Environmental Studies
(For Online Exam)

Sub Code : 22447

EDITION : 2020

- MORE THAN 530 MCQ'S WITH ANSWERS

MSBTE I SCHEME PATTERN
S. Y. DIPLOMA SEM IV
MECHANICAL/ELECTRICAL/CIVIL ENGINEERING GROUP
(ME/EE/EP/EU/CE/CR/CS)
T. Y. DIPLOMA SEM V
COMPUTER/ELECTRONICS ENGINEERING GROUP
(CO/CM/CW/IF/EJ/ET/EN/EX/EQ)

SUBJECT CODE : 22447

As per Revised Syllabus of

MSBTE - I SCHEME

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T.Y. Diploma Semester - V
Computer / Electronics Engineering Group
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ENVIRONMENTAL STUDIES

FOR ONLINE EXAMINATION

Sunil S. Raut
ME (Production), B.E. (Mechanical Engineering),
HOD (Mechanical Department)
Sandip Polytechnic, Nashik

Deepak K. Patil
B.E. (Mechanical Engineering),
Lecturer, Sandip Polytechnic, Nashik

Vishal R. Bhadane
M.E. (Mechanical Engineering),
Lecturer, Sandip Polytechnic, Nashik

Kishor D. Farde
M.E. (Machine Design), B.E. (Mechanical Endineering),
Lecturer, Shivajirao S. Jondhle Polytechnic, Thane

Dr. Rashmi R. Sharma
Ph.D., M.Sc., Organic Chemistry, B.Ed.
Lecturer in Chemistry, Dadasaheb Gawai Charitable Trust's,
Kirti Polytechnic, Amravati

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An Up-Thrust for Knowledge

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First Edition : January 2020

Published by :

TECHNICAL PUBLICATIONS
SINCE 1993 An Up-Thrust for Knowledge

Amit Residency, Office No.1, 412, Shaniwar Peth, Pune - 411030, M.S. INDIA
Ph.: +91-020-24495496/97, Telefax : +91-020-24495497
Email : sales@technicalpublications.org Website : www.technicalpublications.org

Printer :
Yogiraj Printers & Binders
Sr.No. 10/1A,
Ghule Industrial Estate, Nanded Village Road,
Tal. - Haveli, Dist. - Pune - 411041.

Price : ₹ 120/-

ISBN 978-93-89180-37-4

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MSBTE I

PREFACE

The importance of **Environmental Studies** is well known in various engineering fields. Overwhelming response to our books on various subjects inspired us to write this book. The book is structured to cover the key aspects of the subject **Environmental Studies.**

The book uses plain, lucid language to explain fundamentals of this subject. The book provides logical method of explaining various complicated concepts and stepwise methods to explain the important topics. Each chapter is well supported with necessary illustrations, practical examples and solved problems. All chapters in this book are arranged in a proper sequence that permits each topic to build upon earlier studies. All care has been taken to make students comfortable in understanding the basic concepts of this subject.

The book not only covers the entire scope of the subject but explains the philosophy of the subject. This makes the understanding of this subject more clear and makes it more interesting. The book will be very useful not only to the students but also to the subject teachers. The students have to omit nothing and possibly have to cover nothing more.

We wish to express our profound thanks to all those who helped in making this book a reality. Much needed moral support and encouragement is provided on numerous occasions by our whole family. We wish to thank the **Publisher** and the entire team of **Technical Publications** who have taken immense pain to get this book in time with quality printing.

Any suggestion for the improvement of the book will be acknowledged and well appreciated.

Authors

Sunil. S. Raut
Deepak K. Patil
Vishal R. Bhadane
Kishor D. Farde
Dr. Rashmi R. Sharma

Dedicated to God.

SYLLABUS

Environmental Studies (22447)

Teaching Scheme			Credit (L+T+P)	Examination Scheme											
				Theory						Practical					
L	T	P		Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
3	-	-	3	90 Min	70*#	28	30*	00	100	40	--	--	--	--	--	--

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub - topics
Unit - I Environment	1a. Discuss the scope of Environment. 1b. Describe various types of environment. 1c. Describe the importance of enviornment studies. 1d. Discuss about the need of public awarenss about environment. 1e. Describe various environmental issues.	1.1 Definitions, need of environmental studies. 1.2 Segments of environment Atmosphere, Hydrosphere, Lithosphere, Biosphere. 1.3 Environmental Issues - Green house effects, Climate change, Global warming, Acid rain Ozone layer depletion, Nuclear accidents. 1.4 Concept of 4R (Reduce, Reuse, Recycle and Recover). 1.5 Public awarness about environment.
Unit - II Energy Resources	2a. List various natural resources. 2b. Describe Renewable, Nonrenewable and Cyclic resources. 2c. State the causes and effects of depletion of resources. 2d. State advantages and disadvantages of forms of energy. 2e. Select appropriate solutions of efficient use of energy. 2f. State the impacts of overuse of natural resources.	2.1 Natural Resources-Forest Resources, Water Resources, Energy Resources, Land resources, Mineral resources. 2.2 Renewable, Non-renewable and Cyclic Resources. 2.3 Causes and effects of depletion of resources. 2.4 Energy forms (Conventional and non conventional). 2.5 Present global energy use and future demands. 2.6 Energy conservation. 2.7 Over use of natural resources and its impacts on environment.

Unit - III **Ecosystem and Biodiversity**	3a. State the aspects and division of ecosystem. 3b. State the general characteristics and function of ecosystem. 3c. List levels of biodiversity. 3d. Enlist the endangered species. 3e. Describe value of biodiversity. 3f. Suggest methods biodiversity conservation.	3.1 Ecosystem - Definition , Aspects of ecosystem, Division of ecosystem, General characteristics of ecosystem, Functions of ecosystem. 3.2 Biodiversity- Definitions, Levels, Value and loss of biodiversity. 3.3. Biodiversity assessment initiatives in India. 3.4 Threats and Hotspots of biodiversity. 3.5 Conservations of biodiversity- objects, various laws.
Unit-IV **Environmental Pollution**	4a. Define pollution. 4b. State the sources of pollution. 4c. State the effects of land pollution on environment and lives. 4d. State various units and their functions of water treatment plant. 4e. State the needs of water conservation. 4f. State the impacts of sewage. 4g. State various units and their functions of sewage treatment plant. 4h. State sources and effects of air pollution. 4i. Describe various methods to prevent air pollution. 4j. State sources and effects of noise pollution. 4k. Describe preventive measures for noise pollution. 4l. State characteristics of solid waste. 4m. State the impacts of solid waste. 4n. Describe incineration, RDF and sanitary land filling. 4o. State the standards limiting / controlling values of various types of pollution.	4.1 Definition of pollution, types Natural and Artificial (Man-made). 4.2 Soil / Land Pollution - Causes and effects on environment and lives, presentive measures. 4.3 Water pollution - Sources of water (surface and sub surface), source of water pollution effect on environemnt and lives, preventive measures, BIS water quality standards, flow diagram of water treatment plant, Water conservation. 4.4 Waste water - Generation (domestic and industrial), Impacts, flow diagram of sewage treatment plant, CPCB norms of sewage discharge. 4.5 Air pollution - Causes, effects prevention, Ambient air quality standards. 4.6 Noise pollution - Sources, effects, prevention, noise levels at various zones of the city. 4.7 Municipal Solid Waste, Bio-medical waste and E-waste - Sources, generation, characteristics, effects, and method to manage.

Unit-V **Social Issues and Environmental Education**	5a. Elaborate article (48-A) and (51-QA (g)) 5b. Enlist various acts on environment and its provisions. 5c. State the roles and responsibilities of CPCB. 5d. Define sustainable development, and EIA. 5e. Describe rain water harvesting and ground water recharge. 5f. Differentiate between formal and non formal education.	5.1 Article (48-A) and (51-A (g)) of Indian Constitution regarding environment, Environmental, protection and prevention acts, CPCB and MPCB norms and responsibilities, The role ofNGOs. 5.2 Concept of sustainable development, EIA and environmental morality. 5.3 Management Measures - Rain Water harvesting, Ground water recharge, Green Belt Development, Use of Renewable energy, water shed management, interlinking of rivers. 5.4 Role of information technology in environment and human health.

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UNIT - I

1 Environment

Introduction

Environment is everything that is around us. The world environment derived from French word Environner. It can be living or non-living things. It includes physical, chemical and other natural forces. Living things live in their environment. They constantly interact with it and adapt themselves to conditions in their environment. In the environment there are different interactions between animals, plants, soil, water, and other living and non-living things. An example of interactions between non-living and living things is plants getting their minerals from the soil and making food using sunlight. Predation, an organism eating another, is an example of interaction between living things.

Natural Environment

In biology and ecology, the environment is all of the natural materials and living things, including sunlight. If those things are natural, it is a natural environment.

Environment includes the living and nonliving things that an organism interacts with, or has an effect on it. Living elements that an organism interacts with are known as biotic elements: animals, plants, etc., abiotic elements are non living things which include air, water, sunlight etc. Studying the environment means studying the relationships among these various things.

Historical Environment

A person's environment is the events and culture that the person lived in. Environment is everything around us. A person's beliefs and actions depend on his environment. It's simple definition is : Interaction between human and environment in the past.

1.1 Definition and Need of Environmental Studies.

Definition :

Environment means Surrounding in which we are living. Environment includes all those things on which we are directly or indirectly dependent for our survival, whether it is living component like animals, plants or non living component like soil, air water.

OR

'The term environment is used to describe, in the aggregate, all the external forces, influences and conditions, which affect the life, nature, behaviour and the growth, development and maturity of living organisms.'

Environmental Science : Environmental science is defined as an interdisciplinary academic field that integrates various academic fields (particularly sciences) to study the structure and function of our life-supporting environment and to understand causes, effects, and solutions of different environmental problems.

Environmental Studies : Environmental studies are the scientific study of the environmental system and the status of its inherent or induced changes on organisms. It includes not only the study of physical and biological characters of the environment but also the social and cultural factors and the impact of man on environment.

Need of environmental studies :

1. **Environment issues :** It has been well recognized that environment issues like global warming and ozone depletion, acid rain, marine pollution and biodiversity are not merely national issues but are

global issues and hence must be tackled with international efforts and cooperation.

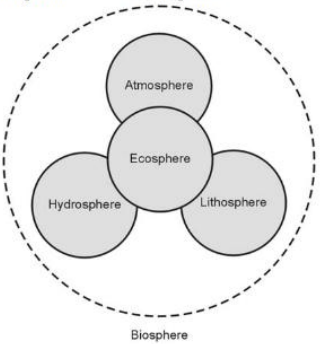
2. **Pollution :** World census reflects that one in every seven persons in this planted lives in India. Evidently with 16 per cent of the world's population and only 2.4 per cent of its land area, there is a heavy pressure on the natural resources including land. Agricultural experts have recognized soils health problems like deficiency of micronutrients and organic matter, soil salinity and damage of soil structure.
3. **Alternative Solution :** It is essential, especially for developing countries to find alternative paths to an alternative goal. We need a goal as under :
   (a) A goal, which ultimately is the true goal of development an environmentally sound and sustainable development.
   (b) A goal common to all citizens of our earth.
   (c) A goal distant from the developing world in the manner it is from the over-consuming wasteful societies of the "developed" world.
4. **To save humanity from extinction :** It is incumbent upon us to save the humanity from extinction. Consequent to our activities constricting the environment and depleting the biosphere, in the name of development.
5. **To understand the impacts of development on environment :** Industrial growth, urbanization, expansion of telecommunication and transport systems, hi-tech agriculture and expansion of housing will result in many people will move out of urban centers to reduce pollution resulting from overpopulation. The goal is to achieve all this sustainably without compromising the future generation's ability to satisfy their own needs.
6. **To discover sustainable ways of living :** Environmental science is more concerned with discovering ways to live more sustainably. This means utilizing present resources in a manner that conserves their supplies for the future.
7. **To utilize natural resources efficiently :** Natural resources bring a whole lot of benefits to a country. A country's natural resources may not be utilized efficiently because of low-level training and lack of management skills. Environmental science teaches us to use natural resources efficiently.
8. **Need for public awareness :** It is essential to make the public aware of the formidable consequences of the Environmental Degradation, if not retorted and reformative measures undertaken would result in the extinction of life. We are facing various environmental challenges. It is essential to get the country acquainted with these challenges so that their acts may be eco-friendly.

1.2 Segments of Environment - Atmosphere, Hydrosphere, Lithosphere, Biosphere.

Segments of Environment :

The environment consists of various segments which includes

1. Atmosphere
2. Hydrosphere
3. Lithosphere
4. Biosphere



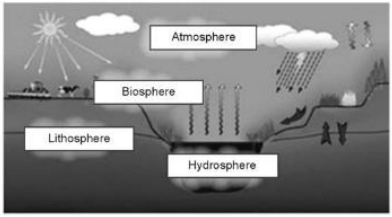


Fig. 1.2.1 Segments of environment

1. Atmosphere :

- The atmosphere of Earth is the layer of gases, commonly known as air, that surrounds the planet Earth and is retained by Earth's gravity.
- The atmosphere of Earth protects life on Earth by creating pressure allowing for liquid water to exist on the Earth's surface, absorbing ultraviolet solar radiation, warming the surface through heat retention (greenhouse effect), and reducing temperature extremes between day and night.
- It acts as a source for CO_2 for plant photosynthesis and O_2 for respiration.
- It acts as a source for nitrogen for nitrogen fixing bacteria and ammonia producing plants.
- By volume, dry air contains 78.09 % nitrogen, 20.95 % oxygen, 0.93 % argon, 0.04 % carbon dioxide, and small amounts of other gases. Air also contains a variable amount of water vapor, on average around 1 % at sea level, and 0.4 % over the entire atmosphere.
- The atmosphere has a mass of about 5.15×1018 kg, three quarters of which is within about 11 km (36,000 feet) of the surface. The atmosphere becomes thinner and thinner with increasing altitude, with no definite boundary between the atmosphere and outer space.

2. Hydrosphere : A **hydrosphere** is the total amount of water on a planet. The **hydrosphere** includes water that is on the surface of the planet, underground, and in the air. A planet's **hydrosphere** can be liquid, vapor, or ice. On Earth, liquid water exists on the surface in the form of oceans, lakes and rivers.

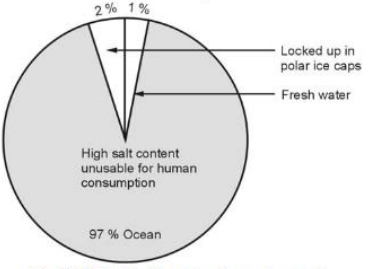


Fig. 1.2.2 Distribution of earths water supply

As can be seen, only 1% of the total water supply is available as fresh water in the form of rivers, lakes, streams and ground water for human consumption and other uses. The extent of the use of available fresh water for various purposes is shown in the following figure 1.2.3

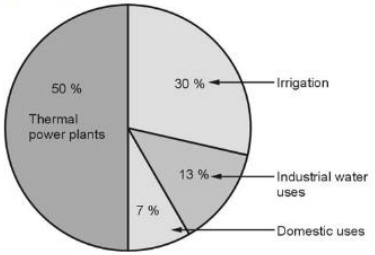


Fig. 1.2.3 Major use of fresh water

The major problem with global water supply is it's non-uniform distribution, since people in areas with low precipitation often consume more than people in regions with more rainfall.

3. Lithosphere :

- The **lithosphere** is the solid shell of the planet Earth. That means the crust, plus the part of the upper mantle that behaves elastically on long time scales.
- Under the lithosphere is the asthenosphere, the weaker, hotter, and deeper part of the upper mantle. This part can flow.
- The lithosphere provides a conductive lid atop the convecting mantle: it reduces heat transport through the Earth, A lithosphere is the rigid, outermost shell of a terrestrial-type planet or natural satellite that is defined by its rigid mechanical properties. On Earth, it is composed of the crust and the portion of the upper mantle that behaves elastically on time scales of thousands of years or greater. The outermost shell of a rocky planet, the crust, is defined on the basis of its chemistry and mineralogy.

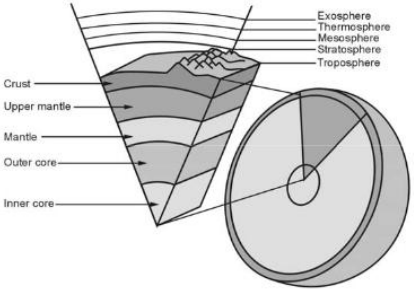


Fig. 1.2.4 Layers of Earth

Types of lithosphere :

1. Oceanic lithosphere, which is associated with oceanic crust and exists in the ocean basins. Oceanic lithosphere is typically about 50–100 km thick
2. Continental lithosphere, which is associated with continental crust. Continental lithosphere has a range in thickness from about 40 km to perhaps 200 km, of which about 40 km is crust.

4. Biosphere :

- The biosphere is the global ecological system integrating all living beings and their relationships, including their interaction with the elements of the lithosphere, geosphere, hydrosphere, and atmosphere.
- In a general sense, biospheres are any closed, self-regulating systems containing ecosystems.

1.3 Environmental Issue – Greenhouse Effect, Climate Change, Global Warming, Acid Rain, Ozone Layer Depletion and Nuclear Accident

Our Mother Earth is currently facing lot of environmental concerns. The environmental problems like global warming, acid rain, air pollution, urban sprawl, waste disposal, ozone layer depletion, water pollution, climate change and many more affect every human, animal and nation on this planet. Over the last few decades, the exploitation of our planet and degradation of our environment have gone up at an alarming rate. As our actions have been not in favor of protecting this planet, we have seen natural disasters striking us more often in the form of flash floods, tsunamis and cyclones.

1. Greenhouse effect :

- The greenhouse effect is a natural process that warms the Earth's surface. When the Sun's energy reaches the Earth's atmosphere, some of it is reflected back to space and the rest is absorbed and re-radiated by greenhouse gases.

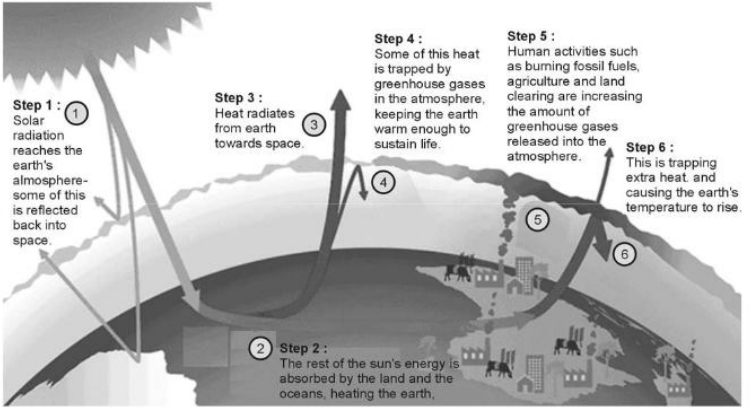


Fig 1.3.1 Greenhouse effect

- Greenhouse gases include water vapour, carbon dioxide, methane, nitrous oxide, ozone and some artificial chemicals such as chlorofluorocarbons (CFCs).
- The absorbed energy warms the atmosphere and the surface of the Earth. This process maintains the Earth's temperature at around 33 degrees Celsius warmer than it would otherwise be, allowing life on Earth to exist.
- The problem we now face is that human activities – particularly burning fossil fuels (coal, oil and natural gas), agriculture and land clearing – are increasing the concentrations of greenhouse gases.

Step 1 : Solar radiation reaches the Earth's atmosphere - some of this is reflected back into space.

Step 2 : The rest of the sun's energy is absorbed by the land and the oceans, heating the Earth.

Step 3 : Heat radiates from Earth towards space.

Step 4 : Some of this heat is trapped by greenhouse gases in the atmosphere, keeping the Earth warm enough to sustain life.

Step 5 : Human activities such as burning fossil fuels, agriculture and land clearing are increasing the amount of greenhouse gases released into the atmosphere.

Step 6 : This is trapping extra heat, and causing the Earth's temperature to rise.

2. **Climate change :** Climate change has emerged as the most pressing global challenge of the 21st century. There is today an increasing understanding that climate change transcends political boundaries and affects the whole global population, making them stakeholders to the solutions too. However, despite the ubiquity of climate change, its more immediate impacts are felt differently by different groups of people. Developing countries, with their low adaptive capacities and high dependence on climatic variables, are highly susceptible to climate-induced tragedies.

a) Rising Concentrations : The effect is that the atmosphere retains more of the Sun's heat, warming the Earth's surface. While the pattern of future warming is very much open to debate, it is indisputable that the surface of the Earth has warmed, on average, 0.3 to 0.6 °C since the late 19th century when reliable temperature measurements began. Under the existing scenarios of economic growth and development leading to greenhouse gas emissions, on a worldwide average, temperatures would rise by 1 to 3.5 °C by the year 2100, and global mean sea level by about 15 to 95 cm.

b) Extreme Weather Events : In addition, most of the ill effects of climate change are linked to extreme weather events, such as hot or cold spells of temperature, or wet or dry spells of rainfall, or cyclones and floods. Predictions of the nature and distributions of such events in a changed climate are even more uncertain- to the extent that virtually no authoritative predictions exist at all. While there are costs as well as benefits associated with climate change, the scientific consensus is clearly that the overall effects are likely to pose a significant burden on the global community.

3. **Global Warming : *Global warming is the phenomenon of increasing average air temperatures near the surface of Earth over the past one to two centuries.***

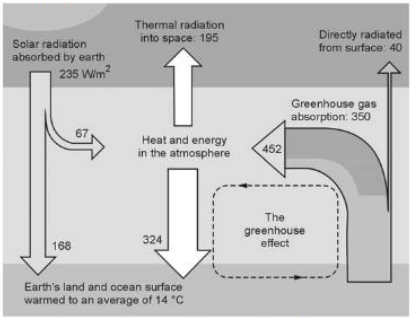


Fig. 1.3.2 Greenhouse effect schematic showing energy flow between space, the atmosphere and earth surface

Greenhouse gases trap heat radiating from Earth to space.This heat, in the form of infrared radiation, gets absorbed and emitted by these gases in the planet's atmosphere warming the lower atmosphere and the surface.

