal plants)

Production of hybrid seeds requires wild plants as raw material, farmers prefer hybrid reeds, many plant species become extinct

Increase in the production of pharmaceutical companies made several numbers of medicinal plants and species on the verge of extinction.

Removal of forest-cover for road laying and also due to soil erosion

Illegal trade of wild life

Population explosion, construction of dam, discharge of industrial effluents use of pesticides.

Poaching of wild life

Due to poaching, illegal trade and smuggling activities most of our valuable fauna are under threat organized crime has moved into illegal wild life smuggling because of huge profit E.g. Tiger, Deer – for hides, Rhinoceros – for horns, Elephant – for ivory tusk, Sea Horse, Star turtle – sold to foreign market.

(Extinction, the elimination of species, is a normal process of the natural world. Species die put and are replaced by others as part of evolutionary change.

Human caused reduction: The climate change caused by our release of green house gases in the atm. could have catastrophic effects. Human disturbance of natural habitat is the largest single cause of loss of biological diversity. Woodlands and grasslands are converted now use about 10% of the world's land surface for crop production and about twice the amount for pasture and grasslands.)

Hunting: Over harvesting is responsible for depletion or extinction of many species.

E.g. The American passenger pigeon was the world's most abundant bird. In spite of this vast population, market hunting and habitat destruction caused the entire population to crash with in 20 years.

Fragmentation

Habitat fragmentation reduces the biodiversity because many animals like bears and large cats require large territories to subsist. Some forest birds reproduce only in deep forest or habitat far from human settlement. A large island for example, can support more individuals of given species and therefore less likely to suffer extinction due to genetic problems and natural catastrophes.

Commercial products: muggling of fuels, hides, horns and folk medicines also affect the biodiversity in an abrupt manner.

Conservation of biodiversity

In general biodiversity is generally disturbed by human activities. To solve the problems, it is essential to protect our bio diversity by two ways.

1. In-situ or on-site conversion
2. Ex-situ conservation

In-situ conservation:

- Conservation of species in its natural habitat, in place where the species normally occurs
- The strategy involves establishing small or large protected areas, called protected areas
- Today in world, there are 9800 protected areas and 1500 national parks

Methods:

1. Nature or biosphere reserves (Eg) Nilgiri Bio reserve
2. national parks and sanctuaries (Eg) Mudumalai, vedanthangal
3. on farm and home garden conservation for plants, vegetables and fruits to maintain traditional crop varieties.

Ex- situ conservation:

It involves maintenance and breeding of endangered plant and animal species under partially or wholly controlled conditions in zoos, gardens and laboratories

The crucial issue for conservation is to identify those species which are more at risk of extinction.

Methods:

1. Long term captive breeding
2. Shortage term propagation and release
3. Animal translocation and re introductions
4. Seed bank
5. Reproductive technology

(i) Embryo transfer technology

(ii) Cloning

Biodiversity and National Environmental law

All environmental problems are regional in nature but their effects are global. Hence environmental problems can be resolved only by extensive co operation among nations. Laws serve to achieve global objective of environmental protection.

Indian law for conservation of biodiversity:

The wild species of the group and other related species constitute a rich gene pool in India. The government of India has enacted laws for the conservation of biological diversity.

The habitat protection laws:

This includes species protection laws and habitat protection laws which indirectly protect and conserve the biological diversity and its components.

The wild life (protection) Act 1972: Enacted

1. To protect wild animals and birds which are in the verge of extinction
2. To protect biological diversity in particular and environmental protection in general.
3. For the protection of wild animals and birds and for all other matters connected there of or ancillary and incidental there to.

Biosphere Reserve and the wild life (protection) Act 1972:

Biosphere reserves are complementary to the existing network of national parks and sanctuaries, this act is enacted to protect biosphere.

UNIT-V

ALTERNATE ENERGY SOURCES

NUCLEAR FISSION

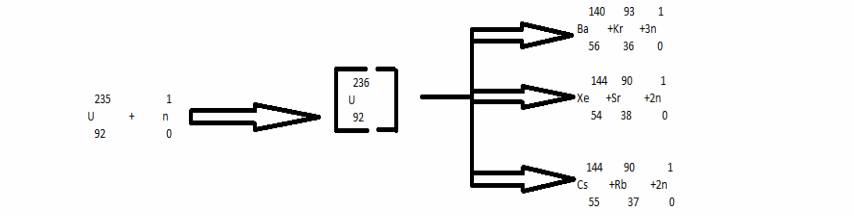
When U^{235} is bombarded by thermal neutron (low energy neutron), it splits into two approximately equal parts with the liberation of a large amount of energy.

DEFINITION

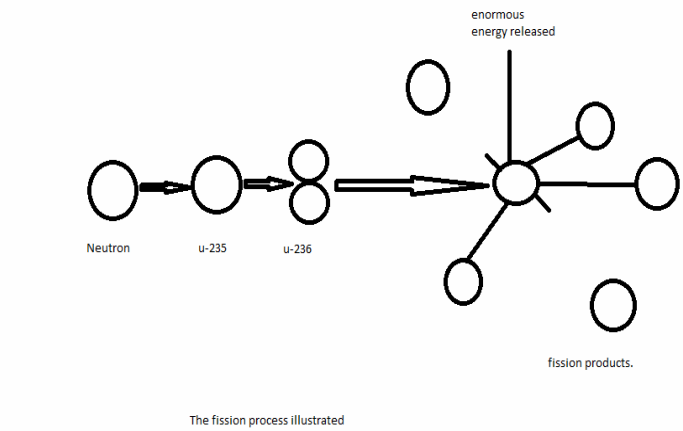
Nuclear fission is defined as "the process of splitting of heavier nucleus into two (or) more smaller nuclei with simultaneous liberation of large amount of energy".

MECHANISM OF NUCLEAR FISSION

When $U^{235}$is bombarded by thermal neutron, unstable U^{236} is formed. The unstable U^{236} then divides into two approximately equal nuclei with the release of neutrons and amount of energy. During the nuclear fission a large amount of energy is released.



ILLUSTRATION



The fission process illustrated

CHARACTERISTICS OF NUCLEAR FISSION

A heavy nucleus when bombarded by slow moving neutrons, split into two or more nuclei.

Two or more neutrons are produced by fission of each nucleus.

A large quantity of energy is produced as a result of conversion of small mass of nucleus into energy.

All the fission fragments are radioactive, giving off B and r radiations.

The atomic weight of fission products ranges from about 70 to 160.

All the fission reactions are self – propagating chain-reactions because fission products contain neutrons which further cause fission in other nuclei.

The nuclear chain reactions can be controlled and maintained steadily by absorbing a desired number of neutrons. This process is used in nuclear reactor.

Every secondary neutron, released in the fission process, does not strike a nuclear, some escape into air and hence a chain reaction cannot be maintained.

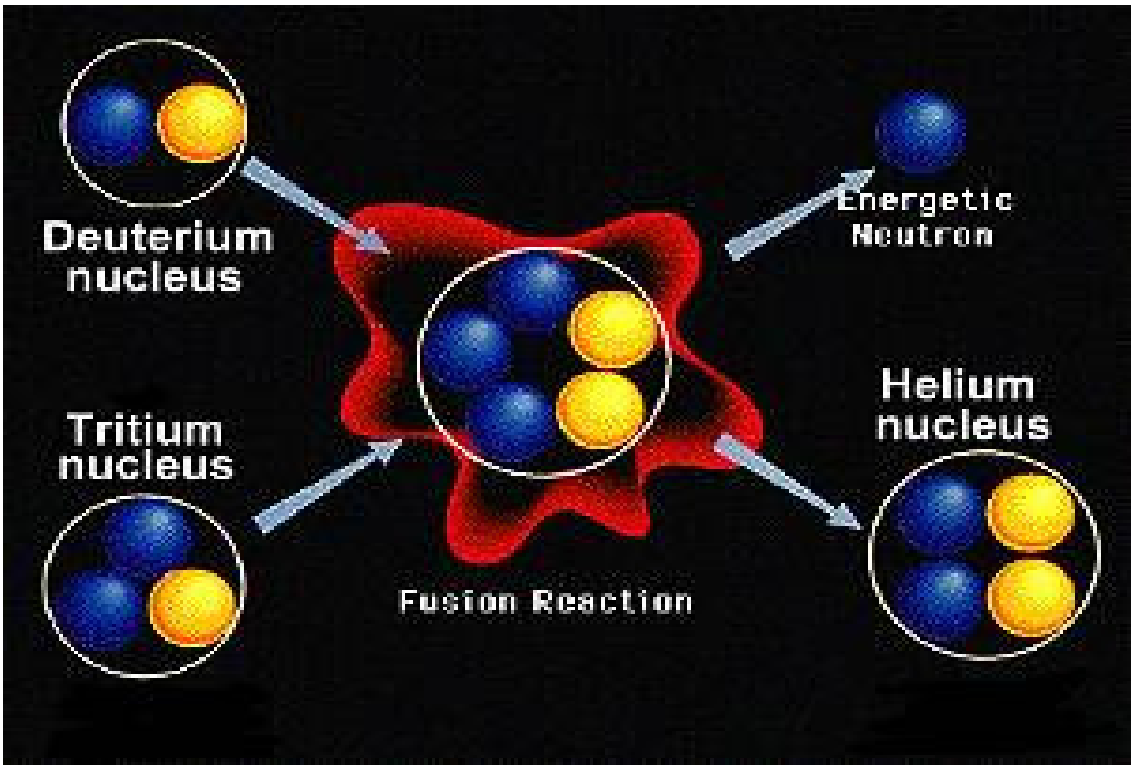
Multiplication factor: the number of neutrons, resulting from a single fission, is known as the multiplication factor.When the multiplication factor is less than 1, a chain reaction does not take place.

NUCLEAR FUSION

Nuclear fusion is defined as, "the process of combination of lighter nuclei into heavier nuclei, whit simultaneous liberation of large amount of energy".