The major greenhouse gases are water vapour, which causes about 36 - 70 % of the greenhouse effect; carbon dioxide (CO_2), which causes 9 - 26 %; methane (CH_4), which causes 4 - 9 %; and ozone (O_3), which causes 3 - 7 %.

a) Causes of global warming -

- **Carbondioxide (CO_2) :** Carbondioxide is also a gas that traps heat. Although it is the weakest greenhouse gas among those listed here, it is by far the most produced. Burning of wood, gas and use of oil and other materials in factories produce this gas, which has increased in amount by 30% in the last 150 years and is perhaps currently the greatest threat as a greenhouse gas
- **Methane :** Methane is second most important. Methane has half the warming effect of CO_2. Levels of atmosphere methane have risen 145 % in the last 100 years. Methane is derived from sources such as rice paddies, bovine flatulence, bacteria in bogs and fossil fuel production.
- **Nitrous Oxide :** Another greenhouse gas is nitrous oxide (N_20), colorless, non-flammable gas with sweetish odour, commonly known as laughing gas, and sometimes used as an anaesthetic. Nitrous oxide is naturally produced by oceans and rainforests. Man-made sources of nitrous oxide include nitric acid production, the use of fertilizers in agriculture, cars with catalytic converters and the burning of organic matter. Nitrous Oxide broken down in the atmosphere by chemical reactions that involve sunlight.
- **Sulfur Hexafluoride (SF_6) :** This is a potent gas that may be found in insulation, circuit breaking and other electrical equipment, and even air soled sneakers. It is also used to melt magnesium and in loudspeakers. The problem with this gas arises when it is released from such products. Having the thermal energy-trapping potential (EPA) of 25,000 times that of carbon dioxide, its portion in the atmosphere is increasing at the rate of 8 % per year
- **Chlorofluorocarbons :** These are gases often used for aerosols in the past and linger in the sphere, trapping heat. They were banned by the United States for this purpose 10 Chlorofluorocarbons (CFCs) also threaten to react with and deplete the con which protects the Earth from harmful solar radiation.
- **Nitrous Oxide (N_2O) :** This is a gas found naturally in soil and natural bodies of water. Although this is beneficial amount of nitrous oxide, use of this gas in fertilizers and manufacturing has increased its amount in the atmosphere.

b) Effects of Global Warming :

- There will be a warming of the Earth's surface and lower atmosphere and cooling of stratosphere.
- The warming trend over the earth's surface is varied. Warming in the tropies is smaller than the global mean by about 2°C-30°C, depending on seasonal changes, while in other latitudes the average warming might account for 5°C-10°C increase in temperatures.
- Precipitation patterns will be changed. Some areas will become wetter and some areas dryer.
- Seasonal patterns will change due to the changing of temperature and precipitation patterns
- Soil moisture regimes will be changed due to the changes in evaporation and precipitation
- With the decrease in cloud cover over Eurasia in summer-which will enhance the solar heating of the surface and increase the land-sea temperature contrast tropical monsoons will be driven with more severity and intensity.
- Wind direction and wind stress over the sea surface will be changed , which will alter ocean currents and cause change in nutrients mixing zones and productivity of oceans .

4. **Acid Rain :** ***Acid rain is a rain or any other form of precipitation that is unusually acidic, meaning that it has elevated levels of hydrogen ions. It can have harmful effects on plants, aquatic animals and infrastructure. Phenomenon of acid rain discovered by Rober Angus Smith.***

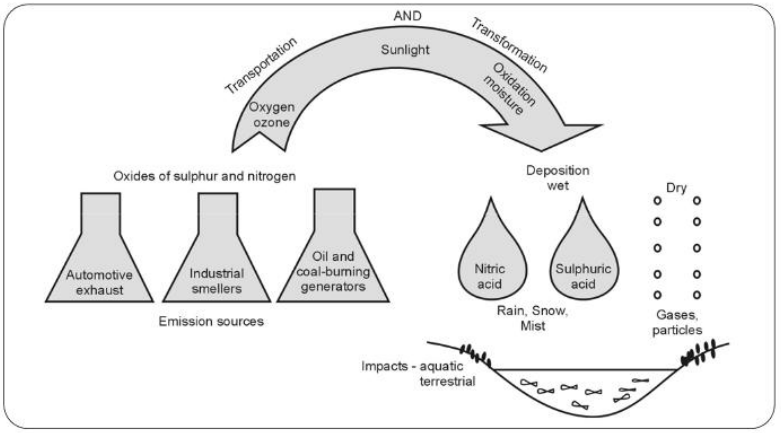


Fig 1.3.3 : The origin of acid rain deposition

- Unpolluted rain is already slightly acidic because of the presence in air of carbon dioxide, which combines with water to form carbonic acid. This rain has a pH value of 5.6, However, rain is seldom unpolluted. When rain is contaminated with sulphuric and nitric acids the pH falls below 5 .6. This is what we refer to as acid rain.
- Acid rain is caused by emissions of **sulphur dioxide** and **nitrogen oxide**, which react with the water molecules in the atmosphere to produce acids.
- In wet deposition, acidic pollutants are deposited by snow, fog and mist, as well as rain. They may also be deposited directly from the atmosphere as gases or particles without any association with precipitation.
- This is called dry deposition. Thus, while the term acid rain will do for general reference to the problem, more precise terms for this form of pollution are acidic precipitation, or, more generally, acidic deposition.
- In some areas wet and dry deposition of acids are about equal. In Newfoundland, however, there is about six times as much wet deposition as dry deposition.

Effect of acid rain :

- Acid rain makes waters acidic, and causes them to absorb the aluminum that makes its way from soil into lakes and streams. This combination makes waters toxic to crayfish, clams, fish, and other aquatic animals.
- Acid rain also damages forests, especially those at higher elevations. It robs the soil of essential nutrients and releases aluminum in the soil, which makes it hard for trees to take up water. Trees' leaves and needles are also harmed by acids.
- The effects of acid rain, combined with other environmental stressors, leave trees and plants less able to withstand cold temperatures, insects, and disease.

5. Ozone depletion : In 1913, Henri Buisson and Charles Fabry discovered the ozone layer and later its properties were studied by G.M.B. Dobson. ***Ozone depletion is a major environmental problem because it increases the amount of ultraviolet (UV) radiation that reaches Earth's surface, which increases the rate of skin cancer, eye cataracts, and genetic and immune system damage.***

- The main cause of ozone depletion and the ozone hole is manufactured chemicals, especially manufactured halocarbon refrigerants, solvents, propellants and foam-blowing agents (chlorofluorocarbons (CFCs), HCFCs, halons), referred to as ozone-depleting substances (ODS).
- These compounds are transported into the stratosphere by the winds after being emitted from the surface.
- Once in the stratosphere, they release halogen atoms through photodissociation, which catalyze the breakdown of ozone (O_3) into oxygen (O_2). Both types of ozone depletion were observed to increase as emissions of halocarbons increased.
- Ozone depletion and the ozone hole have generated worldwide concern over increased cancer risks and other negative effects.
- The ozone layer prevents most harmful UVB wavelengths of ultraviolet light (UV light) from passing through the Earth's atmosphere.
- These wavelengths cause skin cancer, sunburn and cataracts, which were projected to increase dramatically as a result of thinning ozone, as well as harming plants and animals.

6. **Nuclear Accidents :** Nuclear energy was developed by man as an alternate source of clean and cheap energy when compared to fossil fuels. Along with the benefits of nuclear energy there have been a number of accidents which harm many lives. Nuclear energy can be both beneficial and harmful, depending on the way in which it is used. For example X-rays which are used to examine bone fracture is useful. Nuclear bombs are harmful for both organisms and environment. The first nuclear bomb bombard to the twin cities of Japan Hiroshima and Nagasaki. The devastation that nuclear bombs caused to Hiroshima and Nagasaki is terrible. The radioactive waste from nuclear energy has caused, and continues to cause serious environmental damages. The first controlled fission of an atom was carried out in Germany in 1938. Nuclear fission is the splitting of the nucleus of the atom. A nuclear is defined by the International Atomic Energy Agency (IAEA) as ***"An event that has led to significant consequences to people, the environment or the facility."*** Examples include lethal effects to individuals, radioactive isotope to the environment, or reactor core melt." The prime example of a "major nuclear accident" is one in which a reactor core is damaged and significant amounts of radioactive isotopes are released, such as in the Chernobyl disaster in 1986.

Types of nuclear accidents :

a) **Nuclear meltdown :** A nuclear meltdown is a severe nuclear reactor accident that results in reactor core damage from overheating. It has been defined as the accidental melting of the core of a nuclear reactor, and refers to the core's either complete or partial collapse. A core melt accident occurs when the heat generated by a nuclear reactor exceeds the heat removed by the cooling systems to the point where at least one nuclear fuel element exceeds its melting point.

b) **Criticality accidents :** A criticality accident occurs when a nuclear chain reaction is accidentally allowed to occur in fissile material, such as enriched uranium or plutonium. The reactor was supposed to be in a controlled critical state, but control of the chain reaction was lost. The accident destroyed the reactor and left a large geographic area uninhabitable.

c) **Decay heat :** Decay heat accidents are where the heat generated by the radioactive decay causes harm. In a large nuclear reactor, a loss of coolant accident can damage the core: for example, at Three Mile Island a recently shutdown PWR reactor was left for a length of time without cooling water. As a result, the nuclear fuel was damaged, and the core partially melted. The removal of the decay heat is a significant reactor safety concern, especially shortly after shutdown. Failure to remove decay heat may cause the reactor core temperature to rise to dangerous levels and has caused nuclear accidents.

d) **Equipment failure :** Equipment failure is one possible type of accident. A related cause of accidents is failure of control software.

e) **Human error :** Many of the major nuclear accidents have been directly attributable to operator or human error. Two types of mistakes were deemed most serious: errors committed during field operations, such as maintenance and testing, that can cause an accident; and human errors made during small accidents that cascade to complete failure.

1.4 Concept of 4R (Reduce, Reuse, Recycle and Recover)

1. **Reduce :** Minimizing the consumption of raw material true improvement in the design the products may allow a significant reduction in the design of products and in the amount of waste generated when the reached through end of the life cycle.

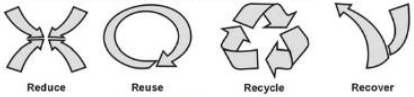


Fig. 1.4.1 Concept of 4R

2. **Reuse :** This is mainly applied to packaging goods been defined as any operation by which the packaging items are refilled or used for the same purpose for which they were made with or without the support of auxiliary products. Consumer and industries encourage promoting the reuse of Goods and packaging instead of disposal. This option can be applied for container such as bottles, bags, etc.
3. **Recycle :** This allows the waste to be reintroduced into the consumption cycle Generally and secondary applications because in many cases the recycle products of lower quality then the virgin ones. The recycling must be applied only when the amount of energy consumed in the recycling process is lower than the energy required for the production of new materials. Plastics can be recycled by using two different approaches Mechanical Recycling, Feedstock recycling.
4. **Recovery :** When the recycling of waste is not feasible or there is no market for the recycle product incarnation can be used to generate energy from the waste combustion heat. Alternatively they can be used as fuel in number of applications like power plants, Industrial furnaces and cement industries.

1.5 Public Awareness about Environment.

- Public awareness of the environment means the ability to emotionally understand the surrounding world, including the laws of the natural environment, sensitivity to all the changes occurring in the environment
- Understanding of cause-and-effect relationships between the quality of the environment and human behavior, an understanding of how the environment works as a system, and a sense of responsibility for the common heritage of the Earth, such as natural resources - with the aim of preserving them for future generations.
- To know and understand what is good and what is better, and at the same time commit a wrong doing, is socially more injurious than committing a wrong doing in ignorance. Therefore, building, in a society, a new system of values with the aim of creating environmental public awareness.
- Environmental public awareness comes from a result of general knowledge, specialist knowledge of a particular problem and also sensitivity to, and a sense of, responsibility for the environment.
- Environmental public awareness is shaped throughout the whole life of particular people living in a given local community, performing specific work and having definite personal characteristics which have a deciding effect on their sense of responsibility and ability to emotionally perceive the environment as having value in itself.

Multiple Choice Questions

Q.1 Environmental education is important only at ____.

a primary school stage
b secondary school stage
c collage stage
d all stages

Q.2 Biosphere is _____

a The solid shell of inorganic materials on the surface of the Earth

b The thin shell of organic matter on the surface of earth comprising of all the living things

c The sphere which occupies the maximum volume of all the spheres

d All of the above

Q.3 Which of the following is not influenced by human activities ?

a Depletion of ground water

b Destruction of mangroves and wetlands

c Increased extinction rate of species

d None of the above

Q.4 Which of the following conceptual sphere of the environment is having the least storage capacity for matter ?

a Atmosphere b Lithosphere

c Hydrosphere d Biosphere

Q.5 The largest reservoir of nitrogen an our planet is :

a Ocean b Atmosphere

c Biosphere d Fossil fuels

Q.6 The world Environment derived from French word

a Environ b Environnering

c E – Environner d Envo

Q.7 _____ is greenhouse gas.

a CO_2 b H_2S

c N_2 d None of the above

Q.8 _____ cause acid rain .

a CO_2 b SO_2

c N_2 d None of the above

Q.9 Ozone depletion is harmful to ____.

a Digestion b Reproduction

c Skin d None of the above

Q.10 All the environment crisis are solely due to ____.

a Population b Water Quality

c Air Quality d None of the above

Q.11 The environment consists of various segments such as Atmosphere, hydrosphere, lithosphere and _____

a Hemisphere b O_2 sphere

c Soil sphere d Biosphere

Q.12 The _____is the protective blanket of gases which is surrounding the earth. It protects the earth from the hostile environment of outer space.

a Hemisphere b Atmosphere

c Lithosphere d Biosphere

Q.13 _____ of the total water supply is available as fresh water in the form of rivers, lakes, streams and ground water for human consumption and other uses.

a 1 % b 2 %

c 3 % d 4 %

Q.14 The lithosphere consists of upper mantle and the _____

a atmosphere b crust

c thrust d none of the above

Q.15 Atmosphere allows transmission of significant amounts of radiation only in the regions of ____

a 100 –200 nm b 200 –500 nm

c 300 –2500 nm d None of the above

Q.16 Atmosphere acts as a source for __for plant photosynthesis and _____ for respiration.

a O_2 and CO_2 b CO_2 and N_2

c NO_2 and CO_2 d CO_2 and O_2

Q.17 _____ acts as a source for nitrogen for nitrogen fixing bacteria and ammonia producing plants.

a Atmosphere b Lithosphere

c Hydrosphere d Nanosphere

Q.18 The _____ is a collective term given to all different forms of water.

a Atmosphere b Lithosphere

c Hydrosphere d Nanosphere

Q.19 The _____ refers to the kingdom of living organisms and their interactions with the environment

a Atmosphere b Lithosphere
c Hydrosphere d Biosphere

Q.20 The biosphere is very large and complex and is divided into smaller units called _____.

a Organisms b Ecosystems
c Module d None of these

Q.21 _____ is a natural process that warms the Earth's surface.

a Greenhouse effect b Global warming
c Deforestation d None of these

Q.22 How is the greenhouse effect experienced on earth ?

a Global worming b Pollution
c Both a. and b d None of the above

Q.23 Which of the following gases is/are responsible for global warming ?

a Carbon dioxide (CO_2) b Water vapour (H_2O)
c Both a. and b. d None of the above

Q.24 In desert areas, there is large difference between day and night temperatures mainly because of

a Presence of carbon dioxide in air as it acts as barrier for emanating infrared radiation from the earth surface
b Presence of water vapour in air as it acts as barrier for emanating infrared radiation from the earth surface
c Absence of carbon dioxide in air as it acts as barrier for emanating infrared radiation from the earth surface
d Absence of water vapour in air as it acts as barrier for emanating infrared radiation from the earth surface

Q.25 The radiation energy from the sun is produced by

a Fission reaction b Fusion reaction
c Both a. and b. d None of the above

Q.26 Which of the following mentioned GHGs has the highest atmospheric lifetime ?

a Carbon tetrafluoride b Nitrous oxide
c Methane d CFC

Q.27 Which of the following greenhouse gas is contributed by cattle farming ?

a Nitrous oxide b Methane
c Carbon monoxide d All of the mentioned

Q.28 Volcanic eruptions contribute to the global greenhouse phenomenon.

a True b False

Q.29 Gas molecules that absorb thermal infrared radiation and are present in large quantity to change climate system are known as

a alpha radiations b beta radiations
c ozone gases d greenhouse gases

Q.30 Greenhouse gases which is present in very high quantity is

a Propane b Ethane
c Carbon dioxide d Methane

Q.31 Exchange of outgoing and incoming radiations that keeps Earth warm is known as

a Greenhouse effect b Radiation effect
c Infrared effect d Ozone layer depletion

Q.32 Wavelength of infrared radiations is

a Greenhouse effect b Radiation effect
c Infrared effect d Ozone layer depletion

Q.33 Greenhouse gases effect on earth's atmosphere is increased by

a CFCs (chlorofluorocarbons)
b air conditioners
c perfumes
d burning fossil fuels

Q.34 If atmosphere doesn't act like greenhouse, temperature of earth would become _____.

a too pleasant to enjoy b too cold to survive
c too hot to survive d too terrible to survive

Q.35 Waves that pass through glass walls of greenhouse are in form of

a gamma rays b x-rays
c infrared waves d radio waves

Q.36 Global warming effects

a forests around the globe
b temperature of the globe
c wind and moisture of the globe
d water around the globe

Q.37 The gases that contribute to the greenhouse effect on Earth are, in order of greatest to smallest in importance,

a CO_2, H_2O, CH_4 b H_2O, CO_2, CH_4
c CH_4, CO_2, H_2O d H_2O, CH_4, CO_2

Q.38 The order of the atmospheric layers, starting from closest to the surface to the top of the atmosphere, is

a Mesosphere, Troposphere, Thermosphere, Stratosphere
b Troposphere, Stratosphere, Mesosphere, Thermosphere
c Thermosphere, Mesophere, Troposphere, Stratosphere
d Troposphere, Mesosphere, Stratosphere, Thermosphere

Q.39 By how much has atmospheric carbon dioxide concentration increased ever since the Industrial Revolution ?

a 20 % b 10 %
c 40 % d 60 %

Q.40 Which is the most abundant greenhouse gas in the atmosphere ?

a Carbon dioxide b Water vapour
c Methane d Nitrogen

Q.41 Which of the following is the largest sink for carbon dioxide gas ?

a Forests b Oceans
c Ice sheets d Grasslands

Q.42 Apart from Earth, which other celestial body(s) exhibits greenhouse gas effect ?

a Venus b Mars
c Titan d All of the mentioned

Q.43 Which of the following radiations of the sun do greenhouse gases trap ?

a Visible radiations b Infrared radiations
c UV radiations d All the radiations

Q.44 Clouds help in cooling down the planet and do not contribute to greenhouse effect. True or false ?

a True b False

Q.45 What does GWP in the context of greenhouse gases indicate ?

a Global Warming Parameters
b Gradual Warming Pattern
c Global Warming Patterns
d Global Warming Potential

Q.46 At what concentration (in ppm), is nitrogen present in the atmosphere ?

a 780,840 b 390,420
c 78,084 d 900,000

Q.47 The planetary boundary layer belongs to which of the following atmospheric layers ?

a Exosphere
b Ionosphere
c Stratosphere
d None of the mentioned

Q.48 What would have been the average temperature of Earth without greenhouse gases ?

a 0 °C b – 7 °C
c – 9 °C d – 19 °C

Q.49 Ever since the industrial revolution, by how much has the average temperature of the Earth increased ?

a 0.24 °C b 0.6 °C
c 1.2 °5C d 1.8 °C

Q.50 How much of the sun's radiation energy is absorbed by the greenhouse gases to warm the planet ?

a 75 PW b 1750 GW
c 1500 MW d 150 TW

Q.51 What is the emissivity of the Earth's surface ?

a 0.457 b 0.578
c 0.135 d 1.42

Q.52 The Earth is still said to be in the "ice age" period.

a True b False

Q.53 Below which of the following pH is rain regarded as 'acid rain' ?

a 7 b 7.3
c 5.6 d 6

Q.54 Glass containers are generally not preferred for sampling rain water. Why ?

a Glass containers are expensive
b Glass containers are not easy to maintain
c Glass containers affect the pH of the rain water
d All of the mentioned

Q.55 Which of the following gases are main contributors to acid rain ?

a Carbon dioxide and carbon monoxide
b Sulphur dioxide and carbon dioxide
c Sulphur dioxide and nitrogen dioxide
d Sulphur dioxide and nitrous oxide

Q.56 Which place in India receives the highest annual rainfall ?

a Mawsynram b Cherrapunji
c Siju d Phyllut

Q.57 Who discovered the phenomenon of acid rain ?

a George Brown b James T. Stewart
c Robert Angus Smith d Charles David

Q.58 Which of the following is/are natural contributor(s) to sulphur dioxide in the atmosphere ?

a Sea sprays b All of the mentioned
c Decaying vegetation d Volcanic eruption

Q.59 What is the pH required for the survival of aquatic animals and plants ?

a 7 b 7.5
c 6.5 d 4.8

Q.60 The acidic air pollutants reach the Earth's surface because of wet deposition only.

a True b False

Q.61 Which of the following gases is responsible for the yellowing of the Taj Mahal ?

a Organic carbon b Black carbon
c Brown carbon d All of the mentioned

Q.62 What is the average concentration of ozone in the ozone layer of the atmosphere ?

a Nearly 100 % b Greater than 90 %
c Between 10-50 % d Less than 10 ppm

Q.63 Who discovered the ozone layer ?

a Henri Buisson & Charles Fabry
b Carl Sagan & Charles Fabry
c G.M.B Dobson
d Carl Sagan &G.M.B Dobson

Q.64 Which of the following devices can be used to measure ozone in the stratosphere from the ground ?

a Spectrometer b Photometer
c Spectrophotometer d Spectro-ozonometer

Q.65 The ozone layer absorbs what range of wavelengths of the sun's radiation ?

a 0.80 nm – 1.50 nm b 200 nm – 315 nm
c 450 nm – 570 nm d 600 nm – 750 nm

Q.66 Who discovered the formation of ozone from photochemical reactions ?

a G.M.B Dobson b Sydney Chapman
c Carl Sagan d Henri Buisson

Q.67 Between what altitudes, is the ozone layer found in highest concentrations ?

a 10-20 km b 20-40 km
c 40-55 km d 55-70 km

Q.68 Nitrogen also helps in preventing UV rays from reaching the Earth.

a True b False

Q.69 Which of the following UV radiations is responsible for causing sun burns and skin cancer ?

a UV-A b UV-B
c UV-C d All of the mentioned

Q.70 The long UV-B radiations are important for vitamin D production of the skin.

a True b False

Q.71 In which season is the ozone found at its maximum level in the northern hemisphere ?

a Winter b Summer
c Spring d Autumn

Q.72 When was the ozone hole discovered ?

a 1974 b 1964
c 1994 d 1984

Q.73 The ozone hole is a phenomenon that has occurred in :

a Arctic region
b Northern temperate region
c Southern temperate region
d None of the mentioned

Q.74 Which of the following chemicals are responsible for the depletion of the stratospheric ozone layer ?

a Refrigerants b Propellants
c Foam-blowing agents d All of the mentioned

Q.75 What does EESC stand for in context of ozone depleting compounds ?

a Equivalent Effective Stratospheric Chlorine
b Equivalent Effective Stratospheric Chlorofluorocarbons
c Equivalent Energy Saving Compounds
d Energy Effective Stratospheric Compounds

Q.76 The Montreal Protocol bans the production of which of the following chemical substances ?

a Chlorine, bromine, CFCs, freons
b Carbon tetrachloride, halons, trichloroethane, CFCs
c CFCs, bromine, halons, freons
d CFCs, halons, freons

Q.77 Where was the first use of nuclear bombs which cause death to the millions of lives ?

a Karachi
b Melbourne and Sydney
c Hiroshima and Nagasaki
d Tokyo

Q.78 Where was the first control fission of an atom carried out ?

a India b Japan
c Russia d Germany

Q.79 Which was the first country to develop atomic bomb ?

a Russia b United States
c China d Japan

Q.80 State true or false. Nuclear energy is only harmful.

a True b False

Q.81 _____ defined as the accidental melting of the core of a nuclear reactor, and refers to the core's either complete or partial collapse

a Nuclear meltdown b Decay heat
c Human error d None of these

Q.82 Which of the following is not cause of Nuclear accident _____

a Nuclear meltdown b Decay heat
c Human error d Volcanic eruption

Q.83 Which State in India nuclear accident took place ?

a Tamil Nadu b Karnataka
c Gujarat d Rajasthan

Q.84 Which one of the following medical condition caused by the high exposure of radiation ?

a Kidney stone b AIDS
c Mutation d Blood pressure

Q.85 What is the main purpose of nuclear energy ?

a To kill the enemy nation

b To waste the excessive energy

c To use it as an alternate source of energy

d To cause mutation for people who are working

Q.86 Approximately how many percentage of electricity produced by nuclear power in the world ?

a 10 b 14

c 17 d 20

Q.87 Which is the main source of nuclear radiations ?

a Nuclear power plant b Sunlight

c Atmospheric air d Volcanoes

Q.88 Which radioactive cause cancer in thyroid gland ?

a U-235 b U-238

c I-132 d C-12

Q.89 State true or false. The use of nuclear energy in war had devastating effects on humans and on the earth.

a True b False

Q.90 What does it mean to reduce ?

a Use something over and over again.

b Use less of something, creating smaller amounts of waste.

c Make something into something new.

d Make something ugly into something beautiful.

Q.91 Reducing, Reusing, and Recycling make the Earth cleaner.

a True b False

Q.92 What does it mean to reuse ?

a Cleaning up a mess.

b Make something into something new.

c Use less of something, creating smaller amounts of waste.

d Use something over and over again.

Q.93 Recycling is something only adults can do.

a True b False

Q.94 Which of the following is NOT a recyclable material ?

a Paper b Plastic

c Food d Metal

Q.95 Plastic bags are better for the environment than reusable bags.

a True b False

Q.96 You can reduce your water usage by shutting off the water while you brush your teeth and taking shorter showers.

a True b False

Q.97 Which of the following is bad for the environment ?

a Recycling b Littering

c Reducing d Reusing

Q.98 No garbage can be recycled.

a True b False

Q.99 How much energy could 1 recycled tin can save ?

a Enough to power a cell phone for 18 hours.

b Enough to power a TV for 3 hours.

c Enough to power a TV for 8 hours.

d None of these

Q.100 It takes more energy to create paper than it does to recycle paper.

a True b False

Q.101 The human activity, among the following, which causes maximum environmental pollution having regional and global impact, is

a Industrialization b Urbanization

c Agriculture d None of these

Q.102 Objective of environmental studies is to

a Create environmental ethics that foster awareness about the ecological inter - dependence of economic, social and political factors in a human community and the environment

b Acquiring skills to help the concerned individuals in identifying and solving environmental problems

c Raise consciousness about environmental conditions

d All of the above

Q.103 The perfect equilibrium existing in the biosphere between the various organisms is known as

a Ecological cycle

b Ecological balance

c Environmental balance d None of these

Q.104 Word "Environment" is derived from :

a French b English

c German d Italy

Q.105 'World Environmental Day' is celebrated every year on :

a 5 July b 5 June

c 5 August d 18 June

Q.106 'Earth's Day' is celebrated every year on :

a 22 July b 13 June

c 13 August d 22 April

Q.107 Reducing the amount of future climate change is called :

a Mitigation b Geo- engineering

c Adaptation d None of these

Q.108 Climate represents _____

a The long-term average weather and its statistical variation for a given region

b Weather averaged over a year

c It is a measure of variations in the amount of precipitation

d None of the above

Q.109 Energy sources that do not increase carbon emissions include –

a Solar cells b Wind mills

c Nuclear power plants d All of the above

Q.110 How does climate change (global warming) affect human health ?

a By increasing illnesses such as heat stress , cardiovascular disease and kidney disease

b By increasing respiratory illnesses such as asthma and allergies

c By increasing insect borne infections such as dengue fever

d All of the above

Q.111 _____ is the artificial modification of Earth's climate systems through two primary ideologies, Solar Radiation Management (SRM) and Carbon Dioxide Removal (CDR).

a Adaptation b Geo- engineering

c Synchronization d Mitigation

Answer Keys for Multiple Choice Questions

Q.1	d	Q.2	d	Q.3	d
Q.4	a	Q.5	b	Q.6	a
Q.7	a	Q.8	b	Q.9	c
Q.10	a	Q.11	d	Q.12	b
Q.13	a	Q.14	b	Q.15	c
Q.16	d	Q.17	a	Q.18	c
Q.19	d	Q.20	b	Q.21	a
Q.22	a	Q.23	c	Q.24	d
Q.25	b	Q.26	a	Q.27	b
Q.28.	b	Q.29	d	Q.30	c
Q.31	a	Q.32	d	Q.33	d
Q.34	b	Q.35	c	Q.36	c
Q.37	b	Q.38	b	Q.39	c
Q.40	b	Q.41	b	Q.42	d
Q.43	b	Q.44	b	Q.45	d
Q.46	a	Q.47	d	Q.48	d
Q.49	b	Q.50	a	Q.51	a
Q.52	a	Q.53	c	Q.54	c
Q.55	d	Q.56	a	Q.57	c
Q.58	b	Q.59	d	Q.60	b
Q.61	d	Q.62	d	Q.63	a
Q.64	c	Q.65	b	Q.66	a

Q.67	b	**Q.68**	a	**Q.69**	b
Q.70	a	**Q.71**	c	**Q.72**	d
Q.73	d	**Q.74**	d	**Q.75**	a
Q.76	b	**Q.77**	c	**Q.78**	d
Q.79	b	**Q.80**	b	**Q.81**	a
Q.82	d	**Q.83**	a	**Q.84**	c
Q.85	c	**Q.86**	c	**Q.87**	a
Q.88	c	**Q.89**	a	**Q.90**	b
Q.91	a	**Q.92**	d	**Q.93**	b
Q.94	c	**Q.95**	b	**Q.96**	a
Q.97	b	**Q.98**	b	**Q.99**	b
Q.100	a	**Q.101**	a	**Q.102**	d
Q.103	b	**Q.104**	a	**Q.105**	b
Q.106	d	**Q.107**	a	**Q.108**	a
Q.109	c	**Q.110**	d	**Q.111**	b

❑❑❑

Notes

2 Energy Resources

Introduction

Natural resources are materials and components (something that can be used) that can be found within the environment. Every man-made product is composed of natural resources (at its fundamental level). A natural resource may exist as a separate entity such as fresh water, air, as well as a living organism such as a fish, or it may exist in an alternate form that must be processed to obtain the resource such as metal ores, rare earth metals, petroleum and most forms of energy.

Biotic Natural Resources

Examples of biotic natural resources :

- Birds
- Ferns
- Flowering plants
- Fruits
- Fungi
- Insects
- Lichens
- Mammals
- Microbes
- Mosses
- Natural gas
- Petroleum
- Reptiles
- Shrubs
- Trees
- Worms

Biotic Resources Grown as Crops

- Basil
- Bay
- Brussels sprouts
- Carrot
- Catnip
- Cauliflower
- Celery
- Cotton
- Corn
- Garlic
- Oat
- Okra
- Parsley
- Peanuts
- Peas
- Rice
- Rye
- Sorghum
- Squash
- Sugarcane
- Sunflower
- Wheat
- Zucchini

Biotic Resources in the Ocean

- Crustaceans and lobsters
- Fish
- Octopi
- Seaweed and kelp
- Shrimp
- Whales and dolphins

Abiotic Natural Resources

Here are examples of abiotic natural resources :

- Barites
- Bauxite
- Chromite
- Coal
- Copper
- Diamond
- Gravel
- Gold
- Iron ore
- Lead
- Marble
- Limestone
- Nickel
- Platinum
- Pumice
- Salt
- Sand
- Silver
- Sulfur
- Talc
- Vanadium
- Zinc

Natural Energy Resources

- Biofuels - Fuels made from plants and animals
- Geothermal energy - Energy generated from and stored in the earth
- Hydroelectric power - Water drives the turbines that produce electricity either in dams or tides
- Natural gas - This is a fossil fuel
- Nuclear energy - Created by splitting the atom
- Solar energy - The sun's rays heat solar cells that make electricity
- Wind power - The wind turn the turbines that make electricity

Natural Resources by Country

Here are examples of natural resources from select countries around the world :

Australia

- Bauxite
- Coal
- Copper
- Diamonds
- Gold Lead
- Iron ore
- Mineral sands
- Natural gas
- Nickel
- Petroleum
- Silver
- Tin
- Tungsten
- Uranium
- Zinc

Brazil

- Bauxite
- Gold
- Hydropower
- Iron ore
- Manganese
- Nickel Petroleum
- Phosphates
- Platinum
- Timber
- Tin
- Uranium

Canada

- Coal
- Copper
- Diamonds
- Fish

- Gold
- Hydropower
- Iron ore
- Lead
- Molybdenum
- Natural gas
- Nickel
- Petroleum
- Potash
- Silver
- Timber
- Wildlife
- Zinc

China

- Aluminum
- Antimony
- Coal
- Iron ore
- Lead
- Mercury
- Magnetite
- Manganese
- Molybdenum
- Natural gas
- Petroleum
- Tin
- Tungsten
- Uranium
- Vanadium
- Zinc

Egypt

- Asbestos
- Gypsum
- Iron ore
- Lead
- Limestone
- Manganese
- Natural gas
- Phosphates
- Petroleum
- Talc
- Zinc

France

- Antimony
- Arsenic
- Bauxite
- Coal
- Feldspar
- Fluorspar
- Fish
- Gypsum
- Iron ore
- Potash
- Timber
- Uranium
- Zinc

Greenland

- Coal
- Diamonds
- Fish
- Gold
- Hydropower
- Iron ore
- Lead
- Molybdenum
- Niobium
- Platinum
- Seals
- Tantalite
- Uranium
- Whales
- Zinc

India

- Arable land
- Bauxite
- Chromite
- Coal
- Diamonds
- Iron ore
- Limestone
- Manganese
- Mica
- Natural gas
- Petroleum
- Titanium ore

Italy

- Arable land
- Asbestos
- Barite
- Coal
- Feldspar
- Fish
- Fluorspar
- Marble
- Mercury
- Potash
- Pumice
- Pyrite
- Zinc

Kenya

- Diatomite
- Fluorspar
- Gemstones
- Gypsum
- Hydropower
- Limestone
- Salt
- Soda ash
- Wildlife
- Zinc

Mexico

- Copper
- Gold
- Lead
- Natural gas
- Petroleum
- Silver
- Timber
- Zinc

New Zealand

- Coal
- Gold
- Hydropower
- Iron ore
- Limestone
- Natural gas
- Sand
- Timber

Norway

- Copper
- Fish
- Hydropower
- Iron ore
- Lead
- Natural gas
- Nickel
- Petroleum
- Pyrites
- Timber
- Titanium
- Zinc

Seychelles

- Cinnamon trees
- Copra
- Fish

South Africa

- Antimony

- Chromium
- Coal
- Copper
- Gem diamonds
- Gold
- Iron ore
- Manganese
- Natural gas
- Nickel
- Phosphates
- Platinum
- Salt
- Tin
- Uranium
- Vanadium

Sri Lanka

- Clay
- Gems
- Graphite
- Hydropower
- Limestone
- Mineral sands
- Phosphates

Sweden

- Arsenic
- Copper
- Feldspar
- Gold
- Hydropower
- Iron ore
- Lead
- Silver
- Timber
- Tungsten
- Uranium
- Zinc

Thailand

- Arable land
- Fish
- Fluorite
- Gypsum
- Lead
- Lignite
- Natural gas
- Rubber
- Tantalum
- Timber
- Tin
- Tungsten

Ukraine

- Arable land
- Coal
- Graphite
- Iron ore
- Kaolin
- Magnesium
- Manganese
- Mercury
- Natural gas
- Nickel
- Oil
- Salt
- Sulfur
- Timber
- Titanium

United Kingdom

- Arable land
- Chalk
- Clay
- Coal
- Gold
- Gypsum

- Iron ore
- Lead
- Limestone
- Natural gas
- Potash
- Petroleum
- Salt
- Silica sand
- Slate
- Tin
- Zinc

United States

- Bauxite
- Coal
- Copper
- Lead
- Gold
- Iron
- Mercury
- Molybdenum
- Natural gas
- Nickel
- Petroleum
- Phosphates
- Potash
- Silver
- Timber
- Tungsten
- Uranium
- Zinc

2.1 Natural Resource - Forest Resources, Water Resources, Energy Resources, Land Resources, Mineral Resources

Forest Resources

Forest types of India

- Wet Evergreen forest.
- Semi Evergreen forest.
- Moist Deciduous forest.
- Dry Deciduous forest.
- Littoral and Swamp forest / Mangrove forest.
- Dry Evergreen forest.
- Thorn forest.
- Sub tropical broad leaved forest.

Forests are among the most diverse and widespread ecosystems on earth, and have many functions: they provide timber and other forest products; have cultural values; deliver recreation benefits and ecosystem services, including regulation of soil, air and water; are reservoirs for biodiversity; and act as carbon sinks. The forest area differs from state to state in India. Madhya Pradesh stands at the top in the total forest area, followed by the Arunachal Pradesh, Chhattisgarh, Maharashtra, and Odisha. One-fourth of the total forest covered area of the country is in the north-eastern states.

Major Causes of Deforestation

- Expansion of Agriculture
- Extension of Cultivation on Hill Slopes
- Cattle Ranching
- Firewood Collection
- Timber Harvesting
- Shifting Cultivation
- Government Policies : As discussed earlier, the policy followed by Colonial ruler and the policy of government in free India.

Water Resources

Water resources are sources of water that are useful or potentially useful to humans. It is important because it is needed for life to exist. Many uses of water include agricultural, industrial, household, recreational and environmental activities. Virtually all of these human uses require fresh water. Only 2.5 % of water on the Earth is fresh water, and over two thirds of this is frozen in glaciers and polar ice caps.

Water demand already exceeds supply in many parts of the world, and many more areas are expected to experience this imbalance in the near future. It is

estimated that 70 % of world-wide water use is for irrigation in agriculture.

Climate change will have significant impacts on water resources around the world because of the close connections between the climate and hydrologic cycle. Due to the expanding human population competition for water is growing such that many of the world's major aquifers are becoming depleted. Many pollutants threaten water supplies, but the most widespread, especially in underdeveloped countries, is the discharge of raw sewage into natural waters.

Some of the water resources are

- Drought, floods and shortage of drinking water.
- Surface and ground water storage.
- Hydro power potential.
- Rivers.
- Lakes.
- Wetlands.
- Water supply and sanitation.

Energy Resources

Energy is the capacity to do work and is required for life processes. An energy resource is something that can produce heat, power life, move objects, or produce electricity. Matter that stores energy is called a fuel.

Most of the energy we use today come from fossil fuels (stored solar energy). But fossils fuels have a disadvantage in that they are non-renewable on a human time scale, and cause other potentially harmful effects on the environment. In any event, the exploitation of all energy sources (with the possible exception of direct solar energy used for heating), ultimately rely on materials on planet Earth.

There are 5 fundamental sources of energy :

1. Nuclear fusion in the Sun (solar energy)
2. Gravity generated by the Earth and Moon.
3. Nuclear fission reactions.
4. Energy in the interior of the Earth.
5. Energy stored in chemical bonds.

Solar Energy : Solar Energy arrives from the Sun by electromagnetic radiation. It can be used directly for heat and converted to electricity for other uses. It is a nearly unlimited source, it is renewable, and largely, non-polluting.

Gravity Generated by the Earth and Moon : Gravitational pull of the Moon on the Earth causes tides. Tidal flow can be harnessed to drive turbines. This is also a nearly unlimited source of energy and is largely non-polluting.

Nuclear Fission Reactions : Radioactive Uranium is concentrated and made into fuel rods that generate large amounts of heat as a result of radioactive decay. This heat is used to turn water into steam. Expansion of the steam can then be used to drive a turbine and generate electricity

Energy in the Interior of the Earth : Decay of radioactive elements has produced heat throughout Earth history. It is this heat that causes the temperature to increase with depth in the Earth and is responsible for melting of mantle rocks to form magmas. Magmas can carry the heat upward into the crust.

Energy Stored in Chemical Bonds : Energy stored in chemical bonds drives chemical reactions. When the reactions take place this energy is either released or absorbed. If it is absorbed, it is stored in the chemical bond for later use. If it is released, it can produce useful heat energy. electricity and light.

Land Resources :

Land is a naturally occurring finite resource. It provides the base for survival of living beings. It holds everything that constitutes terrestrial ecosystems. Increased demand on land in modern times due to the rise in human population and resultant activities has resulted in degradation of land quality and quantity, decline in crop production, and competition for land.

Land and Land Resources refer to a delineable area of the earth's terrestrial surface, encompassing all attributes of the biosphere immediately above or below this surface, including those of the near-surface climate, the soil and terrain forms, the surface hydrology (including shallow lakes, rivers, marshes and swamps), the near-surface

sedimentary layers and associated groundwater and geo-hydrological reserve, the plant and animal populations, the human settlement pattern and physical results of past and present human activity (terracing, water storage or drainage structures, roads, buildings, etc.)

Mineral Resources : Mineral resources are non-renewable and include metals (e.g. iron, copper and aluminum), and non-metals (e.g. salt, gypsum, clay, sand, phosphates). Minerals are valuable natural resources being finite and non-renewable.

Types of Mineral Resources :

A) Fuel Minerals

i) Coal

ii) Crude Oil (Petroleum)

iii) Natural Gas

B) Metallic and Non-metallic Minerals

2.2 Renewable, Non-renewable Resources and Cyclic Resources

2.2.1 Renewable Resources

The resources which can be renewed and reproduced by physical, chemical or mechanical processes are known as renewable or replenishable resources. These resources are able to increase their abundance through reproduction and utilization of simple substances. Examples of such resources are- water, forests and wildlife, plants etc.

Renewable Resources can be further classified as **Living Renewable Resources** and **Non-Living Renewable Resources.**

Examples of renewable resources though they **do not have life cycle** but **can be recycled** are wood and wood-products, pulp products, natural rubber, fibers (e.g. cotton, jute, animal wool, silk and synthetic fibers) and leather.

- **Living Renewable (biological) resources** are those renewable resources which come from living (biotic) sources .
- Examples - forests, plants.
- **Non-Living Renewable resources** are those renewable resources which come from non-living (abiotic) sources like land, water, air.

  Examples - metals, minerals, wind, sun etc.

2.2.2 Non-renewable Resources

A non-renewable resource is a natural resource that is used up faster than it can be made by nature. It cannot be produced, grown or generated on a scale which can sustain how quickly it is being consumed. Once it is used up, there is no more available for the future. Fossil fuels (such as coal, petroleum and natural gas), types of nuclear power (uranium) and certain examples.

2.2.3 Cyclic Resources

The resources which can be used again and again passing through some processes are known as cyclic resources. An example of cyclic resource may be water, coal.

Difference between renewable and non-renewable resources

Parameters	Renewable Resources	Non-renewable Resources
Definition	A **renewable resource** is one that naturally replaces itself at a rate near or equal to the rate at which you're using it.	**Non-renewable** resource does not replace itself at the rate it is being used.
Classification	Renewable resources can be further divided in **two types :** Living Renewable Resources and Non-Living Renewable Resources	Non-Renewable Resources can be further classified into **two types :** Recyclable and Non-Recyclable resources
Advantages	i) Renewable energy is beneficial because we do not have to worry about its depletion. ii) Renewable energies such as wind and hydropower provides for cleaner, environmentally friendlier power sources.	i) Non-renewable resources are easy to use as these are relatively cheap to mine and to convert into energy
Disadvantages	Technologies to utilize renewable resources is very costly and do not give much efficiency.	The non-renewable resources are fast depleting and causing a lot of environmental pollution
Examples	Hydropower, Wind, Solar energy etc	Coal, Oil, Natural gas etc.