Nuclear fusion occurs in sun.

$$_1H^2 +_1H^2 \text{----------} >_2He^4 + \text{energy}$$



NUCLEAR REACTOR OR PILE

If a nuclear fission reaction is made to occur in a controlled manner, then the energy released can be used for many constructive purposes.

DEFINITION

The arrangement or equipment used to carry out fission reaction under controlled condition is called a nuclear reactor.

EXAMPLE:-

The energy released (due to the controlled fission of U^{235} in a nuclear reactor) can be used to produce steam which can run turbines and produce electricity.

COMPONENTS OF A NUCLEAR REACTOR

The main components of the nuclear reactor are

FUEL RODS

The fissionable materials used in the nuclear reactor is enriched $U^{235.}$ The enriched fuel is used in the reactor in the from of rods or strips.

U^{235} ; Pu^{239}

FUNCTION

It produces heat energy and neutrons that starts nuclear chain reaction.

CONTROL RODS

To control the fission reaction (rate), movable rods, maybe of cadmium (or) boron, are suspended between fuel rods. These rods can be lowered or raised and control the fission reaction by absorbing excess neutrons.

If the rods are deeply inserted inside the reactor, they will absorb more neutrons and the reaction becomes very slow. On the other hand, if the rods are pushed outwards, they will absorb less neutrons and the reaction will be fast.

$$Cd_{43}^{113} + n_0^1 \text{----------} > Cd^{114}_{43}$$

$$B_5^{10} + n_0^1 \text{----------} > + B^{11}_5$$

EXAMPLES

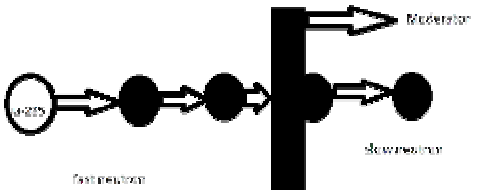
Cd^{113}; B^{10}

FUNCTION

It controls the nuclear chain-reaction and avoids the damage of the reactors.

MODERATORS

The substances used to slow down the neutrons are called moderators.



When the fast-moving neutrons collide with moderator, they lose energy and gets slow down.

EXAMPLES

Ordinary water, heavy water, graphite, beryllium.

FUNCTION

The kinetic energy of fast moving neutrons is reduced to slow neutrons (0.25 ev).

COOLANTS

In order to absorb the heat produced during fission ,a liquid called coolant is circulated in the reactor core .it enters the base of the reactor and leaves at the top. The heat carried by out – going liquid is used to produce steam.

EXAMPLES

Water, heavy water, liquid metal (Na or K), air (Co_2).

FUNCTION

It cools the fuel core.

PRESSURE VESSEL

It encloses the core and also provides the entrance and exit passages for coolant.

FUNCTION

It withstands the pressure as high as 200kg/cm^2 .

PROTECTIVE SHIELD

The nuclear reactor is enclosed in a thick massive concrete shield (more than 10 meters thick).

FUNCTION

The environment and operating personnels are protected from destruction in case of leakage of radiation.

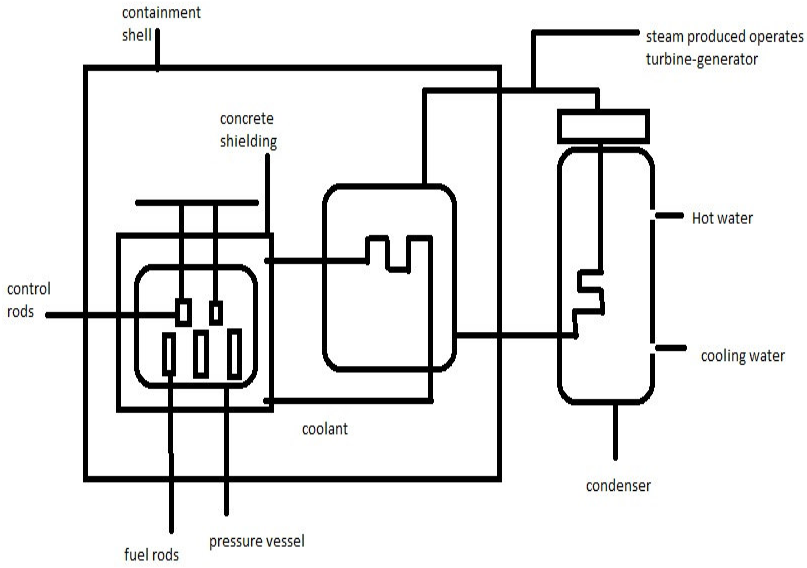
TURBINE

The steam generated in the heat exchanger is used to operate a steam turbine, which drivers a generator to produce electricity.

LIGHT WATER NUCLEAR-POWER PLANT

DEFINITION

Light-water nuclear – power plant is the one, in which U^{235} fuel rods are submerged in water. Here the water acts as coolant and moderator.



WORKING

The fission reaction is controlled by inserting or removing the control rods of B^{10} automatically from the spaces in between the fuel rods. The heat emitted by fission of U^{235} in the fuel core is absorbed by the coolant. The heated coolant then goes to the heat exchanger containing sea water. The coolant here, transfers heat to sea water, which is converted into steam the steam then drives the turbines, generating electricity.

POLLUTION

Though nuclear power plants are very important for production of electricity, they will cause a serious danger to environments.

PROBLEM ON DISPOSAL OF REACTOR WASTE

Disposal of reactor water is another important problem because the fission products viz…, Ba^{139} & Kr^{92} are themselves radioactive. They emit dangerous radiation for several hundred years. So the water is packed in concrete barrels, which are buried deep in the sea.

SOLAR ENERGY

The energy that we get directly from the sun is called solar energy.

The nuclear fusion reaction occurring inside the sun release enormous amount of energy in the form of heat and light, several techniques are available for collecting, converting and using solar energy

METHODS OF HARVESTING SOLAR ENERGY.

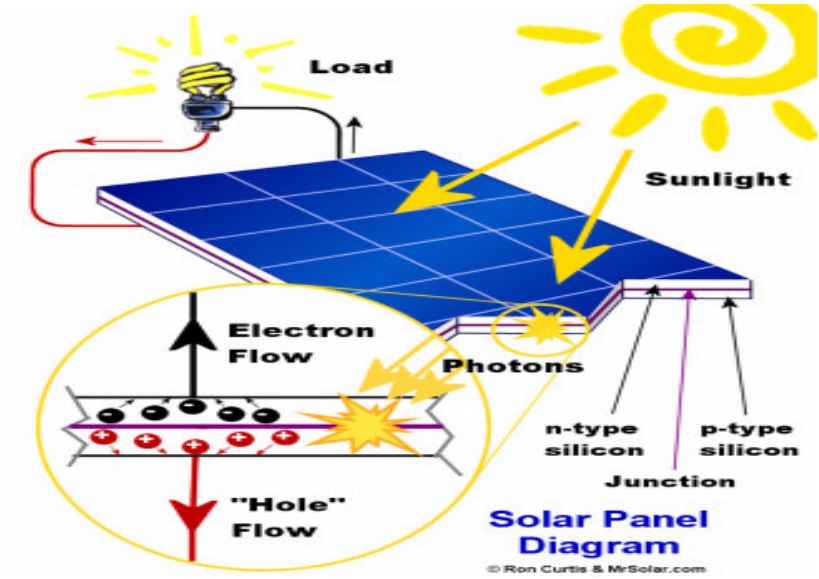
Some important solar energy harvesting devices are given…

***Solar cells (or) Photovoltaic cells (or) PV Cells:**

Solar cell consist of p-type semiconductor **(Such as Si doped with B)** and n-type semiconductor **(Such as Si doped with P)** .They are in close contact with each other. When the solar rays fall on the top layer of p-type semiconductor, **the electrons from the valence band get promoted into conduction band and cross the p-n junction into n- type semiconductor.** There by potential difference between two layers is created, which causes flow of electrons. (i.e., an electric current).

USES

Calculators, Electronic watches,. Street lights, Water pumps, Radios and TVs.



SOLAR CELL

SOLAR BATTERY

When a large of solar cells are connected in series it form a solar battery. Solar battery produces more electricity which is enough to run water pump, to run street – light, etc., They are used in remote areas where non – conventional electricity supply is a problem.

SOLAR HEAT COLLECTORS

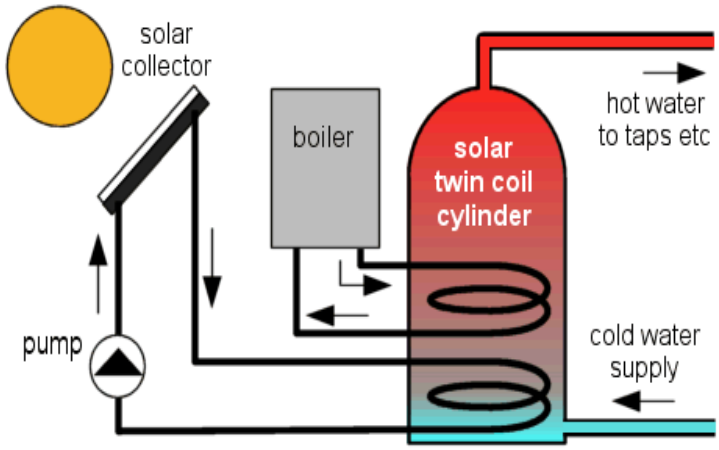
Solar heat collectors consist of natural materials like stones, bricks(or) materials like glass, which can absorb heat during the day time and release is slowly at night.

USES

It is generally used in cold places, where houses are kept in hot condition using solar heat collectors.

SOLAR WATER HEATER

It consists of an insulated box inside of which is painted with black paint. It is also provided with a glass lid to receive and store solar energy. Inside the box is has black painted copper coil. Through which cold water is allowed to flow in, which gets heated up and flows out into a storage tank. From the storage tank water is then supplied through the pipes.