2.3 Causes and Effects of Depletion of Resources

Resource depletion is the consumption of a resource faster than it can be replenished. Natural resources are commonly divided between renewable resources and non-renewable resources. The major causes of resource depletion are listed below.

1. Overpopulation
2. Over-consumption and waste
3. Deforestation and the destruction of ecosystems
4. Mining
5. Technological and industrial development
6. Soil erosion
7. Pollution and contamination of resources

- **Overpopulation** - With increasing population, demands of the country increase which further results in depletion of resources
- **Over-consumption and waste** - As the standards of living of people improves, they tend to consume more and waste even more.
- **Deforestation and the destruction of ecosystems** - Forests are cut annually, to make space for multiplexes, residential complexes etc. This not only destroys trees (and wood as a resource) but also destroys home of thousands of species of animals.
- **Mining** - Mining of minerals and oil-minerals and metals are in high demand in today's world. This is a very big problem as ores are being depleted day by day.

- **Technological and industrial development** - Technology advances and so the need of resources increases.
- **Soil erosion** - Because of deforestation, soil erosion takes place. Thus, soil gets devoid of important minerals and resources.
- **Pollution and contamination of resources** - Water pollution, soil pollution is increasing at an alarming rate today due to negligent attitude of people towards the environment. Pollution has a direct effect on contamination of resources available in nature.

Effects of Natural Resources Depletion

The depletion of natural resources has adverse effect not only on the human life but the environment too. Some of these are as listed below :

- **Resource Scarcity :** Resources like fossil fuels, timber, water and arable land become scarce because of over-consumption and degradation, mostly in the areas of tremendous population growth.
- **Rising Prices :** When natural resources become scarce, food, fuel and energy prices rise. Even the price of renewable resources increases if they need to be shipped to reach areas where these have been depleted.
- **Water Shortages :** When infrastructure development and population growth increase, water shortages occur. As of today, almost 1 billion people lack access to clean water.

Solutions to Prevent / Reduce Natural Resource Depletion

The likely solutions to reduce the resource depletion are as follows :

- **Reduced Use of Fossil Fuels :** We can conserve fossil fuels by using less gasoline and electricity. Driving less and saying yes to carpooling are simple ways to conserve gasoline. Buying a vehicle having high fuel mileage and purchasing energy star appliances can also contribute to conservation of fossil fuels.
- **Keep Water Clean :** Water may seem like a never-ending resource which is found everywhere, but due to population growth, the access to clean water for large populations decreases. Water can be saved by taking small steps in and around our home. Some of these include checking for water leaks and replacing or fixing leaky faucets.
- **Preserve Trees and Forests :** To satisfy the world's need for paper alone, approximately 4 billion trees get cut down per year. Thus, preventing the deforestation is very necessary. One can greatly contribute in this context by using less paper, using more cloth towels and not paper ones or by switching to an online-only subscription of your favourite newspaper. During a visit to a local forest, one should act responsibly and make sure that campfires are safely maintained.
- **Protect Coastal Ecosystems :** Coastal ecosystems are very important for maintaining biodiversity, but they are also extremely valuable for industries like fishing and tourism industries. Seafood consumers should keep in mind how their purchasing decisions can affect the environment. Reefs are extremely sensitive to disturbances. Diving or snorkelling around a reef should be done while treating the reefs with care and respect.

2.4 Energy Forms (Conventional and Non-conventional)

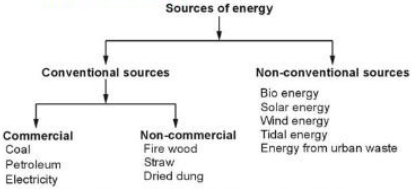


Fig. 2.4.1 Classification of energy resources

Conventional Sources of Energy :

These sources of energy are also called non renewable sources. These sources of energy are in limited quantity except hydro-electric power. These are further classified as commercial energy and non-commercial energy :

Commercial Energy Sources :

These are coal, petroleum and electricity. These are called commercial energy because they have a price and consumer has to pay the price to purchase them.

a) Coal and Lignite : Coal is the major source of energy. Coal deposits in India are 148790 million tonnes. Total lignite reserves found at Neyveli are 3300 million tonnes. In 1950-51, annual production of coal was 32 million tonnes. In 2005-06, annual production of coal was 343 million tonnes.

Lignite production was 20.44 million tonnes in 2005-06. According to an estimate, coal reserves in India would last about 130 years. India is now the fourth largest coal producing country in the world. Coal deposits are mainly found in Orissa, Bihar, Bengal and Madhya Pradesh. It provides employment to 7 lakh workers.

b) Oil and Natural Gas : In these days oil is considered as the most important source of energy in India and the world. It is widely used in automobiles, trains, planes and ships etc. In India it is found in upper Assam, Mumbai High and in Gujarat. The resources of oil are small in India.

In 1950-51, the total production of oil in India was 0.3 million tonnes. It increased to 32.4 million tonnes in 2000-01. Despite tremendous increase in oil production, India still imports 70 % of oil requirements from abroad. In 1951, there was only one oil refinery in Assam. After independence 13 such refineries were set up in public sector and their refining capacity was 604 lakh tonnes. After implementation of economic reforms, private refineries are also engaged in oil refining. As per current rate of consumption, oil reserves in India may last about 20 to 25 years.

Non-Conventional Sources of Energy :

Besides conventional sources of energy there are non-conventional sources of energy. These are also called **renewable sources of energy**. Examples are bio energy, solar energy, wind energy and tidal energy. Govt. of India has established a separate department under the Ministry of Non-conventional Energy Sources for effective exploitation of non-conventional energy.

The various sources are given below :

1. **Solar Energy :** Energy produced through the sunlight is called solar energy. Under this programme, solar photovoltaic cells are exposed to sunlight and in the form of electricity is produced. Photovoltaic cells are those which convert sun light energy into electricity. In year 1999-2000, 975 villages were illuminated through solar energy. Under Solar Thermal Programme, solar energy is directly obtained. Sunlight is converted into thermal power. Solar energy is used for cooking, hot water and distillation of water etc.
2. **Wind Energy :** This type of energy can be produced by harnessing wind power. It is used for operating water pumps for irrigation purposes. Approximately 2756 wind pumps were set up for this purpose. In seven states, wind power operated power houses were installed and their installed capacity was 1000 MW. India has second position in wind power energy generation.
3. **Tidal Energy :** Energy produced by exploiting the tidal waves of the sea is called tidal energy. Due to the absence of cost effective technology, this source has not yet been tapped.
4. **Bio Energy :** This type of energy is obtained from organic matter.

It is of two kinds :

i) Bio Gas : Bio Gas is obtained from Gobar Gas plant by putting cow dung into the plant. Besides producing gas this plant converts gobar into manure. It can be used for cooking, lighting and generation of electricity. 26.5 lakh bio gas plants had been established by the year 2003-04. They produce more than 225 lakh tonnes of manure. About 1828 large community bio gas plants have been established in the country.

ii) Bio Mass : It is also a source of producing energy through plants and trees. The purpose of bio mass programme is to encourage afforestation for energy. So that fuel for the generation of energy based on gas technique and fodder for the cattle could be obtained, 56 MW capacity for the generation of bio mass energy has been installed.

5. **Energy from Urban Waste :** Urban waste poses a big problem for its disposal. Now it can be used for generation of power. In Timarpur (Delhi) a power station of 3.75 capacity has been set up to generate energy from the garbage.

2.5 Present Global Energy Use and Future Demands

Global energy consumption is defined as the total energy used by an individual or organizations from around the world. Disparity between countries in the amount of per capita energy consumption typically reflects income level or climate.

Country (Consumers)	Percent of World Energy Consumed
United States	21 %
China	16
Russia	6
Japan	5

Table 2.5.1 Global energy consumption

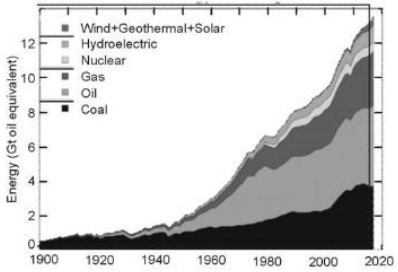


Fig. 2.5.1 Global energy consumption

Energy Consumption by source

Fossil fuels

The twentieth century saw a rapid twenty-fold increase in the use of fossil fuels. Between 1980 and 2006, the worldwide annual growth rate was 2 %. According to the US Energy Information Administration's 2006 estimate, the estimated 471.8 EJ total consumption in 2004, was divided with fossil fuels supplying 86 % of the world's energy :

Coal

In 2000, China accounted for 28 % of world coal consumption, other Asia consumed 19 %, North America 25 % and the EU 14%. The single greatest coal-consuming country is China. Its share of the world coal production was 28 % in 2000 and rose to 48 % in 2009. In contrast to China's ~70 % increase in coal consumption, world coal use increased 48 % from 2000 to 2009. In practice, the majority of this growth occurred in China and the rest in other Asia. China's energy consumption is mostly driven by the industry sector, the majority of which comes from coal consumption.

World annual coal production increased 1,905 Mt or 32 % in 6 years in 2011 compared to 2005, of which over 70 % was in China and 8 % in India. Coal production was in 2011 7,783 Mt, and 2009 6,903 Mt, equal to 12.7 % production increase in two years.

Oil

Oil became the dominant fuel during the twentieth century. The growth of oil as the largest fossil fuel was further enabled by steadily dropping prices from 1920 until 1973. After the oil shocks of 1973 and 1979, during which the price of oil increased from 5 to 45 US dollars per barrel, there was a shift away from oil. Coal, natural gas and nuclear became the fuels of choice for electricity generation and conservation measures increased energy efficiency. In the U.S. the average car more than doubled the number of miles per gallon. Japan, which bore the brunt of the oil shocks, made spectacular improvements and now has the highest energy efficiency in the world. From 1965 to 2008, the use of fossil fuels has continued to grow and their share of the energy supply has increased. From 2003 to 2008, coal was the fastest growing fossil fuel.

It is estimated that between 100 and 135 billion tons of oil has been consumed between 1850 and the present.

Natural Gas

In 2009, the world use of natural gas grew 31 % compared to 2000. 66 % of this growth was outside EU, North America, Latin America, and Russia. Others include the Middle East, Asia, and Africa. The gas supply increased also in the previous regions: 8.6 % in the EU and 16 % in the North America 2000-2009.

Nuclear power

As of 1st July 2016, the world had 444 operable grid-electric nuclear power reactors with 62 others under construction. Since commercial nuclear energy began in the mid 1950s, 2008 was the first year that no new nuclear power plant was connected to the grid, although two were connected in 2009.

Annual generation of nuclear power has been on a slight downward trend since 2007, decreasing 1.8 % in 2009 to 2558 TWh, and another 1.6 % in 2011 to 2518 TWh, despite increases in production from most countries worldwide, because those increases were more than offset by decreases in Germany and Japan. Nuclear power met 11.7 % of the world's electricity demand in 2011.

Renewable energy

Renewable energy is generally defined as energy that comes from resources that are not significantly depleted by their use, such as sunlight, wind, rain, tides, waves and geothermal heat. Renewable energy is gradually replacing conventional fuels in four distinct areas : electricity generation, hot water/space heating, motor fuels, and rural (off-grid) energy services. At the national level, at least 30 nations around the world already have renewable energy contributing more than 20 percent of energy supply. National renewable energy markets are projected to continue to grow strongly in the coming decade and beyond.

2.6 Energy Conservation : Why ?

We must conserve energy because of a number of reasons. These are explained below :

Demand exceed Supply

There is an increasing demand for energy due to increasing population, industrialization, traffic on roads and automation in home, office and farms. We must have observed that the ever increasing population is creating an increasing demand for energy. Increasing number of people need more houses to live in and this leads to increased felling of trees to provide timber and furnishing. At the same time, more coal, kerosene and gas are needed to cook the food for more people. More people today need more electricity to light their home, to run their coolers and geysers, to run washing machines, computers, etc., which results in increased use of power leading to power cuts.

By conservation and wise use of energy available

Energy saved is energy generated

Now, imagine that there is an energy bank. Whatever energy we save in our daily activities gets accumulated in this energy bank so that we can use it in future. As our 'energy savings' grow, there will be less pressure to produce more energy. Similarly, the energy that we save could be used elsewhere. For example, if we decide to have a daytime wedding in the family, with no decorative lights, the electricity we save could perhaps prevent a couple of power cuts in the city.

Every person's motto today should be -

Save on Something (S.O.S.)

Fuels are limited

Fuels are the most common sources of energy and deposits of coal, gas and oil are limited. A look at the chart given below will tell us where we stand today in terms of their availability to us in the years to come.

Fuel	Known supplies (in years)	When likely to run out
Natural Gas	about 30	AD.2035
Oil	about 50	AD.2055
Coal	about 280	AD.2285

Table 2.6.1 Fuel supply distribution

After this what ? We can see that oil and natural gas are likely to run out during your own life time. The choice is before us ! Either we carry on as we are or we must plan the use of fuels so that we conserve them for future use.

Conservation of Energy : How ?

By now, we all have realized the fact that we are facing a very real possibility of some of these energy resources drying up during our lifetime. Conservation of energy has to be the order of the day. Each and every one of us has to unite and collectively take action to preserve and conserve energy. Each one of us has to think, "Is there anything which I can do?"Yes, there are many small ways in which we can contribute our share of efforts in energy conservation. Energy can primarily be conserved :

At home

In the farm or workplace

On the road

Energy Conservation at Home :

a) Power :

Take a look at your last power bill. It need not have been as much as it is. Just a little care, a little alertness on your part could have brought it down . How ?

Switch off lights and fan while leaving a room.

Change over to energy efficient tubelights from power consuming bulbs.

Remember! A40 watt tube light gives twice as much light as a 100watt incandescent bulb. This means a savings of 60 % power in addition to more light!

Replace traditional choke so tube lights with electronic chokes. They consume one third energy.

Keep lights and fixtures clean and dirt free.

b) Fuel :

As for power, We can adopt many simple ways in which to cut down fuel bills. Those of us who use LPG or gas cylinders for cooking at home are already aware of the way in which gas prices have been shooting up recently. Kerosene prices are not far behind. So what can we do to reduce our fuel bills ? Here are some tips.

Use ISI marked cooking stoves only.

Replace traditional wood stoves with the 'unnat chullah' (smokeless chullah) developed by the Government. These are 20-25% more heat efficient.

Use solar cookers as far as possible.

Avoid cooking in open pans. Use a pressure cooker and save your fuel.

Use separator pressure cooker to cook more than one dish at a time.

Use copper bottom or sandwich bottom pans which are more heat sensitive.

Switch on the gas after putting the pan on and switch off before removing the pan.

Energy conservation in the farm and workplace :

Farmers are increasingly using farm machinery like tractors, threshers, water pumps, etc. An effort must be made by farmers too to conserve energy, which means they must try to get maximum work done with the use of least possible energy.

Maintain tractors well. Poor maintenance leads to 25 % loss of diesel.

Prevent leakage of diesel.

Switch off the engine when the tractor is not in use.

Drive in appropriate gear.

Keep the air filter clean to reduce wear and tear of the engine.

Replace old tyres.

Plan the use of tractor on the field. Digging in length wise direction rather than width wise, saves diesel in the field.

Energy Conservation at Workplace :

The feeling people generally have is - "Who cares about energy conservation at the office. After all, I'm not paying for it!"But this is where we go wrong. Ultimately it is we who pay for all the energy that is wasted in the office-in the form of energy shortages, higher price to be paid for energy, more taxes.

Energy Conservation on Road :

Many more people own vehicles today than they did ten years ago. Vehicles are used to go to the office as well as for family outings. This has resulted in a tremendous increase in the use of petrol, diesel and compressed natural gas(CNG). What do you suggest to control the use of petrol, diesel and CNG ?We could consider the following :

Use a carpool instead of individual cars to travel to work

Adopt petrol saving measures such as -

Constant speed

Drive at as low minimize the use of brake and clutch

Maintain proper air pressure in the tyres.

Prevent leakage of fuel at all costs

Keep the engine well tuned.

Encourage installation of light sensitive switches and solar panels for street lights.

2.7 Overuse of Natural Resources and it's Impact on Environment

Environmental consequences across the entire supply chain. In short, raw material extraction and processing always impact on the environment, resulting as they do in soil degradation, water shortages, biodiversity loss, damage to ecosystem functions and global warming exacerbation. And that's not all.

Natural resources exploitation, exploration, mining and processing have caused different types of environmental damages which include ecological disturbances, destruction of natural flora and fauna, pollution of air, water and land, instability of soil and rock masses, landscape degradation, desertification and global warming. The environmental damage has in turn resulted in waste of arable land as well as economic crops and trees. Since much of the damage is inevitable if the natural resources must be developed, both the government and the natural resource industry must be involved in taking precautionary and remedial measures that can minimize the ill-effects of natural resources exploitation. Emphasis should shift from waste disposal to waste minimization through sorting, recycling, bioremediation, afforestation, sewage treatment and pollution control, while the government should provide the regulatory legislation with appropriate sanctions or where these regulatory bodies already exist, the enforcement of laws and policy implementation is of paramount importance. The oil and gas industries, mining companies and other natural resources exploitation bodies are expected to carry out mandatory precautions, remedies or compensation for damage done.

Multiple Choice Questions :

Q.1 Which one of the following is an example of non-renewable resources ?

[a] Wind [b] Water
[c] Vegetation [d] Coal and minerals

Q.2 Which of the following is a renewable resource ?

[a] Soil [b] Water
[c] Flora and fauna [d] All the above

Q.3 ____of stratosphere provides protection to our life.

[a] Nitrogen [b] Hydrogen
[c] Ozone [d] Argon

Q.4 The life supporting gases such as O_2, CO_2 and N_2 are chiefly concentrated in the_____.

[a] troposphere [b] exosphere
[c] homosphere [d] stratosphere

Q.5 Which of the following soil is the best for plant growth ?

[a] Sandy soil [b] Clay
[c] Gravel [d] Loamy soil

Q.6 Both power and manure are provided by _____.

[a] thermal plants [b] nuclear plants
[c] biogas plants [d] hydroelectric plants

Q.7 In the atmosphere, the layer above the troposphere is _____.

[a] stratosphere [b] exosphere
[c] mesosphere [d] thermosphere

Q.8 _____ is the major raw material for biogas.

[a] Plant leaves [b] Cow dung
[c] Mud [d] Grass

Q.9 A biosphere reserve conserves and preserves_____.

[a] wild animals [b] wild land
[c] natural vegetation [d] all the above

Q.10 Atomic energy is obtained by using ores of_____.

[a] copper [b] uranium
[c] neither (a) nor (b) [d] both (a) and (b)

Q.11 Sanctuaries are established to_____.

[a] rear animals for milk [b] entrap animals
[c] protect animals [d] none of the above

Q.12 The death of the last individual of a species is called _____.

a extinction b clad
c neither (a) nor (b) d species diversity

Q.13 Which one of the following is not a fossil fuel ?

a Natural gas b Petrol
c Coal d Uranium

Q.14 Biogas generation is mainly based on the principle of _____.

a fermentation b degradation
c putrification d both (a) and (b)

Q.15 Red Data Book provides a list of _____.

a advanced plants
b rare, endangered or endemic species
c disease resistant animals d none of the above

Q.16 Floods can be prevented by_____.

a afforestation b cutting the forests
c tilling the land d removing the top soil

Q.17 Which of the following is a green house gas ?

a Nitrogen dioxide b Sulphur dioxide
c Carbon dioxide d Carbon monoxide

Q.18 Floods can be prevented by

a afforestation b removing top soil
c deforestation d agriculture

Q.19 Narmada bachao andolan was to _____.

a clean narmada b expand narmada
c save narmada d none of above

Q.20 Which of the following is best method from environment point of view ?

a Reduce b Recycle
c Reuse d All of above

Q.21 The full form of UV rays is _____.

a Ultra violet b Ultra violent
c Ultra valve d Ultimate violet

Q.22 Synthetic material / chemical which depleted Ozone layer is _____.

a CFCs b CFLs
c CO_2 d none of above

Q.23 What is coliform ?

a Group of bacteria b Group of viruses
c Group of micro oragnisms d Group of diseases

Q.24 What is the name given for replenishment of forest ?

a Afforestation b Silviculture
c Deforestation d Sericulture

Q.25 Why should we conserve forest and wild life ?

a To protect biodiversity
b To maintain ecosystem
c To maintain balance
d To continue food chain

Q.26 Water harvesting is a method which _____.

a increase ground water level
b not practiced in modern days
c has no relation with ground water
d decrease ground water level

Q.27 Energy we use to heat our homes, drive our cars and run our computers comes from _____.

a artificial resources b natural resources
c renewable resources
d non renewable resources

Q.28 Way we consume these renewable resources, it effects their _____.

a efficiency b power
c availability d cost

Q.29 To preserve resources for future, we have to ____.

a look for more b save them
c consume more of them
d use them more frequently

Q.30 Most natural resources we consume at our homes or in our cars are ____.

a renewable b non renewable
c infinite d free

Q.31 For travelling short distances, best way to conserve natural resources is _____.

[a] by driving [b] by flying
[c] by taking lift [d] by cycling

Q.32 What strategies has been taken by government for conservation of natural resources ?

[a] Implementation of laws
[b] Minimizing human activities
[c] Less use of coal [d] all of them

Q.33 When natural resources are changed into another product by people is known as

[a] secondary activities [b] primary activities
[c] nutrient cycling [d] tertiary activities

Q.34 Resources that people use are concentrated on the

[a] ocean shelf [b] continental Shelf
[c] ocean [d] water earth

Q.35 Natural resources and wild life are destroyed in which building which source of energy ?

[a] Solar energy [b] Wind energy
[c] Hydro energy [d] Nuclear energy

Q.36 The resources which are found everywhere are known as _____.

[a] ubiquitous
[b] non-renewable resource
[c] human made resources
[d] none of the above

Q.37 The following is (are) the non-renewable resources _____.

[a] Coal [b] Petroleum
[c] Natural gas [d] All of the above

Q.38 Balancing the need to use resources and also conserve them for the future is called _____.