WIND ENERGY

The high speed winds have a lot of energy as kinetic Energy due to their motion. The driving force of the winds is the sun. The wind energy is utilized by making use of wind mills. The blades of the wind mill keep on rotating continuously Due to the force of the striking wind. The rotational motion of the blades drives a number of machines like water pumps, flour mills and electric generators. A large number of wind mills are installed in clusters called wind farms which feed power to the utility grid and produce a large amount of electricity. These farms are ideally located in coastal regions, open grasslands or hilly regions, particularly mountain passes and ridges where the winds are strong and steady.The minimum wind speed required for satisfactory working of a wind generator is 15 Krn Ihour. The wind power potential of our country is estimated to be about 20,000MW, whi Ie at present generating about 1020MW.The largest wind farm of our country is near Kanyakumari in Tarnilnadu generating 380MW electricity. Wind energy is very useful as it does not cause any air pollution

Sustainable Development

Environmental, economic and social well-being for today and tomorrow

Sustainable development has been defined in many ways, but the most frequently quoted definition is from Our Common Future, also known as the Brundtland Report

"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts:

- the concept of needs, in particular the essential needs of the world's poor, to which overriding priority should be given; and
- the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs."

Geothermal Energy

The Earth's heat-called geothermal energy-escapes as steam at a hot springs in Nevada. Geothermal energy is the heat from the Earth. It's clean and sustainable. Resources of geothermal energy range from the shallow ground to hot water and hot rock found a few miles beneath the Earth's surface, and down even deeper to the extremely high temperatures of molten rock called magma.

Almost everywhere, the shallow ground or upper 10 feet of the Earth's surface maintains a nearly constant temperature between 50° and 60°F (10° and 16°C). Geothermal heat pumps can tap into this resource to heat and cool buildings. A geothermal heat pump system consists of a heat pump,

an air delivery system (ductwork), and a heat exchanger-a system of pipes buried in the shallow ground near the building. In the winter, the heat pump removes heat from the heat exchanger and pumps it into the indoor air delivery system. In the summer, the process is reversed, and the heat pump moves heat from the indoor air into the heat exchanger. The heat removed from the indoor air during the summer can also be used to provide a free source of hot water.

In the United States, most geothermal reservoirs of hot water are located in the western states, Alaska, and Hawaii. Wells can be drilled into underground reservoirs for the generation of electricity. Some geothermal power plants use the steam from a reservoir to power a turbine/generator, while others use the hot water to boil a working fluid that vaporizes and then turns a turbine. Hot water near the surface of Earth can be used directly for heat. Direct-use applications include heating buildings, growing plants in greenhouses, drying crops, heating water at fish farms, and several industrial processes such as pasteurizing milk.

Hot dry rock resources occur at depths of 3 to 5 miles everywhere beneath the Earth's surface and at lesser depths in certain areas. Access to these resources involves injecting cold water down one well, circulating it through hot fractured rock, and drawing off the heated water from another well. Currently, there are no commercial applications of this technology. Existing technology also does not yet allow recovery of heat directly from magma, the very deep and most powerful resource of geothermal energy.

Hydroelectric Energy

Worldwide, hydropower is one of the commonly used forms of renewable energy and one of the oldest energy sources. Its major application is in generating electricity and its main benefit is that it produces no direct waste.

Hydroelectric energy refers to an alternative energy resulting from the hydrologic cycle of water. It is the force behind the generation of power through the use of falling water- gravitational force. The flow or fall of water determines the amount of available energy. It is important to understand that a big river with fast flowing water can provide a huge amount of energy in the same way that water that falls rapidly from a high position such as the water falls carries a great

amount of energy.

Hydroelectric Energy Uses

This form of energy mainly comes from dammed water that drives a water turbine and generator. Energy produced, however, is dependent on the volume of water as well as on the difference in height between the source and the outflow of water.

Power for high peak demands is usually provided by pumped storage hydroelectricity. Moving water between reservoirs at different elevations is instrumental in producing power. When electricity needs are low, water is pumped into the higher reservoir and when demand rises again, water is released back into the lower reservoir via the turbine.

Apart from supplying power to public electricity networks, hydroelectric projects are also utilized in certain industrial enterprises. For instance, they provide electricity to aluminum electrolytic plants such as those found in the Scottish Highlands, in the U.S. (Bellingham, Washington), Suriname, Iceland and New Zealand.

Hydroelectric power plants can either be large scale or small scale. The small hydro plants that supply up to 10 megawatts of electricity are ideal for irrigation and flood control. They are common in China which has more than half of the world small hydro capacity.

Pros and cons of Hydroelectricity

With hydroelectricity, use of fuel is totally eliminated. This being so, the operating cost of hydroelectric plants is not affected by the rising cost of fossil fuels.

A big advantage of hydropower is the absence of waste products when used in electricity generation. And since it does not produce harmful elements, it does not cause pollution in water and in the air.

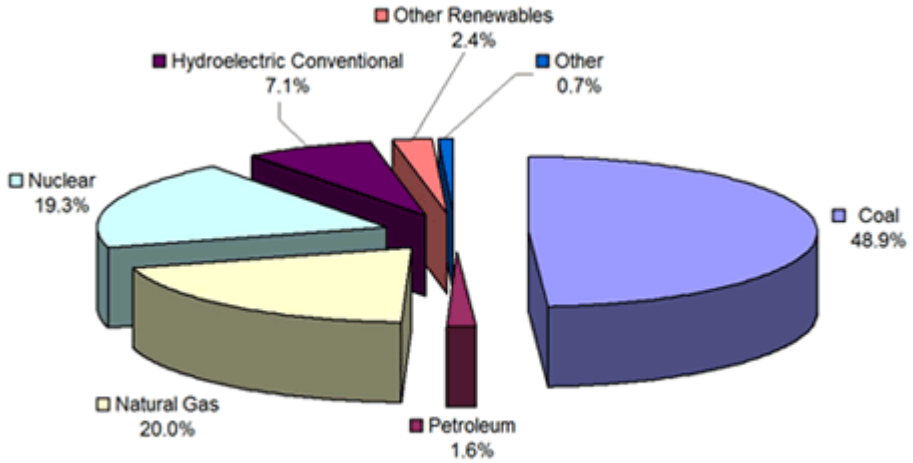
This type of power plant is also seen to be more durable compared to one that uses fuel. In fact, some hydroelectric plants have been in existence for 50 to 100 years already.

Cost of labor is also low for this power plant because it is normally automated with a need for only a few people on site during operation. Construction may entail low cost as well thereby offsetting the costs of operating a dam that serves a variety of purposes.

On the other side of the coin, hydroelectric projects have a tendency to affect the surrounding ecosystems. Dams, for example, have been found to reduce fish population. In addition, hydropower can change the downstream river environment.
Another concern is the emission of methane and carbon dioxide in power plant reservoirs located in tropical areas.

Hydroelectric power must be one of the oldest methods of producing power. No doubt, Jack the Caveman stuck some sturdy leaves on a pole and put it in a moving stream. The water would spin the pole that crushed grain to make their delicious, low-fat prehistoric bran muffins. People have used moving water to help them in their work throughout history, and modern people make great use of moving water to produce electricity.

Hydroelectric power for the Nation



Sources of electricity in the USA 2006. Data from
http://www.eia.doe.gov/cneaf/electricity/epa/epat1p1.html

Although most energy in the United States is produced by fossil-fuel and nuclear power plants, hydroelectricity is still important to the Nation, as about 7 percent of total power is produced by hydroelectric plants. Nowadays, huge power generators are placed inside dams. Water flowing through the dams spin turbine blades (made out of metal instead of leaves) which are connected to generators. Power is produced and is sent to homes and businesses.

World distribution of hydropower

- Hydropower is the most important and widely-used renewable source of energy.
- Hydropower represents 19% of total electricity production.
- China is the largest producer of hydroelectricity, followed by Canada, Brazil, and the United States.
- Approximately two-thirds of the economically feasible potential remains to be developed. Untapped hydro resources are still abundant in Latin America, Central Africa, India and China.

Advantages to hydroelectric power:

- Fuel is not burned so there is minimal pollution
- Water to run the power plant is provided free by nature
- Hydropower plays a major role in reducing greenhouse gas emissions
- Relatively low operations and maintenance costs
- The technology is reliable and proven over time
- It's renewable - rainfall renews the water in the reservoir, so the fuel is almost always there

Disadvantages to power plants that use coal, oil, and gas fuel:

- They use up valuable and limited natural resources
- They can produce a lot of pollution
- Companies have to dig up the Earth or drill wells to get the coal, oil, and gas
- For nuclear power plants there are waste-disposal problems

Hydroelectric power is not perfect, though, and does have some disadvantages:

- High investment costs
- Hydrology dependent (precipitation)
- In some cases, inundation of land and wildlife habitat
- In some cases, loss or modification of fish habitat
- Fish entrainment or passage restriction
- In some cases, changes in reservoir and stream water quality
- In some cases, displacement of local populations

Hydropower and the Environment

Hydropower is nonpolluting, but does have environmental impacts

Hydropower does not pollute the water or the air. However, hydropower facilities can have large environmental impacts by changing the environment and affecting land use, homes, and natural habitats in the dam area.

Most hydroelectric power plants have a dam and a reservoir. These structures may obstruct fish migration and affect their populations. Operating a hydroelectric power plant may also change the water temperature and the river's flow. These changes may harm native plants and animals in the river and on land. Reservoirs may cover people's homes, important natural areas, agricultural land, and archeological sites. So building dams can require relocating people. Methane, a strong greenhouse gas, may also form in some reservoirs and be emitted to the atmosphere.