[a] sustainable development
[b] resource conservation
[c] resource development
[d] human resource development

Q.39 The resources can be conserved by reducing ____

[a] reducing consumption [b] recycling
[c] reusing [d] all of the above

Q.40 Land covers _____ percent of the total area of the earth's surface

[a] 20 [b] 25 [c] 30 [d] 35

Q.41 The total percent of land of world under forest is

[a] 26 [b] 31
[c] 36 [d] 41

Q.42 The thin layer of grainy substance covering the surface of the earth is called _____.

[a] soil [b] sand
[c] mineral [d] organic matter

Q.43 The following is (are) not a factor(s) of soil formation

[a] Organic matter [b] Soil texture
[c] Minerals [d] All

Q.44 The major factor(s) of soil formation is (are)

[a] the nature of the parent rock
[b] climatic factors
[c] time taken for the composition of soil formation
[d] all of the above

Q.45 The following factor(s) is (are) responsible for degradation of soil

[a] Chemical fertilizers [b] Landslides
[c] Floods [d] All of the above

Q.46 The process in which bare ground between plants is covered with a layer of organic matter like straw, is called _____.

[a] mulching [b] contour carriers
[c] shelter belts [d] intercropping

Q.47 The process in which different crops are grown in alternate rows and are sown at different times to protect the soil from rain wash, is known as ____.

[a] crop rotation [b] intercropping
[c] terrace farming [d] contour cropping

Q.48 All forms of water that comes down on earth, including rain, snow, hail etc. is known as _____

[a] calcification [b] fixation
[c] precipitation [d] accumulation

Q.49 The ocean covers _____ percentage of earth's surface.

a 51 % b 61 %
c 71 % d 91 %

Q.50 Green revolution is associated with _____.

a sericulture b agriculture
c fish culture d silvicultur

Q.51 The components of LPG are _____ .

a Methane & Hexane b Propane & Butane
c Ethane & Methane d Propane & Ethane

Q.52 Major consumer of wood from forest is _____.

a thermal power plant b paper industry
c chemistry industry d none

Q.53 The portion of the earth and its environment which can support life is known as _____.

a crust b biosphere
c exosphere d atmosphere

Q.54 What is troposphere ?

a Portion of air
b Portion of water
c Lowest layer of atmosphere where we survive
d Portion of sky

Q.55 The main energy source for the environment is _____.

a solar energy b chemical energy
c bioelectric energy d electrical energy

Q.56 Which gas is likely to be reduced in the atmosphere by deforestation ?

a Carbon dioxide b Nitrogen
c Oxygen d Sulphur dioxide

Q.57 What are rodenticides ?

a That kill fishes b That kill insects
c That kill rats d That kill crocos

Q.58 Which of the following is most responsible for world water crisis ?

a Dams b Floods
c Drought d Population growth

Q.59 The resources that can be replaced by natural ecological cycle is called _____.

a renewable b non-renewable
c exhaustible d natural

Q.60 The amount of solar radiation reaching the surface of the earth is called _____.

a solar flux b reflected light
c minerals d solvents

Q.61 The most harmful of ultraviolet radiations are _____.

a UV-C b UV-B
c UV-A d All the above

Q.62 Grassland of USA is referred to as _____.

a Prairies b Steppes
c Pampas d Veldts

Q.63 Extensive planting of trees to increase forest cover is called _____.

a afforestation b agroforestry
c deforestation d social forestry

Q.64 Soil erosion can be prevented by _____.

a deforestation b afforestation
c overgrazing d removal of vegetation

Q.65 A renewable source of energy is _____.

a petroleum b coal
c nuclear fuel d trees

Q.66 'Smog' is a mixture of _____.

a smoke and fog b snow and fog
c snow and dust
d sulphur dioxide and fog

Q.67 Moisture in the air is known as _____.

a water b fog
c snow d humidity

Q.68 The capacity to do work is termed as _____.

a power b force
c strength d energy

Q.69 Ozone layer is present in _____.

a troposphere b stratosphere
c mesosphere d ionosphere

Q.70 Ozone Umbrella is located in which layer of atmosphere _____.

a troposphere b stratosphere
c mesosphere d ionosphere

Q.71 The unit of total water content of the soil is known as _____.

a Holard b Chraserd
c Echard d All of the above

Q.72 Pedology ?

a Study of water b Study of air
c Study of soil d None

Q.73 What is deforestation ?

a Product of forest b Destruction of forest
c Forest protection d None

Q.74 Deforestation generally decreases _____.

a global warming b drought
c soil erosion d rainfall

Q.75 Which among the following result in the formation of soil ?

a Radiation b Weathering
c Erosion d Pollution

Q.76 Mulching helps in _____.

a soil fertility
b moisture conservation
c improvements soil structure
d soil sterility

Q.77 Atmospheric humidity is measured by _____.

a Auxanometer b Photometer
c Hygrometer d None

Q.78 Boiling water reactor and pressurised water reactors are _____.

a nuclear reactor b solar reactor
c OTEC d biogas reactor

Q.79 The first controlled fission of an atom was carried out in Germany in _____.

a 1920 b 1928
c 1925 d 1938

Q.80 BTU is measurement of _____.

a volume b area
c heat content d temperature

Q.81 Crude oil is _____.

a colourless
b odourless
c smelly yellow to black liquid
d odourless yellow to black liquid

Q.82 The process that converts solid coal into liquid hydrocarbon fuel is called _____.

a liquefaction b carbonation
c catalytic conversion d cracking

Q.83 The one thing that is common to all fossil fuels is that they _____.

a were originally formed in marine environment
b contain carbon
c have undergone the same set of geological processes during their formation
d represent the remains of one living organisms

Q.84 Common energy source in Indian villages is _____.

a electricity
b coal
c sun
d wood and animal dung

Q.85 The outermost layer of the earth is _____.

a magma b mantle
c crust d solid iron core

Q.86 Both power and manure is provided by _____.

a nuclear plants b thermal plants
c biogas plants d hydroelectric plant

Q.87 Fuel cells are _____.

a carbon cell b hydrogen battery
c nuclear cell d chromium cell

Q.88 A fuel cell, in order to produce electricity, burns _____.

a Helium b Nitrogen
c Hydrogen d None of the above

Q.89 Which among the following is not an adverse environmental impact of tidal power generation ?

a Interference with spawing and migration of fish

b Pollution and health hazard in the estuaries due to blockage of flow of polluted water into the sea

c Navigational hazard

d None of the above

Q.90 Identify the non-renewable energy resource from the following :

a Coal b Fuel cells

c Wind power d Wave power

Q.91 Which of the following is a disadvantage of most of the renewable energy sources ?

a Highly polluting

b High waste disposal cost

c Unreliable supply

d High running cost

Answer Keys for Multiple Choice Questions

Q.1	d	**Q.2**	d	**Q.3**	c
Q.4	a	**Q.5**	d	**Q.6**	c
Q.7	a	**Q.8**	b	**Q.9**	a
Q.10	b	**Q.11**	c	**Q.12**	a
Q.13	d	**Q.14**	a	**Q.15**	b
Q.16	a	**Q.17**	c	**Q.18**	a
Q.19	c	**Q.20**	d	**Q.21**	a
Q.22	a	**Q.23**	a	**Q.24**	c
Q.25	a	**Q.26**	a	**Q.27**	b
Q.28	c	**Q.29**	b	**Q.30**	b
Q.31	d	**Q.32**	a	**Q.33**	a
Q.34	b	**Q.35**	c	**Q.36**	a
Q.37	d	**Q.38**	a	**Q.39**	d
Q.40	c	**Q.41**	b	**Q.42**	a
Q.43	c	**Q.44**	d	**Q.45**	d
Q.46	a	**Q.47**	b	**Q.48**	c
Q.49	c	**Q.50**	b	**Q.51**	b
Q.52	b	**Q.53**	c	**Q.54**	c
Q.55	a	**Q.56**	c	**Q.57**	c
Q.58	c	**Q.59**	a	**Q.60**	a
Q.61	a	**Q.62**	a	**Q.63**	a
Q.64	b	**Q.65**	d	**Q.66**	a
Q.67	a	**Q.68**	d	**Q.69**	b
Q.70	b	**Q.71**	a	**Q.72**	c
Q.73	b	**Q.74**	d	**Q.75**	b
Q.76	b	**Q.77**	c	**Q.78**	a
Q.79	d	**Q.80**	c	**Q.81**	c
Q.82	a	**Q.83**	b	**Q.84**	d
Q.85	c	**Q.86**	c	**Q.87**	b
Q.88	c	**Q.89**	d	**Q.90**	a
Q.91	c				

❑❑❑

UNIT - III

3 Ecosystem and Biodiversity

Introduction

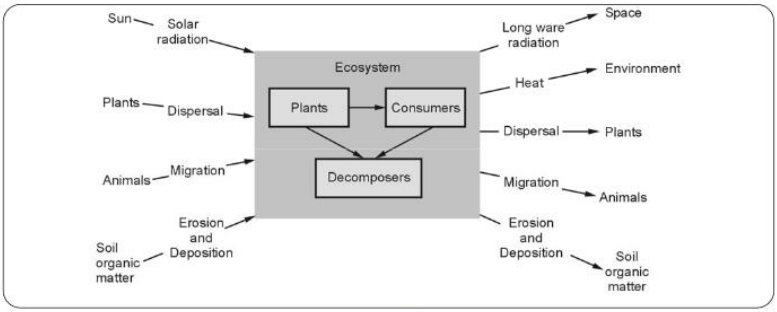


Fig. 3.1

An ecosystem is a community of living organisms in conjunction with the nonliving components of their environment, interacting as a system. These biotic and abiotic components are linked together through nutrient cycles and energy flows. Energy enters the system through photosynthesis and is incorporated into plant tissue. By feeding on plants and on one-another, animals play an important role in the movement of matter and energy through the system. They also influence the quantity of plant and microbial biomass present. By breaking down dead organic matter, decomposers release carbon back to the atmosphere and facilitate nutrient cycling by converting nutrients stored in dead biomass back to a form that can be readily used by plants and other microbes.

Ecosystems are controlled by external and internal factors. External factors such as climate, parent material which forms the soil and topography, control the overall structure of an ecosystem but are not themselves influenced by the ecosystem. Unlike external factors, internal factors are controlled, for example, decomposition, root competition, shading, disturbance, succession, and the types of species present.

3.1 Ecosystem - Definition, Aspects of Ecosystem, Division of Ecosystem, General Characteristics of Ecosystem, Functions of Ecosystem.

Definition :

A biological community of interacting organisms and their physical environment.

An ecosystem is a large community of living organisms (plants, animals and microbes) in a particular area. The living and physical components are linked together through nutrient cycles and energy flows.

Aspects of Ecosystem :

The ecosystem functions through several biogeochemical cycles and energy transfer mechanisms. The ecosystem

which consists of its non-living or Abiotic features such as air, water, climate and soil. Its Biotic components are the various plants and animals. Both these aspects of the ecosystem interact with each other through several functional aspects to form Nature's ecosystems. Plants, herbivores and carnivores can be seen to form food chains. All these chains are joined together to form a 'web of life' on which man depends. Each of these uses energy that comes from the sun and powers the ecosystem.

Structural and Functional aspect of an Ecosystem :

Structural Aspects

Components that make up the structural aspects of an ecosystem include :

1. Inorganic aspects - C, N, CO_2, H_2O.
2. Organic compounds - Protein, Carbohydrates, and Lipids - link abiotic to biotic aspects.
3. Climatic regimes - Temperature, Moisture, Light & Topography.
4. Producers - Plants.
5. Macro consumers - Phagotrophs - Large animals.
6. Micro consumers - Saprotrophs, absorbers - Fungi.

Functional aspects

1. Energy cycles.
2. Food chains.
3. Diversity - Inter linkages between organisms.
4. Nutrient cycles - Biogeochemical cycles.
5. Evolution.

Processes of ecosystems : This figure with the plants, zebra, lion, and so forth illustrates the two main ideas about how ecosystems function : ecosystems have energy flows and ecosystems cycle materials. These two processes are linked, but they are not quite the same.

Energy enters the biological system as light energy, or photons, is transformed into chemical energy in organic molecules by cellular processes including photosynthesis and respiration, and ultimately is converted to heat energy. This energy is dissipated, meaning it is lost to the system as heat; once it is lost it cannot be recycled. Without the continued input of solar energy, biological systems would quickly shut down. Thus the earth is an open system with respect to energy.

Elements such as carbon, nitrogen, or phosphorus enter living organisms in a variety of ways. Plants obtain elements from the surrounding atmosphere, water, or soils. Animals may also obtain elements directly from the physical environment, but usually they obtain these mainly as a consequence of consuming other organisms. These materials are transformed biochemically within the bodies of organisms, but sooner or later, due to excretion or decomposition, they are returned to an inorganic state. Often bacteria complete this process, through the process called decomposition or mineralization.

During decomposition these materials are not destroyed or lost, so the earth is a **closed system** with respect to elements (with the exception of a meteorite entering the system now and then). The elements are cycled endlessly between their biotic and Abiotic states within ecosystems. Those elements whose supply tends to limit biological activity are called **nutrients.**

Producer, Consumer and Decomposers :

Every living organism is in some way dependent on other organisms. Plants are food for herbivorous animals which are in turn food for carnivorous animals. Thus there are different tropic levels in the ecosystem.

Plants are the 'producers' in the ecosystem as they manufacture their food by using energy from the sun. In the forest these form communities of plant life. In the sea these include tiny algal forms to large seaweed.

The **herbivores animals** are **primary consumers** as they live on the producers. In a forest, these are the Insects, Amphibia, Reptiles, Birds and Mammals. The herbivorous animals include for example Hare, Deer and Elephants that live on plant life. In grasslands, there are herbivores such as the blackbuck that feed on grass. In the semi-arid areas, there are species such as the Chinkara or Indian gazelle.

At a higher tropic level, there are **carnivores animals, or secondary consumers,** which live on herbivorous animals.

In our forests, the Carnivores animals are Tigers, Leopards, Jackals, Foxes and Small Wild Cats.

Decomposers or Detrivores are a group of organisms consisting of small animals like worms, insects, bacteria and fungi, which break down dead organic material into smaller particles and finally into simpler substances that are used by plants as nutrition. Decomposition thus is a vital function in nature, as without this, all the nutrients would be tied up in dead matter and no new life could be produced.

The components of the ecosystem are seen to function as a unit when consider the following aspects :

1. Productivity; 2. Decomposition;
3. Energy flow and 4. Nutrient cycling.

1. Productivity : A constant input of solar energy is the basic requirement for any ecosystem to function and sustain. Primary production is defined as the amount of biomass or organic matter produced per unit area over a time period by plants during photosynthesis. It is expressed in terms of weight (g^{-2}) or energy (kcal m^{-2}). The rate of biomass production is called productivity. It is expressed in terms of $g^{-2}yr^{-1}$ or (kcal m^{-2}) yr^{-1} to compare the productivity of different ecosystems. It can be divided into Gross Primary Productivity (GPP) and Net Primary Productivity (NPP). Gross primary productivity of an ecosystem is the rate of production of organic matter during photosynthesis. A considerable amount of GPP is utilised by plants in respiration. Gross primary productivity minus respiration losses (R), is the Net Primary Productivity (NPP).

Net primary productivity is the available biomass for the consumption to heterotrophs (herbivores and decomposers). Secondary productivity is defined as the rate of formation of new organic matter by consumers.Primary productivity depends on the plant species inhabiting a particular area. It also depends on a variety of environmental factors, availability of nutrients and photosynthetic capacity of plants.

2. Decomposition : Decomposers break down complex organic matter into inorganic substances like carbon dioxide, water and nutrients and the process is called decomposition. Dead plant remains such as leaves, bark, flowers and dead remains of animals, including fecal matter, constitute detritus, which is the raw material for decomposition. The important steps in the process of decomposition are fragmentation, leaching, catabolism, humification and mineralisation.

Detritivores (e.g., earthworm) break down detritus into smaller particles. This process is called fragmentation. By the process of leaching, watersoluble inorganic nutrients go down into the soil horizon and get precipitated as unavailable salts. Bacterial and fungal enzymes degrade detritus into simpler inorganic substances. This process is called as catabolism.

It is important to note that all the above steps in decomposition operate simultaneously on the detritus (Fig. 3.1.1). Humification and mineralisation occur during decomposition in the soil.

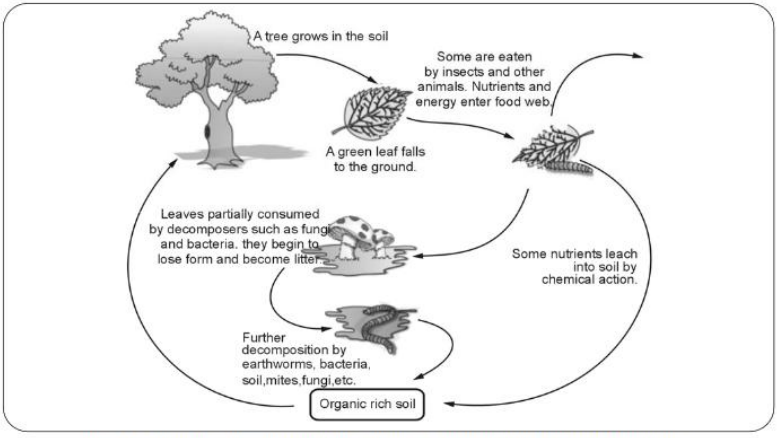


Fig. 3.1.1 Diagrammatic representation of decomposition cycle in a terrestrial ecosystem.

3. **Energy Flow :** Except for the deep sea hydro-thermal ecosystem, sun is the only source of energy for all ecosystems on Earth. The incident solar radiation less than 50 per cent of it is Photo Synthetically Active Radiation (PAR). All organisms are dependent for their food on producers, either directly or indirectly. So you find unidirectional flow of energy from the sun to producers and then to consumers.

   The green plant in the ecosystem-terminology are called producers. In a terrestrial ecosystem, major producers are herbaceous and woody plants. Likewise, primary producers in an aquatic ecosystem are various species like phytoplankton, algae and higher plants.

   All animals depend on plants (directly or indirectly) for their food needs. They are hence called consumers and also heterotrophs. If they feed on the producers, the plants, they are called primary consumers, and if the animals eat other animals which in turn eat the plants (or their produce) they are called secondary consumers. Likewise, you could have tertiary consumers too. Obviously the primary consumers will be herbivores. Some common herbivores are insects, birds and mammals in terrestrial ecosystem and molluscs in aquatic ecosystem. The consumers that feed on these herbivores are carnivores, or more correctly primary carnivores (though secondary consumers). Those animals that depend on the primary carnivores for food are labelled secondary carnivores. A simple Grazing Food Chain (GFC) is depicted below :

   Grass (Producer) → Goat (Primary Consumer) → Man (Secondary consumer)

Organisms occupy a place in the natural surroundings or in a community according to their feeding relationship with other organisms. Based on the source of their nutrition or food, organisms occupy a specific place in the food chain that is known as their trophic level. Producers belong to the first trophic level, herbivores (primary consumer) to the second and carnivores (secondary consumer) to the third (Fig. 3.1.2).

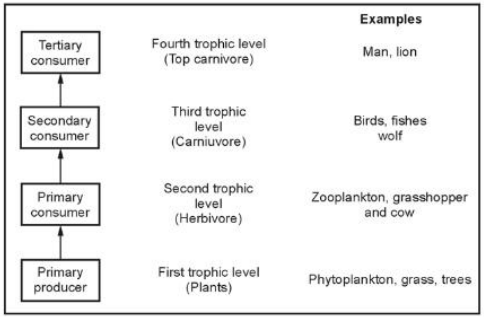


Fig. 3.1.2 Diagrammatic representation of trophic levels in an ecosystem

4. **Nutrient Cycle :** The movement of nutrient elements through the various components of an ecosystem is called nutrient cycling. Another name of nutrient cycling is biogeochemical cycles (bio: living organism, geo: rocks, air, water). Nutrient cycles are of two types : (a) gaseous and (b) sedimentary.

   Thereservoir for gaseous type of nutrient cycle (e.g., nitrogen, carbon cycle) exists in the atmosphere and for the sedimentary cycle (e.g., sulphur and phosphorus cycle), the reservoir is located in Earth's crust.

Environmental factors, e.g., soil, moisture, pH, temperature, etc., regulate the rate of release of nutrients into the atmosphere. The function of the reservoir isto meet with the deficit which occurs due to imbalance in the rate of influx and efflux.Simplified model of carbon cycle in the biosphere as shown in Fig. 3.1.3

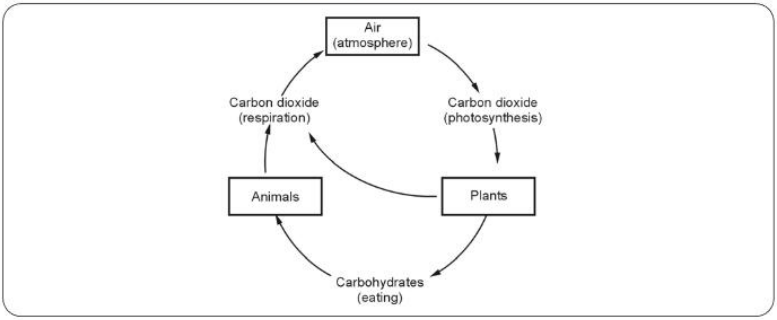


Fig. 3.1.3 Carbon cycle

Division of ecosystem :

An ecosystem is a community made up of living organisms and nonliving components such as air, water, and mineral soil. Ecosystems can be studied in two different ways. The living (biotic) and non-living (abiotic) components interact through nutrient cycles and energy flows as shown in Fig. 3.1.4.

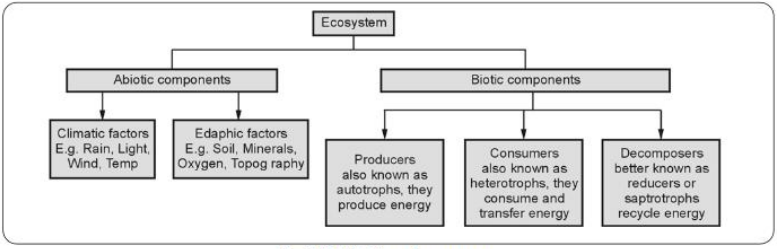


Fig. 3.1.4 Division of ecosystem

1. **Abiotic Components :** The non-living factors or the physical environment prevailing in an ecosystem form the abiotic components. They have a strong influence on the structure, distribution, behavior and inter-relationship of organisms.

Abiotic components are mainly of two types :

a) **Climatic factors :**

Which include rain, temperature, light, wind, humidity etc.

b) **Edaphic factors :**

Which include soil, pH, topography minerals etc.

2. **Biotic components :** The living organisms including plants, animals and micro-organisms (Bacteria and Fungi) that are present in an ecosystem form the biotic components. On the basis of their role in the ecosystem the biotic components can be classified into three main groups :

   a) Producers b) Consumers

   c) Decomposers or Reducers.

a) Producers : Producers make their own food. They do not have to obtain energy from other organisms. They obtain their energy from the sun and make food with that energy through the process of photosynthesis. Producers may also be called **autotrophs**. Most producers are plants, but there are some small organisms that produce food through photosynthesis as well. Producers are at the beginning of any simple food chain.

b) Consumers : Consumers can not make food. They must be find food and eat it to obtain energy. Therefore, they depend on the producers for their food. They are known as **heterotrophs** (i.e. heteros = other, trophos = feeder)

The consumers are of four types, namely :

i) Primary Consumers or First Order Consumers or Herbivores : These are the animals which feed on plants or the producers. They are called herbivores. Examples are rabbit, deer, goat, cattle etc.

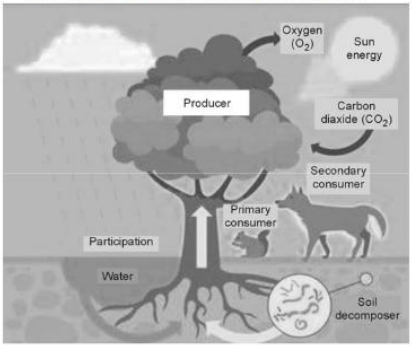
ii) Secondary Consumers or Second Order Consumers or Primary Carnivores : The animals which feed on the herbivores are called the primary carnivores. Examples are cats, foxes, snakes etc.

iii) Tertiary Consumers or Third Order Consumers : These are the large carnivores which feed on the secondary consumers. Example are Wolves.

iv) Quaternary Consumers or Fourth Order Consumers or Omnivores : These are the largest carnivores which feed on the tertiary consumers and are not eaten up by any other animal. Examples are lions and tigers.

c) Decomposers or Reducers : Bacteria and fungi belong to this category. They breakdown the dead organic materials of producers (plants) and consumers (animals) for their food and release to the environment the simple inorganic and organic substances produced as by-products of their metabolisms.

These simple substances are reused by the producers resulting in a cyclic exchange of materials between the biotic community and the abiotic environment of the ecosystem. The decomposers are known as Saprotrophs (i.e., sapros = rotten, trophos = feeder) .Figure shows relationship within the ecosystem.



General Characteristics of Ecosystem :

1. The ecosystem is a major structural and functional unit of ecology.
2. The structure of an ecosystem is related to its species diversity; the more complex ecosystems have high species diversity.
3. The function of the ecosystem is related to energy flow and material cycling through and within the system.
4. The relative amount of energy needed to maintain an ecosystem depends on its structure. The more complex the structure, the lesser the energy it needs to maintain itself.
5. Ecosystems mature by passing from less complex to more complex states. Early stages of such succession have an excess of potential energy and a relatively high energy flow per unit biomass. Later (mature)

stages have less energy accumulation and its flow through more diverse components.

6. Both the environment and the energy fixation in any given ecosystem are limited and cannot be exceeded without causing serious undesirable effects.
7. Alterations in the environments represent selective pressures upon the population to which it must adjust Organisms which are unable to adjust to the changed environment must needs vanish.
8. The ecosystem is an integrated unit or zone of variable size, comprising vegetation, fauna, microbes and the environment. Most ecosystems characteristically possess a well-defined soil, climate, flora and fauna (or communities) and have their own potential for adaptation, change and tolerance.
9. The functioning of any ecosystem involves a series of cycles, e.g., the water cycle and the cycles of various nutrients. These cycles are driven by energy flow, the energy being the solar energy Continuation of life demands a constant exchange and return of nutrients to and from (amongst) the different components of the ecosystem.

Functions of Ecosystem :

1. **Gas regulation :** Relates to the influence of natural and managed systems in relation to biogeochemical processes including greenhouse gases, photo-chemical smog and Volatile Organic Compounds (VOCs).
2. **Climate regulation :** Influence of land cover and biological mediated processes that regulate atmospheric processes and weather patterns which in turn create the microclimate in which different plants and animals (including humans) live and function.
3. **Disturbance regulation :** The capacity of the soil, regolith and vegetation to buffer the effects of wind, water and waves through water and energy storage capacity and surface resistance.
4. **Water regulation :** The influence of land cover, topography, soils, hydrological conditions in the spatial and temporal distribution of water through atmosphere, soils, aquifers, rivers, lakes and wetlands.
5. **Soil retention :** Minimizing soil loss through having adequate vegetation cover, root biomass, retaining rocks and soil biota.
6. **Nutrient regulation :** The role of ecosystems in the transport, storage and recycling of nutrients.
7. **Biological control :** The interactions within biotic communities that act as restraining forces to control populations of potential pests and disease vectors. This function consists of natural and biological control mechanisms.
8. **Supporting function :** Preservation of natural and semi natural ecosystems as suitable living space for wild biotic communities and individual species. This function also includes the provision of suitable breeding, reproduction, nursery, refugia and corridors (connectivity) for species.
9. **Soil formation :** Soil formation is the facilitation of soil formation processes. Soil formation processes include the chemical weathering of rocks and the transportation and accumulation of inorganic and organic matter.
10. **Water supply :** The role of ecosystems in providing water through sediment trapping, infiltration, dissolution, precipitation and diffusion.

3.2 Biodiversity - Definition, Levels, Value and Loss of Biodiversity

Biodiversity boosts ecosystem productivity where each species, no matter how small, all have an important role to play. For example, A larger number of plant species means a greater variety of crops. Greater species diversity ensures natural sustainability for all life forms.

Definition :

Biodiversity means the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species and of ecosystems.

Levels of Biodiversity :

Biodiversity is usually explored at three levels - genetic diversity, species diversity and ecosystem diversity (Fig. 3.2.1).The various levels of organization within biodiversity express different features of the complexity and value of biodiversity and interact with each other through ecological processes.

Levels of bio diversity

Includes three hierarchical levels ;

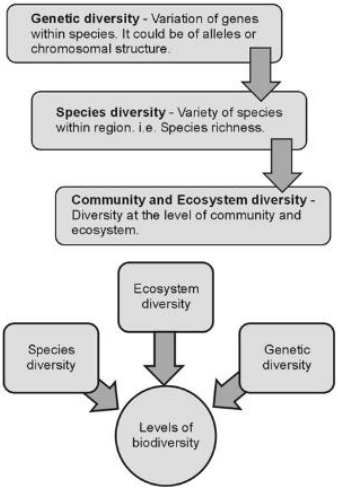


Fig. 3.2.1 Levels of biodiversity

1. **Genetic diversity :** Genetic diversity is the variety of genes within a species. Each species is made up of individuals that have their own particular genetic composition. This means a species may have different populations, each having different genetic compositions. To conserve genetic diversity, different populations of a species must be conserved.

   Genes are the basic units of all life on Earth. They are responsible for both the similarities and the differences between organisms.

2. **Species diversity :** Species (and their subspecies and populations) are generally considered to be the only self-replicating units of genetic diversity that can function as independent units. In the case of most living organisms, each species generally represents a complete, self-generating, unique ensemble of genetic variation, capable of interbreeding and producing fertile offspring. Some animals and many plants can also exchange genes through hybridization, which sometimes results in new species

3. **Ecosystem diversity :** Ecosystem diversity is the variety of ecosystems in a given place. An ecosystem is a community of organisms and their physical environment interacting together. An ecosystem can cover a large area, such as a whole forest, or a small area, such as a pond.

   An ecosystem is a community of organisms and their physical environment interacting together. An ecosystem may be as large as the Great Barrier Reef or as small as the back of a spider crab's shell, which provides a home for plants and other animals, such as sponges, algae and worms.

Value of Biodiversity :

There are main five types of biodiversity as given

1. **Consumptive value :** Direct utilisation of timber, food, fuel-wood and fodder by local communities. Provides forest dwellers with all their daily needs, food, building material, fodder, medicines. They know the qualities and different uses of wood from different species of trees, that they use as food, construction material or medicines.

2. **Productive use value :** This comprises of marketable goods. Biotechnologists search for potential genetic properties in plants and animals that can be used to develop varieties of crops and livestock plantation programs. Pharmacist search for raw material from which new drugs can be identified. Industrialists search for storehouse to develop new products. Agricultural scientists developing better crops by utilizing genetic engineering.

3. **Social value :** Biodiversity has been preserved by traditional societies. These societies valued it as a resource and believed that its depletion would be a great loss to their society. In India, Tulsi, peepal, cow, snake are worshipped.
4. **Ethical and Moral values :** It is based on importance of protecting all forms of life. Most religious and secular creeds believe that all forms of life have the right to exist on earth.Basic philosophy, "Live and let others Live".
5. **Aesthetic value :** It involves appreciation of the presence of biodiversity for its inherent value and beauty, as well as for the contribution it makes to our knowledge, aesthetics, imagination and creativity.

Loss of biodiversity :

Loss of biodiversity refers to the extinction of human, plant or animal species worldwide. It also includes the decrease in the number of a species in a certain habitat. The environmental degradation that leads to the loss can be either reversible or effectively permanent. Though, it has been noticed that global extinction so far is irreversible. Fig. 3.2.2 shows different causes of loss of biodiversity.

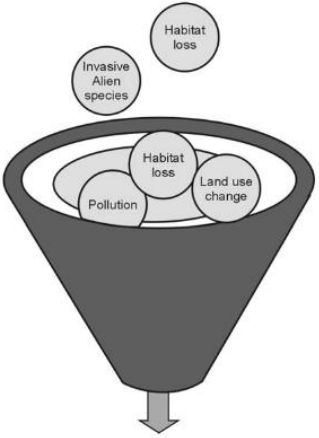


Figure 3.2.2 Loss of biodiversity

Causes of loss of biodiversity :

- **Destruction of habitat :** The natural habitat of animals is destroyed by man for the purpose of settlement, agriculture, mining, industries, construction of highways, and so on. As a result of this, the species must either adapt to the changes in the environment or move to other places. If not, they become target to predation, starvation, disease and eventually die.
- **Hunting :** Hunting of wild animals is done for the commercial utilisation of their products. These include hides and skin, fur, meat, tusk, cosmetics, perfumes, pharmaceuticals and decoration purposes. In recent years, 95 % of the black rhino population in Africa has been exterminated by poachers for their horn.
- **Exploitation of selected species :** Exploitation of medicinally important plants results in their disappearance from their natural habitat. Examples of the plants which are ruthlessly collected for laboratory and other works are the pitcher plant, Nepenthes khasiana, Drosera sp., Psilotum sp. Isoetessp etc.
- **Habitat fragmentation :** An "unnatural separation of expansive tracts of habitats into spatially segregated fragments" that is too limited to maintain their different species for the future, is known as habitat fragmentation. The landmass is broken into smaller units which eventually lead to the extinction of species.
- **Pollution :** Pollution makes survival difficult for the species as it alters their natural habitat. Water pollution is injurious to the biotic components of coastal ecosystems. Toxic wastes entering the water bodies disturb the food chain. In addition, materials like insecticides, pesticides, sulphur and nitrogen oxides, and acid rain also adversely affect the plant and animal species.
- **Natural calamities :** Floods, draught, forest fires, earth-quakes and other natural calamities sometimes take a heavy toll of plant and animal life. These trap a large number of animals while frittering away soil nutrients.

3.3 Biodiversity Assessment Initiatives in India

Among the biologically rich nations, India stands among the top 10 or 15 countries for its great variety of plants and animals, many of which are not found elsewhere. India has 350 different mammals (rated eight highest in the world), 1,200 species of birds (eighth in the world), 453 species of reptiles (fifth in the world) and 45,000 plant species, of which most are angiosperms, (fifteenth in the world). These include especially high species diversity of ferns (1022 species) and orchids (1082 species). India has 50,000 known species of insects, including 13,000 butterflies and moths. It is estimated that the number of unknown species could be several times higher.

The Ministry of Environment, Forest and Climate Change (MoEFCC) is the nodal agency in the administrative structure of the Central Government for the planning, promotion, co-ordination and overseeing the implementation of India's environmental and forestry policies and programmes.

The primary concerns of the Ministry are implementation of policies and programmes relating to conservation of the country's natural resources including its lakes and rivers, its biodiversity, forests and wildlife, ensuring the welfare of animals, and the prevention and abatement of pollution. While implementing these policies and programmes, the Ministry is guided by the principle of sustainable development and enhancement of human well-being.

The Ministry also serves as the nodal agency in the country for the United Nations Environment Programme (UNEP), South Asia Co-operative Environment Programme (SACEP), International Centre for Integrated Mountain Development (ICIMOD) and for the follow-up of the United Nations Conference on Environment and Development (UNCED). The Ministry is also entrusted with issues relating to multilateral bodies such as the Commission on Sustainable Development (CSD), Global Environment Facility (GEF) and of regional bodies like Economic and Social Council for Asia and Pacific (ESCAP) and South Asian Association for Regional Co-operation (SAARC) on matters pertaining to the environment.

The broad objectives are :

- Conservation and survey of flora, fauna, forests and wildlife
- Prevention and control of pollution
- Afforestation and regeneration of degraded areas
- Protection of the environment and
- Ensuring the welfare of animals

These objectives are well supported by a set of legislative and regulatory measures, aimed at the preservation, conservation and protection of the environment.

Besides the legislative measures, the National Conservation Strategy and Policy Statement on Environment and Development 1992; National Forest Policy 1988; Policy Statement on Abatement of Pollution 1992; and the National Environment Policy 2006.

3.4 Threats and Hotspots of Biodiversity

Treats of biodiversity : Biodiversity is under serious threat as a result of human activities. The main dangers worldwide are population growth and resource consumption, climate change and global warming, habitat conversion and urbanisation, invasive alien species, over-exploitation of natural resources and environmental degradation. Major five threats of biodiversity as given

1. **Climate change :** Changes in climate throughout our planet's history have, of course, altered life on Earth in the long run ecosystems have come and gone and species routinely go extinct. But rapid, manmade climate change speeds up the process, without affording ecosystems and species the time to adapt. For example, rising ocean temperatures and diminishing Arctic sea ice affects marine biodiversity and can shift vegetation zones, having global implications.
2. **Deforestation and habitat loss :** Deforestation is a direct cause of extinction and loss of biodiversity. An estimated 18 million acres of forest are lost each year, due in part to logging and other human practices, destroying the ecosystems on which many species depend.

3. **Overexploitation :** Overhunting, overfishing and over-harvesting contribute greatly to the loss of biodiversity, killing off numerous species over the past several hundred years. Poaching and other forms of hunting for profit increase the risk of extinction; the extinction of an apex predator or, a predator at the top of a food chain can result in catastrophic consequences for ecosystems.
4. **Invasive species :** The introduction of non-native species into an ecosystem can threaten endemic wildlife (either as predators or competing for resources), affect human health and upset economies.
5. **Pollution :** From the burning of fossil to dumping 19 billion pounds of plastic into the ocean every year, pollution completely disrupts the Earth's ecosystems. While it may not necessarily cause extinction, pollutants do have the potential to influents species' habits. For example, acid rain, which is typically caused by the burning of fossil fuels, can acidify smaller bodies of water and soil, negatively affecting the species that live there by changing breeding and feeding habits.

Hotspots of biodiversity :

Biodiversity is a critically important part of the Earth's natural capital. Hot spots are the areas that are severely threatened by human activities. It contains some endemic plants and animals.

The earth's biodiversity is distributed in specific ecological regions. There are over a thousand major Eco regions in the world. Of these, 200 are said to be the richest, rarest and most distinctive natural areas. These areas are referred to as the Global 200.

It has been estimated that 50,000 endemic plants which comprise 20 % of global plant life, probably occur in only 18 'hot spots' in the world. Countries which have a relatively large proportion of these hot spots of diversity are referred to as 'mega diversity nations'.

The rate at which the extinction of species is occurring throughout our country remains scure. It is likely to be extremely high as our wilderness areas are shrinking rapidly. Our globally accepted national 'hot spots' are in the forests of the North-East and the Western Ghats, which are included in the world's most biorich areas.

The Andaman and Nicobar Islands are extremely rich in species and many subspecies of different animals and birds have evolved. Among the endemic species i.e. those species found only in India, a large proportion are concentrated in these three areas. The Andaman and Nicobar Islands alone have as many as 2200 species of flowering plants and 120 species of ferns. Out of 135 genera of land mammals in India, 85 (63 %) are found in the Northeast. The Northeast States have 1,500 endemic plant species. A major proportion of amphibian and reptile species, especially snakes, are concentrated in the Western Ghats, which is also a habitat for 1,500 endemic plant species.

Coral reefs in Indian waters surround the Andaman and Nicobar Islands, Lakshadweep Islands, the Gulf areas of Gujarat and Tamil Nadu. They are nearly as rich in species as tropical evergreen forests.

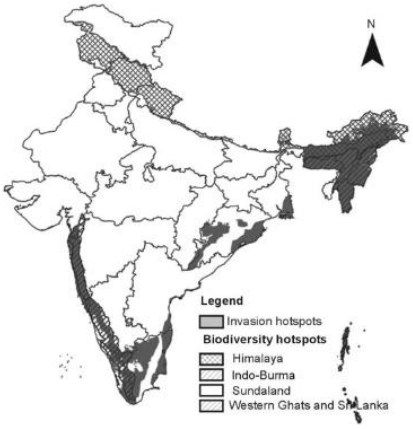


Fig. 3.4.1 Hotspot of biodiversity in India

3.5 Conservation of Biodiversity Objects, Various Law

Conservation of biodiversity objects :

1. To maintain essential ecological processes and life supporting systems.
2. To preserve the diversity of species.
3. To make sustainable utilization of species and ecosystems.
4. To conserve all the possible varieties (old or new) of food, forage and timber plants, live stock, agriculture animals and microbes
5. To conserve all the economically important organisms in protected areas .
6. To give priority to preserve unique ecosystems.
7. To prevent poaching and hunting of wildlife .
8. To create public awareness regarding biodiversity and its importance for the living organisms.
9. To protect useful animals, plants and their wild relatives both in their natural habitat (in-situ) and in zoological botanical gardens (ex-situ)

Various laws of biodiversity conservation :

The need for protection and conservation of environment and sustainable use of natural resources is reflected in the constitutional framework of India and also in the international commitments of India. The Constitution under Part IVA (Art 51A-Fundamental Duties) casts a duty on every citizen of India to protect and improve the natural environment including forests, lakes, rivers and wildlife, and to have compassion for living creatures. Further, the Constitution of India under Part IV (Art 48A-Directive Principles of State Policies) stipulates that the State shall endeavour to protect and improve the environment and to safeguard the forests and wildlife of the country.

Several environment protection legislations existed even before Independence of India. However, the true thrust for putting in force a well-developed framework came only after the UN Conference on the Human Environment (Stockholm, 1972). After the Stockholm Conference, the National Council for Environmental Policy and Planning was set up in 1972 within the Department of Science and Technology to establish a regulatory body to look after the environment-related issues. This Council later evolved into a full-fledged Ministry of Environment and Forests (MoEF).

MoEF was established in 1985, which today is the apex administrative body in the country for regulating and ensuring environmental protection and lays down the legal and regulatory framework for the same. Since the 1970s, a number of environment legislations have been put in place. The MoEF and the pollution control boards ("CPCB", ie, Central Pollution Control Board and "SPCBs", ie, State Pollution Control Boards) together form the regulatory and administrative core of the sector. Some of the important legislations for environment protection are as follows :

- The National Green Tribunal Act, 2010
- The Air (Prevention and Control of Pollution) Act, 1981
- The Water (Prevention and Control of Pollution) Act, 1974
- The Environment Protection Act, 1986
- The Hazardous Waste Management Regulations, etc.

Multiple Choice Questions

Q.1 What is called for a discrete group of organisms of the same kind ?

[a] Genes [b] Community
[c] Species [d] Column

Q.2 Approximately, how many species are assigned with scientific names ?

[a] Around 1 million [b] Around 1.5 million
[c] Around 2 million [d] Around 2.5 million

Q.3 What is the significance of spices diversity ?

[a] Species interacts with its environment and thus perform certain functions
[b] Species minimize interaction with its environment and thus perform certain functions
[c] Species never interacts with environment
[d] Though species interacts with environment it do no perform any functions

Q.4 How do human activities affect species diversity ?

a Due to over-exploitation of humans

b Due to conserving the forests

c Due to decline in population growth in humans

d Due to decrease in the pollution causing by industries

Q.5 State true or false. We cannot calculate species diversity.

a True b False

Q.6 How will increasing species diversity affect ecosystem ?

a It increase the efficiency and productivity of an ecosystem

b It increase only the efficiency and not productivity of an ecosystem

c It does not increase the efficiency and productivity of an ecosystem

d It only increase the productivity of an ecosystem

Q.7 Which is the largest scale of biodiversity ?

a Species diversity b Genetic diversity

c Cell diversity d Ecological diversity

Q.8 Which one of the following diversity boosts the availability of oxygen ?

a Species diversity b Ecosystem diversity

c Genetic diversity d Cell diversity

Q.9 Which of the following is an example of ecosystem diversity ?

a Earth b Sun

c River d Glass

Q.10 State true or false. Forests are the only example for ecosystem diversity.

a True b False

Q.11 Ecosystem is smallest unit of _____.

a ionosphere b lithosphere

c biosphere d mesosphere

Q.12 Energy _____ in an ecosystem.

a is released b is absorbed

c flows d none of the above

Q.13 The set of ecosystems is called a _____.

a biome b climate

c subsystem d structure

Q.14 The following is an example of Terrestrial Biome

a Tropical rain forest b Rivers

c Streams d All of the above

Q.15 Ecosystems rely on the following major sources of energy _____.

a sun

b chemical or nuclear fuels

c both (A) and (B)

d none of the above

Q.16 The following type of ecosystems have a low productivity or capacity to do work.

a Unsubsidized natural solar powered ecosystems

b Naturally subsidized solar powered ecosystems

c Man subsidized Solar powered ecosystems

d Fuel powered ecosystems

Q.17 Industrial parks are examples of _____.

a unsubsidized natural solar powered ecosystems

b naturally subsidized solar powered ecosystems

c man subsidized solar powered ecosystems

d fuel powered ecosystems

Q.18 Every Ecosystem has ___ major component(s).

a one b two

c three d four

Q.19 The following is (are) Abiotic components of the ecosystem _____.