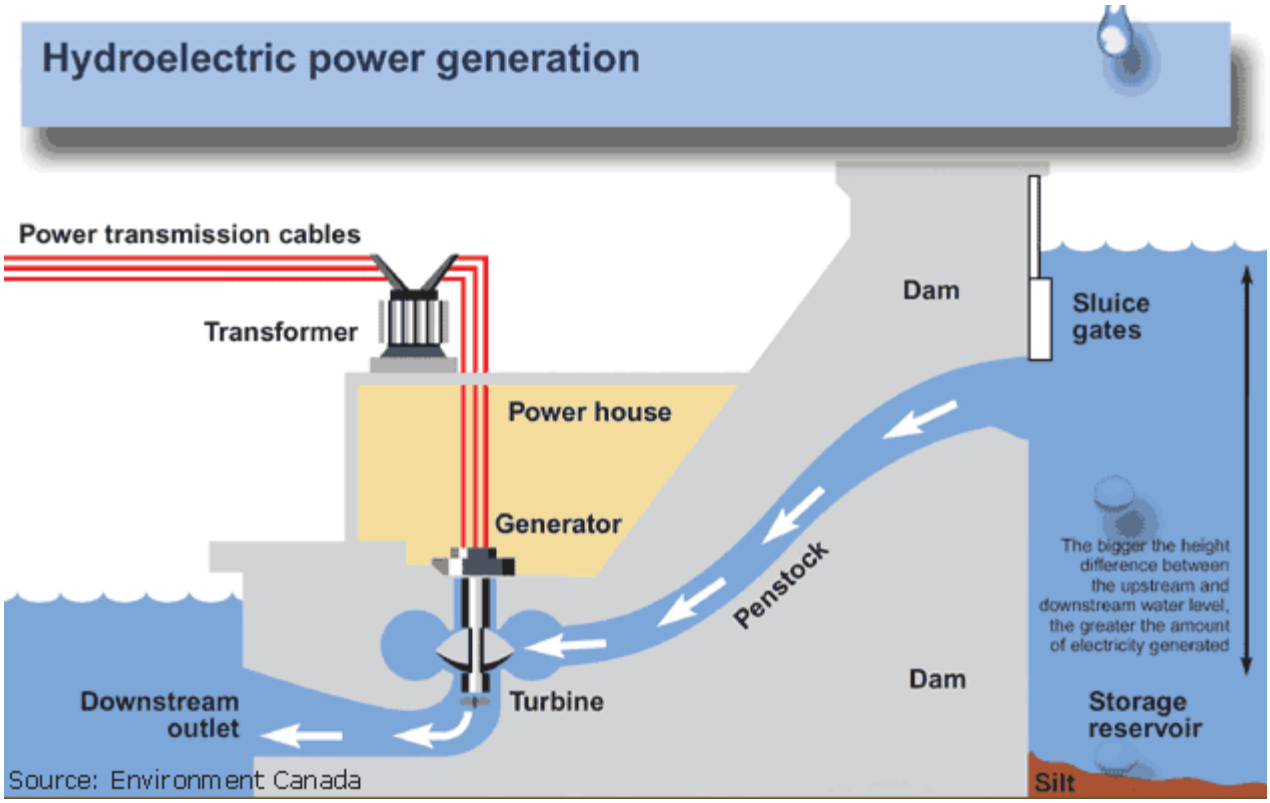
Gosh, hydroelectric power sounds great -- so why don't we use it to produce all of our power? Mainly because you need lots of water and a lot of land where you can build a dam and reservoir, which all takes a LOT of money, time, and construction. In fact, most of the good spots to locate hydro plants have already been taken. In the early part of the century hydroelectric plants supplied a bit less than one-half of the nation's power, but the number is down to about 10 percent today. The trend for the future will probably be to build small-scale hydro plants that can generate electricity for a single community.

As this chart shows, the construction of surface reservoirs has slowed considerably in recent years. In the

middle of the 20th Century, when urbanization was occuring at a rapid rate, many reservoirs were constructed to serve peoples' rising demand for water and power. Since about 1980, the rate of reservoir construction has slowed considerably.

Typical hydroelectric powerplant

Hydroelectric energy is produced by the force of falling water. The capacity to produce this energy is dependent on both the available flow and the height from which it falls. Building up behind a high dam, water accumulates potential energy. This is transformed into mechanical energy when the water rushes down the sluice and strikes the rotary blades of turbine. The turbine's rotation spins electromagnets which generate current in stationary coils of wire. Finally, the current is put through a transformer where the voltage is increased for long distance transmission over power lines.

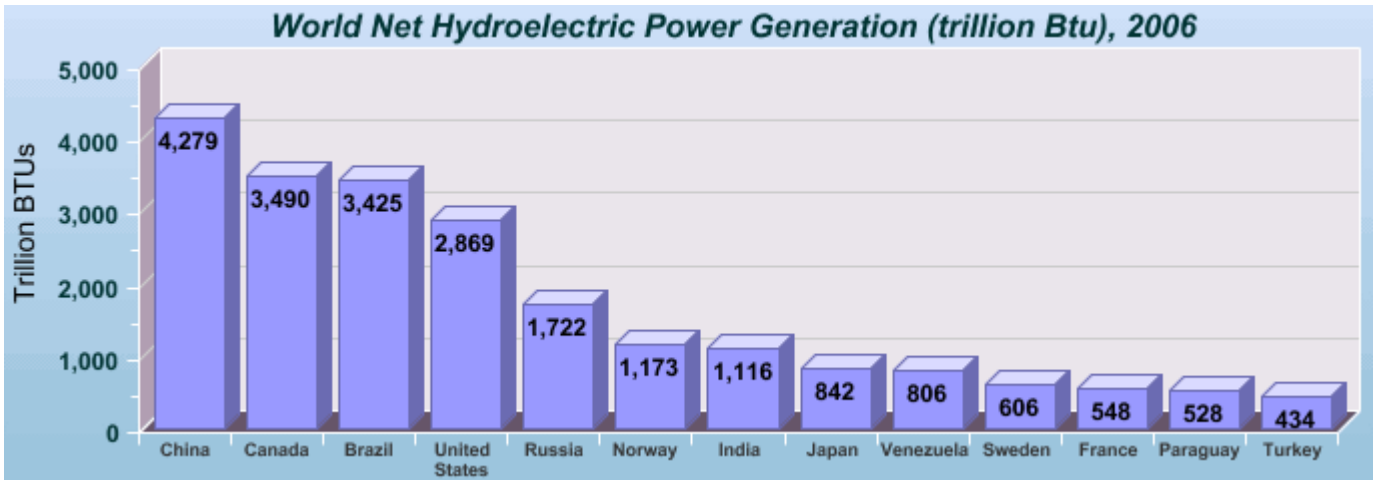


Hydroelectric-power production in the United States and the world

As this chart shows, in the United States, most states make some use of hydroelectric power, although, as

you can expect, states with low topographical relief, such as Florida and Kansas, produce very little hydroelectric power. But some states, such as Idaho, Washington, and Oregon use hydroelectricity as their main power source. in 1995, all of Idaho's power came from hydroelectric plants.

The second chart shows hydroelectric power generation in 2006 for the leading hydroelectric-generating countries in the world. China has developed large hydroelectric facilities in the last decade and now lead the world in hydroelectricity usage. But, from north to south and from east to west, countries all over the world make use of hydroelectricity—the main ingredients are a large river and a drop in elevation.



Degree UG
Branch BE
Subject Environmental Science and Engineering
Unit I Planet Earth
Type

Questions	opt1	opt2	opt3	opt4	answer
The science which deals with study of environment is called	Environmental science	Geology	Ecology	Pedacology	Environmental science
The living component of environment is called	Biotic	Abiotic	Lithosphere	Energy	Biotic
Which among of the following is an abiotic component----------	Soil	Fungi	cat	birds	Soil
Which of the following is a layer of the atmosphere?	Angiosphere	Gymnosphere	Stratosphere	Pycnosphere.	Stratosphere
What level of the atmosphere occurs at the highest altitude?	Ozone	Stratosphere	Mesosphere	Troposphere	Mesosphere
Which atmospheric layer is largely responsible for absorbing most of the sun's Ultra Violet radiation?	Troposphere	Cumulus cloud	Strato nimbus	Ozone.	Ozone.
Which of the following atmospheric layer helps in the transmission of Radio waves?	Troposphere	Stratosphere	Mesosphere	Thermosphere	Thermosphere
The lithosphere is	Located below the ionosphere	The crust and top part of the mantle	Roughly 5 to 20 km thick	Core part of the earth	The crust and top part of the mantle
The biosphere is the area where	Living organisms exist	Water exist	Soil & rocks exist	Lithosphere	Living organisms exist
The part of earth, upwards at least to a height of 10 Km is _____.	Atmosphere	Biosphere	Hydrosphere	Lithiosphere	Biosphere
Part of earth surrounding up to nearly 500 Km above from earth's surface is _____.	Atmosphere	Biosphere	Hydrosphere	Lithiosphere	Atmosphere
Region 20 - 40 Km above earth's surface is _____.	Atmosphere	Biosphere	Environment	Ozonosphere	Ozonosphere
Region at about 40 – 100 Km above earth's surface which contains charged particles is called as _____.	Ozonosphere	Ionosphere	Charge sphere	Atmosphere	Ionosphere
Layer which absorbs harmful UV radiations falling on earth from sun is known as _____.	Ionosphere	Environment	Ozonosphere	Atmosphere	Ozonosphere
A major burden of air pollution is carried by	Troposphere	Stratosphere	Thermosphere	Ionosphere	Troposphere
When carbon monoxide is inhaled, it causes	Skin cancer	Hemoglobin inactive	Greenhouse effect	Cancer	Hemoglobin inactive
CO has more affinity for haemoglobin --------- times more than oxgyen	210	50	100	25	210
The main pollutants emitted from thermal power stations are	Fly ash and sulphur dioxide	Water	Chlorine	Iodine	Fly ash and sulphur dioxide
Which of the following produces another air pollutant by reacting with oxides of Nitrogen in presence of sunlight?	HCl	SO_2	O_3	HCN gas.	O_3
If the amount of human produced carbon dioxide being absorbed into the oceans gets High enough, the ocean's to,layer may become increasingly	Acidic	Basic	Neutral	Slightly acidic	Acidic
Very toxic gas which cause headache, visual difficulty, paralysis and even death in human being is		CO2	O3	CO	CO
Which of the following hydrocarbon, is released by the breakdown of organic matter and the carbonization of coal?	Methane	Silicon	Graphite	Sulphur	Methane
Most dangerous pollutant emitted in air during incomplete combustion of fuels is _____	. CO	CO2	NO2	CH4	CO

Colorless, odorless, non corrosive air pollutant is	SO2	CO	CO2	O3	O3
An increase in number or size of dust particle in air leads to warming because such particles	Increase moisture in air	Scatter only blue light	Scatter all kind of light	Are very cold	Scatter all kind of light
Which among the following is a secondary pollutant?	Nitrous oxide	Carbon monoxide	Ozone	SO_2.	Ozone
Which of the following is the major individual primary pollutant emitted by automobile exhausts?	NO_x	SO_2	CO	O_3	CO
Carbogen is a mixture of	O_2 and CO_2	O_2 and CO	O_2 and Cl_2	O_2 and He.	O_2 and CO_2
Mercury is emitted into air by	Burning coal	Burning garbage	Coal fire	Thermometer usage and disposal.	Thermometer usage and disposal.
Bhopal gas tragedy in 1984 was caused by	Carbonyl chloride	Carbon monoxide	Methyl cyanide	Methyl isocyanate	Methyl isocyanate.
The single largest source of air pollution in Calcutta is	Jute mills	Thermal power plants	Garbage bins	Automobile exhaust gases.	Jute mills
Which of these atmospheric pollutants is not released by car exhausts?	Carbon Monoxide	Carbon dioxide	Magnesium Oxide	Lead oxide	Magnesium Oxide
The most important indoor air pollutant is	SO_2	CO_2	NO_2	Radon gas	Radon gas
An example of gaseous air pollutants_____	Mist	Lead	Arsenic	SO_2	SO_2
SO_2 is	released from coal burnings.	a primary pollutant	causing asthma	All of these	All of these
Atmospheric pollutants from volcanic eruptions affect	Only insects and plants	All living organisms worldwide	Only humans living at the base of the mountain	Polar climates only.	All living organisms worldwide
Which one of the following gases has maximum contribution to green house effect	CO_2	CH_4	N_2O	Lead oxide	CO_2
Green house gases are	Hypothetical	Measurable	Mostly made up of argon	Immeasurable.	Measurable
Nitrogen dioxide, which gives the sky that yellow-brown look, is also known as	The Aurora Borealis	Smog	Sleet	Turbidity.	Smog
Which of the following are greenhouse gases?	N_2O	Water vapour	Chlorine	Iodine	N_2O
Green house effect is caused by	CO_2	CH_4	N_2O	All of these	All of these
Which of the following is not a green house gas?	CO_2	CFC's	CO	Water vapour.	CO
What percentage of total green house gases comes from carbon dioxide	30%	55%	70%	90%	55%
The cattle, sheep and termites are responsible for the release of which of the following gas?	CH_4	N_2O	CO_2	NO	CH_4
The greenhouse effect is where	Heat energy is trapped by the atmosphere	Too many buildings are built from glass	Solar panels are attached to the roofs of houses	Water is getting adsorbed	Heat energy is trapped by the atmosphere
Global warming will not result in:	Melting of the ice caps	Increasing sea levels	Increasing the size of the hole in the ozone layer	Unpredictable climate patterns	Increasing the size of the hole in the ozone layer
Ozone concentration is measured by	Flame photometer	Dobson's spectrometer	Jackson's turbidometer	Calorimeter	Dobson's spectrometer
The maximum depletion of ozone occurs above the	Equator	Artic	Andartic	Temperate region	Andartic
In the stratosphere, ozone is an effective filter capable of absorbing Ultraviolet radiation with wavelengths between	200 – 315 nm	315 – 400 nm	100 – 150 nm	400 – 600 nm.	200 – 315 nm

The presence of which of the following gases in air checks the Ultraviolet light from sunlight.	SO_2	O_3	CO_2	NO	O_3
Which one of the following can cause depletion of ozone?	H_2S	CH_4	Smoke	CFC	CFC
Chlorofluorocarbons rise to the stratosphere and	react directly with stratospheric ozone to destroy it.	after interacting with UV energy, become free radicals, which destroy ozone.	become free radicals that react with oxygen to create ozone.	react with free radicals to remove carbon dioxide.	after interacting with UV energy, become free radicals, which destroy ozone.
Ozone concentration is measured in --------- units	Dobson	ppm	mgs	gms	Dobson
Holes in the ozone layer are thought to have been caused by:	Space exploration	CFC's	Methane	Carbon dioxide	CFC's
Smog is a mixture of -------	Smoke and hydrocarbons	Smoke and fly ash	Smoke and fog	Smoke and dust	Smoke and fog
Which of the following is a constituent of photochemical smog?	N_2O_5	PAN	N_2O_3	CO	PAN
Photochemical smog is formed by combination of nitrogen oxide and _____.	Hydrocarbons	Smoke	Fog	SO2	Hydrocarbons
Acid rain is cause of---------	Oxides of N and S	Oxides of C and O	Oxides of C	Chlorides	Oxides of N and S
Air pollutants mixing up with rain can cause	High acidity	Low acidity	Neutral condition	High alkaline	High acidity
The atmospheric emission of nitrogen oxides and---------- leads to acid rain	Sulphuric oxides	Lead	Mercury	Lead oxide	Sulphuric oxides

Degree UG
Branch BE
Subject Environmental Science and Engineering
Unit II- Hydrosphere

Questions	opt1	opt2	opt3	opt4	answer
What percentage of water covers the earth's surface?	40%	50%	75%	88 %.	75%
What percentage of total water is stored as fresh water in glaciers and icecaps, ground water, lakes, rivers and soil	1%	3%	5%	10 %.	3%
Water found on the surface of earth	Surface water	Underground water	Brackish water	Saline water	Surface water
Percapita use of water is highest in	USA	India	Kuwait	Indonesia	USA
Water found deep inside the earth surface	Surface water	Underground water	Brackish water	Saline water	Underground water
The layer closest to the surface, where spaces between soil particles are filled with both air and water, is called the	Zone of hydration	Zone of aeration	Zone of acclimation	Zone of precipitation	Zone of aeration
When water changes from a liquid to a gas or vapour, it is called	Aeration	Precipitation	Evaporation	Sublimation.	Evaporation
The Earth is called 'Blue Planet'. Because	It receives much of blue colour from sun light	It contains 75% of water	Blue-green algae is the first living organism appeared on the earth.	It contains soil	It contains 75% of water
A balanced , continuous, natural process of cyclic movement of water throughout the environmental segments is	Atmospheric cycle	Hydrological cycle	Geological cycle	climatic cycle	Hydrological cycle
The process of evaporation of water from leaves of plants is	Transpiration	Respiration	Evaporation	Condensation	Transpiration
A layer of sediment or rock that is highly permeable and contains water is called	Aquifer	Non-aquifers	Storage place	Ground subsidence	Aquifer
Aquifers which are overlaid by permeable earth material and are recharged by seeping water are called ------- aquifer	Confined aquifer	Unconfined aquifer	Waershed	Pit	Unconfined aquifer
Aquifers which are sandwiched between two impermeable layers of rocks or sediments are called ------ aquifers	Confined aquifer	Unconfined aquifer	Waershed	Pit	Confined aquifer
Ground subsidence occurs due to	withdrawal of more ground water than its recharge	equal rates of recharge and withdrawal	more recharge of groundwater than its withdrawal	Recharge of water	withdrawal of more ground water than its recharge
Excessive irrigation with brackish water causes	Lowering of water table	subsidence	salinity	Evaporation	salinity
In- filtration takes place when	Rainfall soaks into the ground	Deserts get drier and drier	Plants use water during photosynthesis	Food is absorbed by the stomach.	Rainfall soaks into the ground
The management of rainfall and resultant runoff is called	Watershed	Dam	River	Lake	Watershed
Which one of the following method is used to raise the underground water level	Rainwater harvesting	Watershed	Both rain water harvesting and Watershed	Land degradation	Both rain water harvesting and Watershed
A drainage basin with a well defined topographic boundary and one water outlet is known as _____	Watershed	Dam	River	Lake	Watershed

Which one of the following chemical is added to wastewater during coagulation?	Alum	Carbon	Sodium	Polonium.	Alum
Aerobic oxidation is caused by	Aerobic bacteria in presence of excess of oxygen	Anaerobic bacteria in presence of insufficient oxygen	Aerobic bacteria in presence of absence of oxygen	Both aerobic and anaerobic bacteria in any condition	Aerobic bacteria in presence of excess of oxygen
Trickling filter process of sewage treatment is a _____ treatment process.	Primary	secondary	tertiary	Quaternary	secondary
The chemical used in primary treatment of sewage water treatment	Aluminium sulphate	Water	Sodium chloride	Potassium iodide	Aluminium sulphate
The chemical used in sterilising water	Chlorine	Water	Ammonium carbonate	Sodium carbonate	Chlorine
Marine pollution is mostly caused in the open ocean due to	Oil spills	River discharge	Coastal industries	Municipal waste water discharge	Oil spills
The pollutants discharged from specific site are called	Point source	Non point source	BOD	COD	Point source
An example for non point source of water pollution	Surface runoff	Industry	Household waste water	Dye waste	Surface runoff
Municipalities, industries and agriculture are all sources of	Cranberries	Water pollution	Landscaping materials	Graphite.	Water pollution
Oil in water affects fish by affecting	Gills	Scales	Eyes	Mouth	Gills
Which of the following does not cause water pollution	Agricultural runoff	Land deforested and developed	Natural, extremely deep underground aquifers	Sudden or ongoing, accidental or deliberate, discharge of a polluting material	Natural, extremely deep underground aquifers
Blue baby syndrome is caused by contamination of water due to	Phosphates	sulphate	arsenic	Nitrates	Nitrates
Most poisonous pollutant in water is	Zinc	Phosphate	Arsenic	Carbon dioxide	Arsenic
Aerobic oxidation takes place in	Stale sewage	Septic sewage	Rain water	Water	Septic sewage
A river with high BOD value indicates	River is highly polluted	Highly clean	Non polluted	Non hazardous	River is highly polluted
Lead in water can cause	Eye disease	Arthritis	Kidney damage	Hair falling.	Kidney damage
Activated sludge process of sewage treatment is a _____ treatment process.	Primary	Secondary	Tertiary	Quaternary	Secondary
Bacteriological pollution of water is due to the presence of	Pathogenic bacteria	Pathogenic protozoa	Viruses	All micro organisms	All micro organisms
Excessive addition of nitrates and phosphates into water bodies cause ---------	Eutrophication	Putrification	Sterilization	Sedimentation	Eutrophication
Porous water- saturated layers of underground rock are known as	Recharge areas	Aquifers	Watersheds	Runoff areas	Aquifers
Temperature is of great significance to biological processes in controlling	Digestion	Respiratory rates	Excretion	Transpiration	All of these
The progressive accumulation of Non-biodegradable chemicals in the food chain is called	Biomagnification	Biological degradation	Eutrophication	Ecological balance	Biomagnification
The progressive accumulation of organomercurials in the body of higher organisms	Bioamplification	Biological degradation	Eutrophication	Ecological balance	Bioamplification