[a] soil [b] carbon
[c] protein [d] all of the above

Q.20 Human is _____ factor of an Ecosystem.
[a] physical [b] chemical [c] both (A) and (B)

Q.21 The following is (are) producer(s) _____.
[a] algae [b] green plants
[c] photosynthetic bacteria
[d] all of the above

Q.22 The autotropsv _____.
[a] are self nourishing organisms
[b] derive energy from sunlight
[c] make organic compounds from inorganic compounds
[d] All of the above

Q.23 Autotropic components are _____.
[a] producers [b] donsumers
[c] decomposers [d] none of the above

Q.24 _____ are primary consumers.
[a] Herbivores [b] Carnivores
[c] Omnivores [d] All of the above

Q.25 The following are dependent on others for food
[a] autotrops [b] heterotrops
[c] both (A) and (B) [d] none of the above

Q.26 _____ are secondary consumers.
[a] Herbivores [b] Carnivores
[c] Omnivores [d] All of the above

Q.27 The following have vegetarian as well as non-vegetarian diet
[a] Herbivores [b] Carnivores
[c] Omnivores [d] All of the above

Q.28 Snake is a _____.
[a] primary consumer [b] secondary consumers
[c] tertiary consumers

Q.29 The following is a secondary consumer _____.
[a] goat [b] lizard
[c] wolf [d] lion

Q.30 In the process of photosynthesis, plants use chlorophyll to transform sunlight into _____ energy.
[a] heat [b] chemical
[c] light [d] none of the above

Q.31 The following is the correct grazing food chain _____.
[a] Grass - Grasshopper - Frog - Snake - Hawk
[b] Grass - Frog - Grasshopper- Snake - Hawk
[c] Grass - Grasshopper - Frog - Hawk - Snake
[d] Grass - Grasshopper - Snake - Frog – Hawk

Q.32 The following is not a type of ecosystem _____.
[a] grassland ecosystem [b] aquatic ecosystem
[c] desert ecosystem [d] mountain ecosystem

Q.33 Which one of the following is not a functional unit of an ecosystem ?
[a] Productivity [b] Stratification
[c] Energy flow [d] Decomposition

Q.34 What is true of ecosystem ?
[a] Primary consumers are least dependent upon producers
[b] Primary consumers out-number producers
[c] Producers are more than primary consumers
[d] Secondary consumers are the largest and most powerful

Q.35 Transfer of energy from source of plants through a series of organism is known as _____
[a] food web [b] energy cycle
[c] food chain [d] biological system

Q.36 What flows through ecosystem while matter cycles within them ?
[a] Energy [b] Force
[c] Pressure [d] Wind

Q.37 Total primary production in an ecosystem is known as _____
[a] gross final production

[b] gross primary production
[c] gross middle production
[d] net primary production

Q.38 The three functional components interact with each other to form _____
[a] environmental succession
[b] environmental depression
[c] environmental system
[d] ecology

Q.39 Green plants are the most important organisms for an ecosystem.
[a] True [b] False

Q.40 Which among the following is product of photosynthesis ?
[a] Glucose [b] Carbon
[c] Monoxide [d] Nitrogen

Q.41 Why energy flow is linear in an ecosystem ?
[a] Because it flows in air medium
[b] Because it is very particular
[c] Because ecosystem is linear
[d] Because energy flows from one tropic level to the next higher one

Q.42 Energy flow is cyclic
[a] True [b] False

Q.43 Flow of nutrients is _____
[a] unidirectional [b] rectangular
[c] cyclic [d] triangular

Q.44 Why plants in forests do not make use of all the light energy available to them ?
[a] Because plants do not require energy
[b] Because plants are grown only in winter season
[c] Because of the absence of chlorophyll
[d] Because sunlight doesn't fall on the leaves fully

Q.45 Which form of Sun's energy is trapped by the producers in the energy flow ?
[a] Light energy [b] Chemical energy
[c] Wind energy [d] Pressure energy

Q.46 There is always a loss of some energy as heat during energy flows through an ecosystem.
[a] True [b] False

Q.47 Which state in India has the maximum percentage of its area covered by forests ?
[a] Arunachal Pradesh [b] Madhya Pradesh
[c] Mizoram [d] Nagaland

Q.48 Forest plays an important role in ecosystem.
[a] True [b] False

Q.49 The term "ecosystem" was first proposed by _____.
[a] A.G. Tansely [b] H.T. Odum
[c] Karl Mobius [d] None of these

Q.50 _____break down complex organic matter into inorganic substances like carbon dioxide, water and nutrients
[a] Decomposers [b] Producers
[c] Both a and b [d] None of the above

Q.51 _____ is a example of detritivores
[a] Man [b] Trees
[c] Rabbit [d] Earthworm

Q.52 _____ and mineralisation occur during decomposition in the soil.
[a] Photosynthesis [b] Decomposition
[c] Humidification [d] None of these

Q.53 Decomposers break down complex organic matter into inorganic substances like carbon dioxide, water and nutrients and the process is called decomposition
[a] Fermentation [b] Decomposition
[c] Humidification [d] None of the above

Q.54 The incident solar radiation less than 50 per cent of it is photo synthetically active radiation (PAR)
[a] 30 [b] 20
[c] 10 [d] 50

Q.55 Those animals that depend on the primary carnivores for food are labelled _____

a primary consumer b secondary consumer
c secondary carnivores d primary carnivores

Q.56 The movement of nutrient elements through the various components of an ecosystem is called _____ cycling

a cabon b sulpher
c nutrient d none of these

Q.57 Nutrient cycles are of two types _____

a gaseous and sedimentary.
b organic and sedimentary.
c organic and inorganic.
d Gaseous and liquid.

Q.58 The non-living factors or the physical environment prevailing in an ecosystem form the _____ components.

a biotic b abiotic
c both a and b d none of the above

Q.59 The living organisms including plants, animals and micro-organisms that are present in an ecosystem form the _____ components

a biotic b abiotic
c both a and b d none of the above

Q.60 _____ make their own food.

a Consumer b Decomposer
c Producer d None of these

Q.61 What are called for the value of nature's products that are consumed directly ?

a Productive value b Indirect value
c Non-consumptive value d Consumptive value

Q.62 "Flowers offered to the god" is an example of _____.

a non-consumptive values of biodiversity
b consumptive values of biodiversity
c social value of biodiversity
d ethical values of biodiversity

Q.63 Which one of the following values of diversity we can classified for 'The beauty of waterfall in the Western Ghats' ?

a Ethical values b Social values
c Option values d Aesthetic values

Q.64 Why biodiversity is of great scientific value ?

a Because many species of plants and animals are the subjects of our research
b Because biodiversity can be use only in space
c Because biodiversity can only be useful for scientist
d Because biodiversity provides only few products that helps for humans

Q.65 State true or false. Biodiversity provides Option values.

a True b False

Q.66 Which one of the following is the backbone of viable ecosystems on which we depend on for basic necessities ?

a Pollution b Atmosphere
c Biodiversity d Pollination

Q.67 What is called for the illegal collection of indigenous plants by corporations who patent them for there own use ?

a Biopiracy b Biomagnifications
c Biodegradation d Biodiversity

Q.68 Why we should not encourage biopiracy ?

a Because it kills the whole biodiversity
b Because it don't provide any useful for humans
c Because it takes years of time
d Because it creates inequality between nations

Q.69 Why India has been traditionally one of the targets of biopiracy ?

a Because India has more population
b Because India has large amount of biodiversity

c Because India's don't use biodiversity
d Because India do not impose any punishment for biopiracy

Q.70 When did Convention on Biological Diversity established ?
a 1990 b 1991
c 1992 d 1993

Q.71 Which event provided conditions for high levels of biological diversity in India ?
a Biological events in the atmosphere
b Geological events in the rivers
c Biological events in the rivers
d Geological events in the landmass

Q.72 How can we say India as one of the bio-rich nations ?
a Because of its great variety of plants and animals
b Because of its low variety of planets and animals
c Because of the more population of humans
d Because of more pollution

Q.73 Who introduced the term hotspot of diversity ?
a Darwin b McLean
c Mike Housie d Myers

Q.74 Which of the following region has maximum diversity ?
a Mangrooves b Temperature rainforest
c Taiga d Coral reefs

Q.75 Hotspot are region of high _____.
a rarerity b endemism
c diversity
d critically endangered population

Q.76 Endemic species are _____.
a Rare species
b Species localized at specific region
c Cosmopolitan in distribution
d Critically endangered species

Q.77 Biodiversity can be broadly classified into how many types ?
a 2 b 5
c 3 d 4

Q.78 Biodiversity is of importance as it offers _____.
a Stability of ecosystems
b Stability of atmosphere
c Stability of species
d Stability of research

Q.79 The loss in biodiversity is not attributed to ____.
a Explosion in human population
b Transforming earth's surface
c Destruction of natural habitats
d Use of sustainable products

Q.80 Biodiversity has an aesthetic value to it.
a True b False

Q.81 In how many ways does the conservation of biodiversity work ?
a 5 b 2
c 3 d 4

Q.82 The area of National Parks range between :
a 0.61 to 7818 kms b 0.04 to 3162 kms
c 0.14 to 3612 kms d 0.16 to 8718 kms

Q.83 The activities of cultivation of land, timber harvesting is permitted in :
a sanctuaries b national parks
c biosphere reserves d protected areas

Q.84 Hot spot areas have :
a low density of biodiversity
b only endangered plants
c high density of hot springs
d high density of biodiversity

Q.85 The law which ensure environmental stability and maintenance of ecological balance is ____.
a Forest Act 1927
b National forest policy 1988
c Wild life Act 1992

[d] Wild life protection act 1991

Q.86 Term used for species which is in danger of being extinct in near future is _____.

[a] degradability [b] extinct
[c] endangered [d] global biodiversity

Q.87 International organization IUCN is abbreviation of _____.

[a] Internal Union Council for Natural gas
[b] International Union Council for Nature
[c] International Union for Conservation of Nature
[d] Internal United Council of Nations

Q.88 Major causes of extinction of different species includes _____.

[a] habitat loss and over-hunting
[b] climate change and pollution
[c] deforestation [d] all of above

Q.89 Which of the following is a function of ecosystem _____.

[a] biological control [b] water retention
[c] soil retention [d] all of above

Q.90 The function of the ecosystem is related to _____ and material cycling through and within the system

[a] energy flow [b] energy transfer
[c] Both a and b [d] none of these

Q.91 MoEF was established in _____

[a] 1990 [b] 1975
[c] 1985 [d] 1966

Q.92 MoEF is stand for _____

[a] Ministry of environment and forests
[b] Ministry of ecology and forests
[c] Ministry of environment and fermentation
[d] Ministry of energy and forests

Q.93 Which of the following is the threat of biodiversity _____.

[a] climate change [b] deforestation
[c] both a and b [d] none of these

Q.94 An "unnatural separation of expansive tracts of habitats into spatially segregated fragments" that is too limited to maintain their different species for the future, is known as _____ fragmentation

[a] habitat [b] species
[c] diversity [d] none of these

Q.95 Which one of the following is the cause for man-wildlife conflicts ?

[a] Reduction in the availability of natural food resources
[b] Increase in the forest area
[c] Adequate rainfall
[d] Curiosity of wildlife animals that leads for the invasion to outside the forest area

Q.96 Which one of the following is not the outcome of man-wildlife conflict ?

[a] Damage to human property
[b] Increase in the forest area
[c] Injury and loss of life of humans and wildlife
[d] Destruction of habitat

Q.97 The Jim Corbett National Park is famous for notable man-eaters _____.

[a] Leopard [b] Tiger
[c] Bear [d] Lion

Q.98 Which one of the following is a way to reduce human-wildlife conflict ?

[a] Killing all the wild animals
[b] Shifting all the wild animals from natural forests to zoo
[c] Use of strobe lights
[d] Kill the animals when they invade outside the forests

Q.99 Which one of the following is the major threat for biodiversity ?

[a] Reduction in the cutting of trees
[b] Increase in the number of trees
[c] Climate change

d Balance in the predator and prey in forests

Q.100 Habitat destruction which results in the threat to biodiversity is resulted due to _____

a agricultural industries

b decrease in the human population

c adequate rainfall

d decrease in the human-wildlife conflicts

Q.101 What is called for the natural habitats under in-situ conservation ?

a Unprotected areas b Depleted areas

c Exploited areas d Protected areas

Q.102 Which one of the following is the way for conservation of biodiversity ?

a Increase in the pollution level in the ecosystem

b Converting forest land into agricultural land in rapid way

c Removal of exotic species

d Overexploitation

Q.103 Who among the following defined the term biodiversity hot spots ?

a Norman Myers b Aziz Ab'Saber

c Charles Christopher Adams d Warder Clyde Allee

Q.104 Consider the following statement (s) related to the biodiversity hotspot.

I. It is an area with unusual concentration of species, many of which are endemic.

II. It is marked by serious threat to its biodiversity by humans.

Code :

a Only I b Only II

c Both I & II d Neither I nor II

Q.105 Consider the following statement (s) related to the biodiversity hotspots in India.

I. The North-eastern India is included in a separate CEPF funding region (Eastern Himalayas Biodiversity Hotspot), while Bangladesh and Malaysia only extend marginally into the Indo-Burma hotspot.

II. India shares its territories into three biodiversity hotspots viz. Eastern Himalaya, Western Ghats and Indo-Burma.

Code :

a Only I b Only II

c Both I & II d Neither I nor II

Q.106 Which of the following is not the biodiversity hotspot region ?

a California Floristic Province

b Madrean pine-oak woodlands

c Mesoamerica

d Antarctica

Q.107 Which of the following statement correctly defined the term biodiversity hotspot ?

a It is a biogeographic region that is both a significant reservoir of biodiversity and is threatened with destruction.

b The term biodiversity hotspot specifically refers to biologically rich areas around the world that have lost at least 70 % of their original habitat.

c Only B d Both B & C

Q.108 The concept of Mega-diverse countries was first developed by _____ in 1988.

a Norman Myers

b Russell Mittermeier

c Aziz Ab'Saber

d Charles Christopher Adams

Q.109 Why biodiversity hotspots are important ?

a It important due to the high vulnerability of habitats and high irreplaceability of species found within large geographic regions.

b The identification of an area as a biodiversity hotspot increases the likelihood of conservation investment. In addition, other designations for biodiversity conservation are likely to be present within these broad areas which may have more formal management structures.

c It is because it provides grants to organizations around the world that are working to help protect biodiversity hotspots.

d All of the above

Q.110 Which of the following is not the criterion to qualify as a hotspot ?

a It must contain at least 1,500 species of vascular plants (> 0.5 % of the world's total) as endemics;

b It has to have lost ? 70 % of its original native habitat.

c It must be the part of underdeveloped country.

d None of the above

Q.111 Consider the following statement (s) related to the hotspot conservation.

I. Hot spots have the highest concentrations of unique biodiversity on the planet

II. They are the places at the greatest risk of destruction

III. The need for conservation in the hot spots regions is urgent to present a wave of species extinctions.

Code :

a Only I b Only II

c Only III d I, II & III

Q.112 Which of the following two regions from India included as hot spot ?

a Eastern Himalayas and Western Ghats

b Western Himalayas and Western Ghats

c Northern Himalayas and Western Ghats

d Southern Himalayas and Western Ghats

Answer Keys for Multiple Choice Questions

Q.1	c	Q.2	b	Q.3	a
Q.4	a	Q.5	b	Q.6	a
Q.7	d	Q.8	b	Q.9	c
Q.10	b	Q.11	d	Q.12	c
Q.13	a	Q.14	a	Q.15	c
Q.16	a	Q.17	d	Q.18	b
Q.19	d	Q.20	b	Q.21	d
Q.22	d	Q.23	a	Q.24	a
Q.25	b	Q.26	b	Q.27	c
Q.28	c	Q.29	b	Q.30	b
Q.31	a	Q.32	d	Q.33	b
Q.34	c	Q.35	c	Q.36	a
Q.37	b	Q.38	c	Q.39	a
Q.40	a	Q.41	d	Q.42	b
Q.43	c	Q.44	d	Q.45	a
Q.46	a	Q.47	b	Q.48	a
Q.49	a	Q.50	a	Q.51	d
Q.52	c	Q.53	b	Q.54	d
Q.55	c	Q.56	c	Q.57	a
Q.58	b	Q.59	a	Q.60	c
Q.61	d	Q.62	c	Q.63	d
Q.64	a	Q.65	a	Q.66	c
Q.67	a	Q.68	d	Q.69	b
Q.70	d	Q.71	d	Q.72	a
Q.73	d	Q.74	d	Q.75	b
Q.76	b	Q.77	c	Q.78	a
Q.79	d	Q.80	a	Q.81	b
Q.82	b	Q.83	a	Q.84	d
Q.85	b	Q.86	c	Q.87	c
Q.88	d	Q.89	d	Q.90	a
Q.91	c	Q.92	a	Q.93	c
Q.94	a	Q.95	a	Q.96	b
Q.97	a	Q.98	c	Q.99	c
Q.100	a	Q.101	d	Q.102	c
Q.103	a	Q.104	c	Q.105	c
Q.106	d	Q.107	d	Q.108	b
Q.109	a	Q.110	c	Q.111	d
Q.112	a				

❑❑❑

4 Environmental Pollution

Introduction

Pollution started from prehistoric times, when man created the first fires. Environmental pollution is one of the most serious problems facing humanity and other life forms on our planet today. Environmental pollution is defined as "The contamination of the physical and biological components of the earth/atmosphere system to such an extent that normal environmental processes are adversely affected." Pollutants can be naturally occurring substances or energies, but they are considered contaminants when in excess of natural levels. Any use of natural resources at a rate higher than nature's capacity to restore itself can result in pollution of air, water, and land.

4.1 Pollution - Definition, Types

Pollution is the introduction of a contamination into the environment.

OR

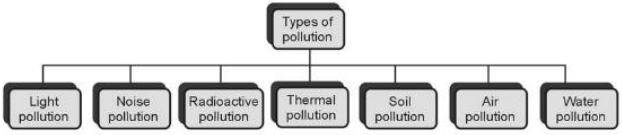
The addition of unwanted substances in a concentration that has an adverse effect on organisms and environment is called Pollution.

OR

An undesirable change in the physical, chemical and biological characteristics of the environment especially air, water and land that may adversely affect human population and the wild life, industrial processes, cultural assets(building and monuments), is called pollution.

The agents that pollute the environment or cause pollution are called pollutants. The three main types of pollution are: Land Pollution, Air Pollution and Water Pollution. We perform a number of daily activities such as bathing and washing of clothes with soaps and detergents. By doing so we add some chemical residue to water and change its quality. This water may mix with the water in ponds and rivers due to ignorance and carelessness. Cooking of food by using firewood may release smoke in the air. Agricultural activities may dump fertilizers and pesticides in the environment.

Types of Pollution :



Sources of pollution can be Natural or Artificial (Man - Made)

Depending upon the area or the part of environment affected, pollution may be of the following types :

1. Land pollution
2. Water pollution
3. Air pollution
4. Noise pollution

4.2 Soil/Land Pollution - Causes and Effects on Environment and Lives, Preventive Measures

Soil Pollution / Land Pollution

Addition of substances that change the quality of soil by making it less fertile and unable to support life is called soil pollution.

4.2.1 Causes of Soil Erosion

1. Natural Sources

a) **Water Erosion :** During rainfall, drops of rain can break down soil aggregates and disperse them. The loosened soil particles are transported with the runoff water. If vegetation is depleted by drought, raindrops are free to hit the soil, causing erosion during rainfall.

b) **Wind Erosion :** Wind can move large amounts of soil. Wind erosion is a serious means of soil erosion. Blowing soil not only leaves a degraded area behind but can also bury and kill vegetation where it settles. Winds blow away the fine particles of soil during drought.

2. Anthropogenic (Produced by humans)

a) Extensive cutting down of forests and trees exposes the ground surface to the direct impact of rain and wind. For example, in the absence of proper vegetation cover there is no interception of rainfall and the falling rain strikes the soil surface directly resulting in the throwing up of loose soil particles in the air which are washed away by rainwater.

b) Construction work, mining, digging canals and ditches change the structure of soil. This accelerates soil erosion due to high-speed winds as well as rainwater.

c) While making roads. soil is cut and massive digging of earth takes place. This leads to soil erosion by water or wind.

d) Excessive use of plough, machines, fertilizers and irrigation may damage the land.

e) In many areas, trees and grasses are depleted because of overgrazing by animals. This makes the soil susceptible to erosion.

4.2.2 Sources of Soil Pollution

Soil pollution is caused due to :

1. **Domestic sources :** plastic bags, kitchen waste, glass bottles, and paper
2. **Industrial sources :** chemical residue, fly ash, metallic waste, and
3. **Agricultural residues :** fertilizers and pesticides.

4.2.3 Harmful Effects of Soil Pollution

1. Decrease in irrigated land thereby reduction in agricultural production.
2. Decrease in soil productivity.
3. Carryover of pollutants into the food chain.
4. Damage to landscape.