Minimata disease is caused by	Organomercurial compounds	DDT	BHC	Chlorine	Organomercurial compounds
Clay is an example of	Aquifers	Non-aquifers	Storage place	Land surface	Non-aquifers
Which of the following is a point source of pollution?	Acid deposition	Urban streets	Oil tanker	Suburban lawns	Oil tanker
Which of the following is an important marker of a river's ability to support aquatic life?	Carbon tetra fluoride	Dissolved oxygen	Free nitrogen	Not many fisherman	Dissolved oxygen
The dissolved oxygen level in water can be measured by	Winkler's method	Photon method	Desalination method	In-filtration method	Winkler's method
The ingrease in amount of oxgyen demanding waste -------- DO value	Increases	Decreases	Remains same	Constant	Increases
The oxidation of organic impurities in water in measuring COD is done by	Microorganisms	Potassium dichromate	Sodium chloride	Potassium chloride	Potassium dichromate
The slow or sudden movement of rock down slope as a result of gravity is called	Intrusion	Topography	Extrusion	Land slide	Land slide
Sudden movements of soil or rock that occur when the upper layers separate from the underlying rock and involve one distinct sliding surface are called _____.	Mass movement	Horizon	Weathering	Landslides	Landslides
An example for natural disaster	Earthquake	Bomb blast	Automobile fire	Pollution	Earthquake
Man made disaster is----------	Earthquake	Bomb blast	Tsunami	Cyclone	Bomb blast
Heavy amount of rainfall due to cyclone may tresult in	Landslides	Tsunami	Earthquake	Bomb blast	Landslides
Which one of following enhance the frequency of earthquake	Underground nuclear testing	Fire accidents	Automobiles	Deporestation	Underground nuclear testing
When coherent rocks of soil masses move downslope---------- occurs	Landslides	Earthquake	Tsunami	Cyclones	Landslides
Earthquake is measured in	Richter scale	ppm	mg/L	no unit	Richter scale
Whenever the magnitude of earthquake is higher ------- occurs	Landslides	Earthquake	Tsunami	Cyclones	Tsunami
The point Where the first movement occurs during earthquake	Epicenter	Radius	Tsunami	Curvature	Epicenter
Which among the following is the form of cyclone	Hurricanes	Watershed	Tsunami	Floods	Hurricanes

Degree UG
Branch BE
Subject Environmental Science and Engineering
Unit III Lithosphere

Questions	opt1	opt2	opt3	opt4	answer
A thick solid zone called _____ surrounds the core	The core	The mantle	The crust	None.	The mantle
The lithosphere is	Located below the ionosphere	The crust and top part of the mantle	Roughly 5 to 20 km thick	Core part of the earth	The crust and top part of the mantle
Which of the following is physical weathering?	oxidation	hydrolysis	frost wedging	dissolution	frost wedging
Water is an important weathering agent in the case of	Thermal weathering	Freeze thaw weathering	Dissolution weathering	Pressure release weathering.	Freeze thaw weathering
The breakdown of large rocks into smaller bits that have the same chemical and mineralogical makeup is called	Rotational weathering	Mechanical weathering	Chemical weathering	Gravel.	Mechanical weathering
The balance of weathering, subduction and volcanism controls	Atmospheric carbon dioxide concentrations over geologic time	The formation of cumulonimbus clouds in the winter	The duration of the summer solstice	Stock prices.	Atmospheric carbon dioxide concentrations over geologic time
Chemical weathering is not due to	Acid action	Hydrolysis	Intoxication	Oxidation	Intoxication
The most important natural acid formed when carbon dioxide dissolves in water is called	Acetic acid	Carbonic acid	Hydrochloric acid	Ascorbic acid	Carbonic acid
What physical weathering type is an important rock breaking force in wet climates?	Laterite	Biological decay	Frost wedging	Typhoons.	Frost wedging
Alternate freezing and thawing of water causes	cracks	frost wedging	oxidation	hydrolysis	frost wedging
Depending on composition and texture, weathering that occurs at different rates in the same geographical region is known as	Drought	Sequential weathering	Differential weathering	Global warming	Differential weathering
When rock disintegrates and is removed from the surface of continents, it is	An eruption	Denudation	Shedding	Lithification	Denudation
Quartz is an example for	Igneous rocks	Sedimentary rocks	Metamorphic rocks	hard rocks	Igneous rocks
When plant roots grow into rock fissures to reach collected soil and moisture, it is known as	Recreational weathering	Biological weathering	Zoological weathering	Desertification	Biological weathering
The Science which deals with the study of soil is called	Ecology	Zoology	Pathology	Pedology	Pedology
The soil found in dry or semi-arid climates with little organic matter and little to no leaching of minerals is called	Pedocal	Pedalfer	Laterite	Muck	Pedocal
Which of the following soil is the best for plant growth	Clay	Sandy soil	Gravel	Loamy soil	Loamy soil
A reddish-brown-to-white layer found in many desert soils is called	Rojo	Desert dung	Caliche	Caliente.	Caliche
The removal of topmost layer of soil is called	soil erosion	desertification	deforestation	disintegration	soil erosion

Wide destruction of native vegetation across the planet has increased	Soil exposure and erosion	The number of scenic vacation spots	Oxygen levels in homes	Volcanic eruptions	Soil exposure and erosion
Wind erosion blows sand grains in a series of skipping movements called	Tai chi	Vegetation	Blasting	Saltation.	Saltation.
Which following is water induced soil erosion?	Rill erosion	Saltation	Suspension	Contour farming	Rill erosion
Excessive grazing of grassland by livestock and cattle is known as	Overgrazing	Deforestation	Afforestation	Biodiversity.	Overgrazing
Over grazing results in	Protective soils	Soil erosion	Retention of useful species	Landslides	Soil erosion
To slow or stop erosion, farmers use all of the following methods except	Water diversion and control	Proper crop maintenance and rotation	Overgrazing and frequent tilling	Local holding ponds and dams	Overgrazing and frequent tilling
Water logging is not associated with----------	Salinity	Excessive irrigation	Reduction in plant growth	watershed	watershed
Forests prevent soil erosion by binding soil particles in their	Leaves	Roots	Buds	Stems	Roots
Minimum disturbance is cause to soil during	Contour farming	No-till farming	Terrace farming	Alley cropping No-till farming	
Sudden movements of soil or rock that occur when the upper layers separate from the underlying rock and involve one distinct sliding surface are called _____.	Mass movement	Horizon	Weathering	Landslides	Landslides
Deserts day time temperatures can go up to	32°C	45°C	57°C	62°C.	57°C
Ancient sand deserts are called	Paleodeserts	Old dunes	Bad picnic spots	Beaches.	Paleodeserts
Halophytes are	Angels	Animals that can see in the dark	Plants that are able to tolerate extremely high levels of salts	Fish that are bioluminescent	Plants that are able to tolerate extremely high levels of salts
A fertile, green place in a sandy desert containing a spring, well, or irrigation is called	An ice cap	A neutral zone	An oasis	A deciduous forest.	An oasis
Atacama desert is the example of	Hot desert	Coastal desert	Trade wind desert	Cold desert	Coastal desert
Desert plants that adjust to high salt levels are known as	Shrubberies	Neophytes	Geophytes	Halophytes	Halophytes
Loss of fertility of soil is	desertification	land degradation	deforestation	disintegration	land degradation
Deforestation, overgrazing and bad irrigation practices are all factors that contribute to	Juvenile delinquency	Desertification	Glacier formation	Metamorphism.	Desertification
Which of the following isnot responsible for desertification?	Deforestation	Over grazing	Mining	Afforestation	Afforestation
Extensive planting of trees to increase cover is called	Afforestation	Agroforestation	Deforestation	Social forestry	Afforestation
Deforestation generally decreases	Rainfall	Soil erosion	Draught	Global warming	Rainfall
Which of the following is not responsible for desertification?	Deforestation	Mining	Overgrazing	Afforestation	Afforestation
Over planting, overgrazing, deforestation and poor irrigation methods are all factors that can lead to	Earthquakes	Tsunamis	Desertification	Fossilization.	Desertification
Which of the following is not the effect of modern agriculture?	Nitrate pollution	Eutrophication	Biomagnification	Ozone depletion	Ozone depletion

_____ is known as the building block of life and is the foundational element of all organic substances	Carbon	Nitrogen	Phosphorus	Sulphur.	Carbon
Nitrogen fixation can be done by	Chemical method	Mechanical method	Bacteria	Viruses	Bacteria
Most abundant element on the earth is	Oxygen	Aluminium	Nitrogen	Silicon	Nitrogen
Biological, Chemical and radioactive are three major classes of	Hazardous waste	Solar energy.	Sedimentary rock	Facial peels	Hazardous waste
Hazardous and toxic chemicals are generated by all of the following except	Households	Sand dunes	Agriculture	Industries	Sand dunes
Municipal solid waste is an example of	Non-hazardous waste	Chemical waste	Hazardous waste	Bioactive	Non-hazardous waste
Toxic chemicals are	Highly inflammable	Damaging the skin	Spoil the health when consumed	Cures diseases	Spoil the health when consumed
When solid waste does not pose a threat to the environment or to human health it is classified as	Hazardous waste	Fluid waste	Non-hazardous waste	Transuranic waste	Non-hazardous waste
Disposal of waste materials by burning is called	sanitary fill	incineration	dumping	composting	incineration
Highly flammable, corrosive, reactive or toxic wastes are considered	Non-hazardous	Low priority	Hazardous	Lively.	Hazardous
Molecules broken down into simpler elements by microorganisms are said to be	Quantum strings	Biodegradable	Inorganic esters	Buckyballs	Biodegradable
In order to make garbage disposal costs fair, some municipal areas have	Higher taxes	Mobile landfill facilities	“Pay-as-you-throw” policies	Larger trash cans	Pay-as-you-throw” policies
These types of waste are responsible for the highest radioactive danger found in high level wastes after a thousand years	Silicate	Transuranic	Biological	Landfill	Transuranic
Nuclear waste comes from all of the following sources except	Hair salons	Nuclear reactor byproducts	Research facilities	Hospitals.	Hair salons
The dangers of disposing of toxic chemicals underground came to public attention in which of the following locations?	Bhopal, India	Chernobyl, Ukraine	Love Canal, New York	Minamata, Japan	Love Canal, New York
Vermicompost is done with	aerobic bacteria	anaerobic bacteria	earthworm and air	air	earthworm and air
The popular slogan of environmental conservation is	Chop, slash and burn	Location, location, location.	All pesticides all the time	Reduce, reuse and recycle	Reduce, reuse and recycle

Degree UG
Branch BE
Subject Environmental Science and Engineering
Unit IV- Biosphere

Questions	opt1	opt2	opt3	opt4	answer
A complex community of plants, animals and microorganisms linked by energy and nutrient flow is called an	Aquarium	Equilateral atoll	Ecosystem	Alternate dimension.	Ecosystem
The part of earth, upwards at least to a height of 10 km is	Atmosphere	Biosphere	Hydrosphere	stratosphere	Biosphere
The biosphere is the area where	Living organisms exist	Water exist	Soil & rocks exist	None of these.	Living organisms exist
Fungi is an example of	Producers	primary consumers	secondary consumers	Decomposers	Decomposers
Extinct species are those which	exist in large numbers	exist in few numbers	did not exist recently	did not exist for the past 50 years	did not exist for the past 50 years
Which of the following ecosystem helps in flood control by absorbing high flow and releasing water slowly?	High plains	Wetlands	Arctic	Rocky mountains.	Wetlands
When unique plant or animal species naturally occur in only one area or region, they are said to be	Exotic	Adventitious	Epidemic	Endemic	Endemic.
What is the primary cause of declining biodiversity?	Increase of mating pairs	Habitat loss	A hole in ozone	Pesticides.	Habitat loss
Which of the following is considered one of the world's "hottest of hotspots"?	Sicily	Melbourne, Australia	The Atlantic Forest	The Himalaya Mountains	The Atlantic Forest
A group of biotic communities of species interacting with one another and with their non- Living environment, exchanging energy and matter is known as	Ecosystem	Biodiversity	Habitat	Wetland.	Ecosystem
The variety and variability among all groups of living organisms and the ecosystem Complexes in which they occur is called as	Ecosystem	Biodiversity	Habitat	Wetland	Biodiversity
Western-Ghats are very rich in endemic species of	Birds	Lions	Amphibians	Mollusks	Amphibians
Which of the following is an endemic species of India?	Asian elephant	Lion-tailed macaque	Whale	Panda	Lion-tailed macaque
Which of the following is an in-situ conservation measure taken by India?	Project Elephant	Project Lion	Project Rhino	All of these	Project Elephant
Who introduced the term biodiversity hotspot?	Christopher Columbus	Norman Myers	WWF	Charles Darwin.	Norman Myers
Lion-tailed Macaque is found in	Western Ghats	Eastern Ghats	Caucasus	Western Himalaya.	Western Ghats
Which of the following is a cause of loss of biodiversity	Habitat Degradation and Loss	Invasion of non-native species	Pollution	All of these.	All of these.
The dodo was extinct due to	Invasion of non-native species	Over-exploitation of resource	Global environmental change.	Deforestation	Invasion of non-native species
Which of the following is not a biodiversity hotspot?	Brazil's Cerrad	Central Chile	California Floristic Province	Pakistan	Pakistan

Which of the following is a possible producer in an ecosystem?	Autotrops and chemo-autotrophs	Animals	Human beings	Fish	Autotrops and chemo-autotrophs
Which of the following statement is false?	Inorganic nutrients are recycled in an ecosystem.	Energy "flows" through the ecosystem in the form of	Carbon – Carbon bonds.	Respiration process releases energy.	Carbon – Carbon bonds.
A tropic level refers to	Area in the tropics	An organism's position in a food chain	An organism's position in an ecosystem	An organism's position in a biome.	An organism's position in a food chain
A large area with similar flora, fauna and microorganisms is called	Biome	Soil	Air.	Water	Biome
In an aquatic ecosystem phytoplankton can be considered as a	Consumer	Producer	Saprotrophic organisms	Macro consumer	Producer
Which of the following is not a biotic component?	Producers	Consumers	Saprotrophs	Temperature.	Temperature.
The sequence of eating and being eaten in an ecosystem is known as	Food	Poison	Food chain	Food web	Food chain
Energy flow which keeps the ecosystem going. This follows the	Laws of thermodynamics	Faraday's law	Ohm's Law	Newton's law	Laws of thermodynamics
There are only two sanctuaries in India dealing with preservation of plants the plants are	Cinchona – Orchid	Citrus – Pitcher plant	Mango – Citrus	Mango – Pitcher plant.	Citrus – Pitcher plant
The international year of biodiversity is	2010	2009	2003	2000	2010
Which one of the following national park do not have tigers as their main wildlife?	Gir	Corbette	Ranthanbore	Dudwa.	Gir
Which one of the following is not a biogeographic habitat of India as per classification?	Himalayas	Sunderbans	Desert	Western Ghats.	Sunderbans
Which one of the following is an example of ex-situ conservation?	Biosphere Reserve	Gene Bank	Sanctuary	All of these	Gene Bank
Which of the following hotspots of biodiversity has the maximum number of plants and vertebrate species?	Carribean	Madagascar	Tropical Andel	Indo – Burma Eastern Himalayas.	Tropical Andel
Kaziranga national park is famous for	One – Horned rhino	Kangaroo	Tiger	Elephant.	One – Horned rhino
Which of the following is one among the twelve "mega biodiversity" nations	India	Pakistan	China	Sri Lanka	India
Which country has different types of climate and topography?	Pakistan	China	Sri Lanka	India.	India.
India occupies the _____ position among the plant rich nations.	First	Second	Fifth	Tenth.	Tenth.
India ranks ____ position in endemic species of higher vertebrates.	Second	Fourth	Eleventh	Fifteenth.	Eleventh
How many hotspots are found in India?	1	2	3	4	2
Western Ghats is _____ of biodiversity.	Hot spots	Genetic diversity	Structure	Values	Hot spots
The number of species that can be found at a single point in a given space is known as	Point richness	Alpha richness	Beta richness	Gamma richness	Point richness
Species which are restricted only to a particular area are known as	Endangered species	Endemic species	Marine species	vulnerable species	Endemic species
The rate of change in species composition across different habitats is known as	Point richness	Alpha richness	Beta richness	Gamma richness	Beta richness
Areas which exhibit high species richness as well as high species endemism termed as	Hot spots of biodiversity	Mega biodiversity	Threats to biodiversity	Regional biodiversity.	Hot spots of biodiversity

Which of the following is a hot spots of India?	Eastern Himalayas	Western Himalayas	Eastern Ghats	Gangetic plains.	Eastern Himalayas
On a global level, the number of hot spots identified was	2	6	10	12	12
The various threats to biodiversity are	Habitat protection	Poaching of wildlife	Man - Wildlife conflicts	All of these.	All of these
The habitat is divided into small and scattered patches and this phenomenon known as	Loss of habitat	Habitat fragmentation	Habitat integration	Habitat conservation	Habitat fragmentation
Poaching means	Cultivation of plants	Growing of animals	Killing of animals	Cultivation of microorganisms .	Killing of animals
The following is one of the remedial measures to avoid man-wild life conflict	Conservation project	Project Tiger	Gir Lion project	Project Elephant	Conservation project
Which of the following is a true statement?	India has recorded 81,000 species of plant and 47,000	India has recorded 47,000 species of plant and 81,000	Maximum global diversity is found in temperate forest	Biodiversity is richness of plant species only.	India has recorded 47,000 species of plant and 81,000
The number of biosphere reserves in India is	7	80	120	420	7
The number of botanical gardens in India is	7	80	120	420	120
Nilgiri is an example of	Biosphere reserve	National park	Wildlife sanctuary	Botanical garden	Biosphere reserve
An area dedicated for the conservation of wildlife along with its environment is called as	Biosphere reserve	National park	Wildlife sanctuary	Botanical garden	National park
In Northeast India, a gene sanctuary is available for	Coconut	Apple	Citrus	Banana.	Citrus
The chemical used in cryo-preservation of seeds is	Liquid ammonia	Liquid Helium	Liquid mercury	Liquid nitrogen	Liquid nitrogen
Red data book deals about	Endangered species	Endemic species	Rare species	Extinct species.	Endangered species
_____ is the Life blood of Biosphere	water	Milk	Soft drinks	Alcohol	water
When plants and animals are transported to a far distant location, they are known as	Native species	Colourful characters	Non-native species	Contraband.	Non-native species
The over Nourished lakes with Algal blooms are called	Eutrophic	Oligotrophic	Dystrophic	Meromictic	Eutrophic

Degree UG
Branch BE
Subject Environmental Science and Engineering
Unit V- Alternate Energy

Questions	opt1	opt2	opt3	opt4	answer
Which of the following types of coal has maximum carbon and Calorific value?	Anthracite	Bituminous	Lignite	Wood coal	Anthracite
The isotope of uranium that undergoes fission and releases huge amounts of energy is	U190	Pt225	I60	U235.	U235.
Nuclear power is generated using the metal	Copper	Uranium	Mercury	Actinium	Uranium
Identify the non-renewable energy resource from the following	Coal	Fuel cell	Wind Energy	Wave Power	coal
Solar energy can provide electricity for all of the following uses, except	Calculator	Lighting for parking lots	Submarines	Traffic lights	Submarines
Solar panels convert sunlight directly into electricity using silicon-filled	Mood rings	Photovoltaic cells	Rubber balls	Plant cells.	Photovoltaic cells
Photovoltaic energy is the conversion of sunlight into	Chemical energy	Biogas	Electricity	Geothermal energy	chemical energy
Cadmium telluride is a common material used to make	Dark chocolate	Nylon	Clothes hangers	Wafer-thin solar cells	Wafer-thin solar cells
Geothermal reservoirs can reach temperatures of	370°C	560°C	740°C	820°C	370°C
Impoundment, diversion and pumped storage are all types of	Solar cells	Hydroelectric power plants	Dams	Wind turbines	Hydroelectric power plants
Flowing water that creates energy and is turned into electricity is called	Nuclear power	Hydroelectric power	Solar power	Thermal energy.	Hydroelectric power
What force is perpendicular to the lift force of a wind turbine rotor?	Friction	UV radiation	Heat	Fusion.	Friction
Both power and manure is provided by	Nuclear plants	Thermal plants	Biogas plants	Hydroelectric plant	Biogas plants
Horizontal axis and vertical axis are the types of	Nuclear reactor	Wind mills	Biogas reactor	Solar cell	Wind mills
When deep underground heat is transferred by thermal conduction through water to the surface, it is called	Solar energy	Nuclear energy	Wind energy	Geothermal energy	Geothermal energy
Propeller like turbine blades are used to generate electricity from	Sunlight	rain	Wind	Snow.	Wind
Nuclear energy is produced as a result of fission of	Uranium	Copper	Lead	Aluminium	Uranium
The study of compounds at the single atom level or 10-9 meter scale is called	Chemical engineering	Nanotechnology	Microbiology	Kinesiology.	Nanotechnology
Going green means choosing alternative processes and products that	Are used once and then thrown away	Allow the environment to sustain itself	Involve artificial turf / grass in sports	Emit a small amount of radiation	Allow the environment to sustain itself
Biomass energy can be obtained from	Energy plantations	Petro crops	Agricultural and urban waste biomass	All of these	All of these
Gasocol is a mixture of -------- and----------	Methanol and Gasoline	Ethanol and Gasoline	Natural gas and alcohol	methanol and ethanol	Ethanol and Gasoline
Ideal location for installation of wind-mills are	coastal regions	open grasslands	hilly regions	All of these	All of these

Electricity production is considered green energy if it is created	Without causing any harmful environment impact	In the Rocky Mountains	Only at night	By cutting down old growth forests	Without causing any harmful environment impact
What is produced by slicing thin wafers from a high purity single crystal?	Monocrystalline silicon	Heterocrystalline sandstone	Diamonds	Graphite	Monocrystalline silicon
Photovoltaic arrays follow the sun's path through the sky during the day using	Single axis tracking	Two axis tracking	Three axis tracking	Disposable generators	Single axis tracking
Internal geothermal heat, fueled by core processes, supplies energy for all of the following except	Plate tectonics	Earthquake	Volcanic eruptions	Beach erosion	Beach erosion
The energy sources obtained from the atmosphere is called	Natural gas	LPG	Petroleum Productions	Wind Energy	Wind Energy
The way the Earth's natural atmospheric gases decrease the amount of heat released from the atmosphere is called the	Ventilation cycle	Green house effect	Calcium cycle	Light house effect	Green house effect
Droughts affect hydroelectric plant operations because, when water is low or absent,	Fish can't swim upstream	Irrigation needs less water	Plants can't make electricity	Turbines turn faster	Plants can't make electricity
The uranium oxide mineral uraninite is commonly called	Molasses	Molasses	Vermillion	Pitchblende.	Pitchblende.
The ERT's Clean Power Program includes all of the following except	Verifying specific energy blocks as green	Creating a Power Scorecard Rating System	Developing an EcoPower ticket program that guarantees PURCHASED POWER	Investing in large quantities of foreign coal, oil and gas	Investing in large quantities of foreign coal, oil and gas
Aerodynamic lift is used in what type of power generation?	Solar	Hydroelectric	Wind	Biomass.	Wind
Who is often called the Father of the Petroleum Industry?	Jed Clampett	Abraham Gesner	Howard Hughes	Douglas Williams	Abraham Gesner
Solar cells	Function more efficiently under focused	Function less efficiently under focused	Cannot function under focused light	Only use focused light to generate heat	Function more efficiently under focused
Natural gas is mainly made up of	Methane	Ethane	Sewage	All of these	Methane
Which nonrenewable energy source takes millions of years to form?	Wind	Fish to spawn prematurely	Propane	Solar.	Petroleum
Hydroelectric power plants affect water quality and flow and can cause	Overgrowth of lily pads	Petroleum	Brownouts in metropolitan areas	Low dissolved oxygen levels in the water	Low dissolved oxygen levels in the water
An example for fossil fuel	coal	petroleum	natural gas	All of these	All of these
All of the following are used to clean up oil spills except	Brooms	Skimmers	Sorbents	Vacuum trucks	Brooms
Choosing alternative processes and products that allow the environment to sustain, it is called	Being thrifty	Natural selection	Going green	Fuel economy	Going green
What cutting-edge technology shows great potential in the areas of energy storage and transmission?	Nanotechnology	Biosensors	Holographic imaging	Advanced robotics	Nanotechnology
The uranium oxide mineral uraninite is found in	Sandstone	Granite and other volcanic rocks	Clays	Sodium chloride.	Granite and other volcanic rocks

Green energy products must get a large percentage of their power from a mixture of	Blue-green algae	Nuclear isotopes	Biomass and battery recycling	Wind, Solar, Geothermal, Biomass and hydroelectric power	Wind, Solar, Geothermal, Biomass and hydroelectric power
In 1857, Michael Dietz invented a	Water - flushing toilet	Carbon - filament light bulb	Clean – burning kerosene lamp	Robotic vacuum cleaner	Clean - burning kerosene lamp
This most common type of hydroelectric power plant that uses a dam to store river water in a reservoir is called	A diversion plant	An impoundment plant	A pumped storage plant	A compoundment plant	An impoundment plant
NRC is the acronym for what energy agency?	National Rubber Committee	Nuclear Registration Committee	National Registered Cranes	Nuclear Regulatory Commission	Nuclear Regulatory Commission
When core temperature escalate out of control in a nuclear power plant,causing a core meltdown, it is known as	The French Syndrome	Murphy's Law	The Law of Inverse Proportions	The China Syndrome	The China Syndrome.
The Pacific Ocean's Ring of Fire is	Low in geothermal potential	A film about hobbits	High in geothermal potential	A tale from Greek mythology	High in geothermal potential
_____ vehicles give off low levels of toxins and ozone forming hydrocarbons.	Compressed Natural Gas	Liquified Petroleum Gas	Gasoline	Ethanol	Compressed Natural Gas
When the sun's energy is stored within materials like plant and animal matter, it is known as	Soil	Land	Rock	Biomass	Biomass
Soilds, liquids and gases created through the compression of ancient organic plant and animal material in the earth's crust are called	Fossil fuels	Radioactive materials	Solar fuels	Bio fuels.	Fossil fuels
Wood alcohol is	Ethanol	Methanol	Propanol	None.	Methanol
Electrochemical solar cells use a _____ to absorb light.	Photovoltaic cell	Silicon	Dye sensitizer	None.	Dye sensitizer
The energy created by the earth's atmospheric circulation patterns, Which is known as?	Solar energy	Geothermal energy	Bio energy	Wind energy	Wind energy.
The drawbacks of wind energy are	It is not always predictable	Wind turbines are ugly	Noise created by the rotors	All of these	All of these
A working Fluid boils and flashes to a gas at a lower temperature than water. An example of working fluid is	Isobutane	Butane	Ethane	None.	Isobutane
Currently, the fastest-growing source of electricity generation using new renewable sources is	Solar	wind	natural gas	hydro	Wind
Which of the following methods can be called passive solar energy collection?	using heat-absorbing construction materials	rooftop solar panels	photovoltaic cells	rooftop flat-plate solar collectors	using heat-absorbing construction materials
Potential energy sources from oceans	chemoluminescent bacteria	motion of currents, waves and tides; ocean thermal energy	solar reflection	lightning strikes in salt water	motion of currents, waves and tides; ocean thermal energy
A major disadvantage to using wind to produce electricity is	the emissions it produces once in place	its energy efficiency compared to conventional power sources	that people can use a single mill or develop a large-scale wind farm	the initial startup cost	the initial startup cost

The largest problem with adopting the new technology of renewable resources is	in evaluating the scientific and economic impacts	that the start-up costs are high	that long-term maintenance costs are higher than those for fossil fuels	that technological advances have not been made in the last 30 years to meet our energy needs	that the start-up costs are high