4.2.4 Preventive Measures of Soil Pollution

1. Judicious use of chemical fertilizers and pesticides.
2. Proper and appropriate irrigation practices
3. Conversion of farm wastes into compost and much use of bio fertilizers and manure in farming. Ensure use of pollution free or treated waste water only for irrigation.
4. Recycling of waste material for example plastic, metal and glass are recyclable and incineration of non-recyclable, wastes.

4.2.5 Soil Erosion :

The process of detaching and removal of loosened soil particles by water (running water, ground water, rain, sea waves) and wind is known as soil erosion. Soil may be eroded by water and wind, each contributing towards a significant amount of soil loss every year in our country.

Types of soil erosion :

a) **Wind erosion :** Erosion of large quantity of fine soil particles and sand from deserts by wind is known as wind erosion. It is spread over the cultivated land and thus, destroys fertility of that land.

b) **Sheet erosion :** When water moves over the land surface as a sheet, it takes away the topmost thin layer of soil. This phenomenon occurs uniformly on the slopes of hilly areas, river beds and areas affected by floods. This type of erosion is known as sheet erosion.

c) **Gully erosion :** When water moves down the slope as a channel, it scoops out the soil and forms gullies which gradually multiply and spread over a large area. This type of soil erosion is known as gully erosion.

4.2.5.1 Effects of Soil Erosion

- Soil erosion may have several adverse effects such as,
- The top layer of productive land may be washed away.
- Roads, fences, bridges, trees and houses may get damaged.
- Fine soil may be transported far away.
- Crops and pasture lands may be destroyed either by being washed out or by getting covered with mud.
- Flooded fields may take a long time to recover and fertilizers may also be washed out leading to reduction in agricultural yield.
- Organic matter of the soil, residues or any applied manure , is relatively lightweight and can be readily washed off the field. Crop emergence, growth and yield are directly affected by the loss of natural nutrients and fertilizers in the soil. Seeds and plants can get disturbed or completely removed from the eroded soil.
- Soil erosion changes the composition of soil leaving infertile rock behind. Soil quality, structure. stability and texture may also be affected.
- The breakdown of aggregates and the removal of smaller particles or entire Health layers of soil or organic matter can weaken the structure and even change the texture. Textural changes can in turn affect the water-holding capacity of the soil making it more susceptible to extreme conditions, such as drought.
- Sediment which reaches streams or water-courses due to soil erosion clog drainage and stream channels, deposit silt in reservoirs and reduce quality downstream water.

4.2.5.2 Prevention of Soil Erosion

- Some methods to control soil erosion are discussed below.
- The roots of the trees hold soil material together. Therefore, we should protect our forests and trees from being cut down. Afforestation means planting trees in place of cut-down forest trees. Planting of trees along river-side, waste lands and mountainous slopes reduces excessive erosion of soil that takes place in these regions. It is also effective in controlling wind erosion. Grazing by domesticated animals in a planned way reduces soil erosion by protecting vegetation cover especially on the hill slopes which are more prone to soil erosion.
- Protected channels for water movement must be provided to stop soil erosion.If the waterways are properly maintained the speed of water gets reduced and soil erosion decreases. Dam should be constructed on rivers to control flooding and consequently soil erosion. This can also be done by diverting water to dry areas through canals, in a planned way.
- Obstructions known as bunds should be constructed in lands affected by gully erosion.
- Terracing is a method of farming to conserve the thin soil layer on the mountain slopes. This helps in controlling soil erosion and using water resources of these areas more economically and effectively for growing crops on these terraces.
- Ploughing and tilling of land along the contour levels in order to cause furrows to run across the land slopes is known as the contour ploughing. This method is most suited to areas that have a rolling landscape.
- Windbreaks which mean planting trees to protect bare soil from the full force of wind also help in preventing

soil erosion by wind. Windbreaks reduce the velocity of wind thereby decreasing the amount of soil that it can carry away.

4.3 Water Pollution - Sources, Effects, Preventive Measures, BIS Water Quality Standards, Flow diagram of Water Treatment Plant, Water Conservation

Water Pollution

Water is considered polluted if some substances or condition is present to such a degree that the water cannot be used for a specific purpose.

OR

Water pollution to be the presence of excessive amounts of a hazard (pollutants) in water in such a way that it is no long suitable for drinking, bathing, cooking or other uses. It is created by industrial and commercial waster, agricultural practices, everyday human activities and most notably, models of transportation. No matter where you go and what you do, there are remnants earths environmental and its inhabitants in many ways.

4.3.1 Sources of Water Pollution

i) Sewage leakages
ii) High population density
iii) Oil spillage
iv) Menace of Nipa palm and water hyacinth
v) Industrial waste dumped into our waters
vi) Pollution of ground water through drilling activities
vii) Flooding during rainy season which carries waste deposits into our waters.
viii) Building lavatories and visionaries over running water or even the sea as it the practice in some riverine areas.
ix) Radioisotopes
x) Heavy metal
xi) Combustion
xii) Toxic waste disposal at sea
xiii) Mineral processing plant (e.g. coal production)
xiv) Eroded sediments
xv) Deforestation
xvi) Mining
xvii) Littering
xviii) Pesticides
xix) Herbicides and fertilizers
xx) Failing septic system
xxi) House hold chemicals
xxii) Animal wastes.

4.3.2 Effects of Water Pollution on Environment and Lives

There is a greater association between pollution and health problem. Disease causing microorganisms are known as pathogens and these pathogens are spreading disease directly among humans. Some pathogens are worldwide some are found in well-defined area. Many water borne diseases are spreading man to man. Heavy rainfall and floods are related to extreme weather and creating different diseases for developed and developing countries. 10% of the population depends on food and vegetables that are grown in contaminated water. Many waterborne infectious diseases are linked with fecal pollution of water sources and results in fecal-oral route of infection. Health risk associated with polluted water includes different diseases such as respiratory disease, cancer, diarrheal disease, neurological disorder and cardiovascular disease. Nitrogenous chemicals are responsible for cancer and blue baby syndrome. Mortality rate due to cancer is higher in rural areas than urban areas because urban inhabitants use treated water for drinking while rural people don't have facility of treated water and use unprocessed water. Poor people are at greater risk of disease due to improper sanitation, hygiene and water supply. Contaminated water has large negative effects in those women who are exposed to chemicals during pregnancy; it leads to the increased rate of low birth weight as a result fetal health is affected. Poor quality water destroys the crop production and infects our food which is hazardous for aquatic life and human life . Pollutants disturb the food chain and heavy metals, especially iron affects the respiratory system of fishes. An iron clog in to fish gills and it is lethal to fishes, when

these fishes are eaten by human leads to the major health issue. Metal contaminated water leads to hair loss, liver cirrhosis, renal failure and neural disorder.

Bacterial diseases

Untreated drinking water and fecal contamination of water is the major cause of diarrhea. Campylobacter jejuni spread diarrhea 4% to 15% worldwide. Fever, abdominal pain, nausea, headache are major symptoms of diarrhea. Good hygienic practices and use of antibiotics can prevent this disease. Disease cholera is caused by the contaminated water. Vibrio Cholerae is responsible for this disease. This bacterium produces toxins in digestive tracts. The symptoms of this disease are watery diarrhea, nausea, vomiting and watery diarrhea leads to dehydration and renal failure. Anti- microbial treatment is used to get rid of this disease. Shigellosis is a bacterial disease caused by Shigella bacteria. It affects the digestive tract of humans and damages the intestinal lining. Watery or bloody diarrhea, abdominal cramps, vomiting and nausea are symptoms and it can be cured with antibiotics and good hygienic practice. Salmonellosis infects the intestinal tract. Salmonella bacteria are found in contaminated water and it results in inflammation of intestine and often death occurs. Antibiotics are prescribed for this disease.

Viral diseases

Hepatitis is a viral disease caused by contaminated water and infects the liver. Jaundice, loss of appetite, fatigue, discomfort and high fever are symptoms of hepatitis. If it persists for a long time it may be fatal and results in death. Vaccine is available for hepatitis and by adopting good hygienic practice; one can get rid of this disease. Encephalitis is inflammatory disease spread by bite of infected mosquitoes. Culex mosquito lays their eggs in contaminated water. Most people don't show any symptoms but some symptoms are headache, high fever, muscle stiffness, convulsions however in severe cases coma and paralysis results. No vaccine is available for this disease. Poliomyelitis virus is responsible for poliomyelitis. Sore throat, fever, nausea, constipation and diarrhea and sometimes paralysis are symptoms of poliomyelitis. Vaccine is available for this disease. Gastroenteritis is caused by different viruses including rotaviruses, adenoviruses, calciviruses and Norwalk virus. Symptoms of gastroenteritis are vomiting, headache and fever. Symptoms appear 1 to 2 days after infecting. Sickness can be dangerous among infants, young children and disabled person.

Parasitic diseases

Cryptosporidiosis is a parasitic disease caused by the cryptosporidium parvum. It is worldwide disease and symptoms are diarrhea, loose or watery bowls, stomach cramps and upset stomach. Cryptosporidiumis resistant to disinfection and affects immune system and it is the cause of diarrhoea and vomiting in humans. Galloping amoeba is caused by the Entamoeba histolytica and affects stomach lining. This parasite undergoes cyst and non-cyst form. Infection occurs when cyst found in contaminated water and it is swallowed. Symptoms are fever, chills and watery diarrhea. According to WHO, diarrheal cases are about 4 billion and results in 2.2 million deaths. Giardiasis is caused by Giardia lamblia. Cells of intestinal lining may become injure. Giardia is resistant to wintry temperature and disinfectant. Sometimes it is known as travelers' disease. People suffering from giardiasis have symptoms bloating, excess gas, watery diarrhea and weight loss.

4.3.3 Pollution Management and Control

i) Wash your car far away from any storm water drains.
ii) Don't throw trash, chemicals or solvents into sewer drains
iii) Inspects your septic system every 3 - 5 years
iv) Avoid using pesticides and fertilizers that can run off into water systems
v) Sweep your driveway instead of hosing it down.
vi) Always pump your waste-holding tanks on your boat
vii) Use non-toxic cleaning materials
viii) Clean up oil and other liquid spills with kitty litter and sweep them up
ix) Don't wash paints brushes in the sink.

4.3.4 Bureau of Indian Standards (BIS) Water Quality Standards

Drinking Water : Drinking water is water intended for human consumption for drinking and cooking purposes from any source. It includes water supplied by pipes or any other means for human consumption by any supplier.

Water Quality Standards

Drinking water shall comply with the requirements given in Table 4.3.1, Table 4.3.2, Table 4.3.3 and Table 4.3.4

Sr. No.	Substance or characteristic	Requirement (Acceptable Limit)	Undesirable effect outside the acceptable limit	Permissible limit in the absence of alternate source	Method of test (Ref to IS)	Remarks
i)	Colour, Hazen units, Max	5	Above 5 consumer acceptance decreases	15	3025 (Part 4)	Extended to 15 only if toxic substances are not suspected in absence of Alternate sources.
ii)	Odour	Agreeable	-	Agreeable	3025 (Part 5)	a) Test cold and when heated b) Test at several dilutions.
iii)	Taste	Agreeable	-	Agreeable	3025 (Part 7 and 8)	Test to be conducted only after safety has been established.
iv)	Turbidity, NTU, Max	1	Above 5 consumer acceptance decreases	5	3025 (Part 10)	-
v)	Dissolved solids, mg/l, Max	500	Beyond this palatability decreases and may cause gastrointestinal irritation.	2000	3025 (Part 16)	-
vi)	pH value	6.5-8.5	Beyond this range the water will affect the mucous membrane and/or water supply system.	No Relaxation	3025 (Part 11)	-

vii)	Total hardness (as CaCO3), mg/l, Max	200	Encrustation in water supply structure and adverse effects on domestic use.	600	3025 (Part 21)	-

Table 4.3.1 Organoleptic and physical parameters

Sr.No.	Substance or characteristic	Requirement (Acceptable Limit)	Undesirable effect outside the acceptable limit	Permissible limit in the absence of alternate source	Method of test (Ref to IS)	Remarks
i)	Iron (as Fe), mg/l, Max	0.3	Beyond this limit taste/appearance are affected, has adverse effect on domestic uses and water supply structures, and Promotes iron bacteria	No relaxation	3025 (Part 53)	Total concentration of Manganese (as Mn) and Iron (as Fe) shall not exceed 0.3 mg/l
ii)	Aluminium (as Al), mg/l, Max	0.03	Cumulative effect is reported to cause dementia.	0.2	3025 (Part 55)	-
iii)	Copper (as Cu), mg/l, Max	0.05	Astringent taste, discoloration and corrosion of pipes, fitting and utensils will be caused beyond this.	1.5	3025 (Part 42)	-
iv)	Manganese (as Mn), mg/l, Max	0.1	Beyond this limit taste/appearance are affected, has adverse effect on domestic uses and water supply structures.	0.3	IS 3025 (Part 59)	Total concentration of Manganese (as Mn) and Iron (as Fe) shall not exceed 0.3 mg/l
v)	Zinc (as Zn), mg/l, Max	5	Beyond this limit it can cause astringent taste and an opalescence in water.	15	3025 (Part 49)	-
vi)	Magnesium (as Mg), mg/l, Max	30	Encrustation in water supply structure and adverse effects on domestic use.	No Relaxation	3025 (Part 46)	-
vii)	Barium (as Ba), mg/l, Max	0.7	May lead to cardiovascular problem.	No relaxation	Annex F of IS 13428*/I S 15302	-
viii)	Calcium (as Ca), mg/l, Max	75	Encrustation in water supply structure and adverse effects on domestic use.	200	3025 (Part 40)	-
ix)	Silver (as Ag), mg/l, Max	0.1	-	No relaxation	Annex J 0f IS 13428	-

x)	Selenium (as Se), mg/l, Max	0.01	Beyond this, the water becomes toxic.	No relaxation	3025 (Part 56) or IS 15303*	-
xi)	Molybdenum (as Mo), mg/l, Max	0.07	Beyond this it may cause osteoporosis/ bone disorders.	No relaxation	3025 (Part 2;2002)/ ISO 11885 : 1996	-
xii)	Boron (as B), mg/l, Max	0.5	-	1.0	IS 3025 (Part 57)	-
xiii)	Nitrate (as NO3) mg/l, Max	45	Beyond this methaemoglobina mia takes place/may be indicative of pollution	No relaxation	3025 (Part 34)	-
xiv)	Sulphate (as SO4) mg/l, Max	200	Beyond this Causes gastro intestinal irritation when magnesium or Sodium is present.	400	3025 (Part 24)	May be extended to 400 provided that Mg does not exceed 30
xv)	Sulphide (as H2S), mg/l, Max	Below detectable limit	Beyond this it may cause objectionable taste and odour	No relaxation	3025 (Part 29)	-
xvi)	Fluoride (as F) mg/l, Max	1.0	Fluoride may be kept as low as possible. High fluoride may cause fluorosis.	1.5	IS 3025 (Part 60)	-
xvii)	Chlorides (as Cl) mg/l, Max	250	Beyond this limit taste corrosion and palatability are affected.	1000	3025 (Part 32)	-
xviii)	Ammonia (as total ammonia- N), mg/l, Max	0.5	Toxicological effect about 200 mg per kg of body weight.	No relaxation	IS 302 (Part 34)	-
xix)	Chloramines (as Cl2), mg/l, Max	0.2	Eyes,nose irritation, anaemia, stomach discomfort	No relaxation	IS 3025 (Part 26) or APHA 4500-Cl G.	-
xx)	Residual, Free chlorine, mg/l, Min	0.2	-	1	3025 (Part 26)	To be applicable only when water is chlorinated. Tested at consumer end. When protection against viral infection is required, it should be minimum 0.5 mg/l.
xxi)	Total Alkalinity as calcium carbonate, mg/l, Max	200	Beyond this limit taste becomes unpleasant.	600	3025 (Part 23)	-

xxii)	Phenolic compounds (as C6H5OH) mg/l, Max	0.001	Beyond this may cause objectionable taste and odour.	0.002	3025 (Part 43)	-
xxiii)	Mineral Oil, mg/l, Max	Below detectable limit	Beyond this limit undesirable taste and odour after chlorination take place.	No relaxation	IS 3025 (Part 39) Infrared partition method	-
xxiv)	Anionic detergents (as MBAS) mg/l, Mineral Oil, mg/l, Max	0.2	Beyond this limit it can cause a light froth in water.	1	Annex K to IS 13428	-

Table 4.3.2 General Parameters concerning substances undesirable in excessive amounts

Sr. No.	Substance or characteristic	Requirement (Acceptable Limit)	Undesirable effect outside the acceptable limit	Permissible limit in the absence of alternate source	Method of test (Ref to IS)	Remarks
i)	Total Chromium (as Cr6+), mg/l, Max	0.05	May be carcinogenic above this limit	No relaxation	3025 (Part 52)	-
ii)	Total Arsenic (as As), mg/l, Max	0.01	Beyond this the water becomes toxic	0.05	3025 (Part 37)	-
iii))	Mercury (as Hg), mg/l, Max	0.001	Beyond this the water becomes toxic	No relaxation	3025 (Part 48)/ Mercury Analyser	-
iv)	Cadmium (as Cd), mg/l, Max	0.003	Beyond this the Water becomes toxic	No relaxation	3025 (Part 41)	-
v)	Lead (as Pb), mg/l, Max	0.01	Beyond this the water becomes toxic	No relaxation	3025 (Part 47)	-
vi)	Nickel (as Ni), mg/l, Max	0.02	Beyond this it may cause allergic reaction.	No relaxation	3025 (Part 54)	-
vii)	Cyanide (as CN), mg/l, Max	0.05	Beyond this the water becomes toxic	No relaxation	3025 (Part 27)	-
viii)	Polynuclear Aromatic Hydrocarbons (as PAH), mg/l, Max	0.0001	May be carcinogenic	No relaxation	APHA 6440	-

ix)	Polyclorinated biphenyls mg/l, Max	0.0005	May be carcinogenic	No relaxation	ASTM 5175/ APHA 6630	-
x)	Trihalomethanes					
a)	Bromoform mg/l, Max	0.1	May be carcinogec above this limit	No relaxation	ASTM D 3973-85/ APHA	-
b)	Dibromochloro methane mg/l, Max	0.1	May be carcinogenic above this limit	No relaxation	ASTM D 3973-85/ APHA	-
c)	Bromodichloro methane mg/l, Max	0.1	May be carcinogenic above this limit	No relaxation	ASTM D 3973-85/ APHA	-
d)	Chloroform mg/l, Max	0.1	May be carcinogenic above this limit	No relaxation	ASTM D 3973-85/ APHA	-
xi)	Pesticides mg/l, Max	Table 4.5.1	Toxic	No relaxation	Table 4.5.1	-

Table 4.3.3 Parameters concerning toxic substances

Sr. No.	Substance or characteristic	Requirement (Acceptable Limit)	Undesirable effect outside the acceptable limit	Permissible limit in the absence of alternate source	Method of test (Ref to IS)	Remarks
i)	Radioactive Materials					
a)	Alpha emitters Bq/l, Max	0.1	May be carcinogenic above this limit	0.1	IS 14194 (Pt. 2)	-
b)	Beta emitters Bq/l, Max	1.0	May be carcinogenic above this limit	1.0	IS 14194 (Pt. 1)	-

Table 4.3.4 Parameters concerning radioactive substances

4.3.5 Water Treatment Processes

It is essential that the design of any treatment process is based on a full investigation of site conditions, including chemical and microbiological analysis of the water to be treated, a risk assessment and the results of laboratory or pilot scale tests to determine the effectiveness of the process and the chemical dosing requirements.

Following flow chart provides an overview of the basic principles of water treatment plant.

Most treatment systems are designed to remove microbiological contamination and those physical constituents, such as suspended solids (turbidity) that affect aesthetic acceptability or prevent effective disinfection. A final disinfection stage is nearly always included at the end of the treatment process to inactivate any remaining micro organisms. When a persistent disinfectant, such as chlorine, is applied this also provides a residual that will act as a preservative to prevent biological regrowth during storage and/or distribution in larger systems.

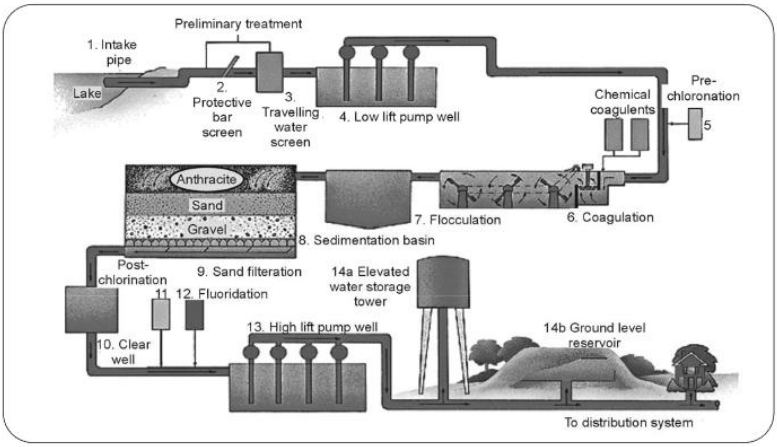


Fig. 4.3.1 Water treatment plant

a) Coagulation and flocculation : Coagulation and flocculation are used to remove color, turbidity, algae and other micro organisms from surface waters. The addition of a chemical coagulant to the water causes the formation of a precipitate, or floc, which entraps these impurities. Iron and aluminium can also be removed under suitable conditions. The floc is separated from the treated water by sedimentation and/or filtration, although flotation processes may be used in place of sedimentation. The advantages of coagulation are that it reduces the time required to settle out suspended solids and is very effective in removing fine particles that are otherwise very difficult to remove. Coagulation can also be effective in removing many protozoa, bacteria and viruses.

b) Sedimentation : Simple sedimentation (i.e. unassisted by coagulation) may be used to reduce turbidity and solids in suspension. Sedimentation tanks are designed to reduce the velocity of flow of water so as to permit suspended solids to settle under gravity. There are many different designs of tanks and selection is based on simple settlement tests or by experience of existing tanks treating similar waters. Without the aid of coagulation, these will only remove large or heavy particles, and due to the length of time this process will take, the system will usually require storage tanks to balance peaks and troughs in demand.

c) Filtration : Turbidity and algae are removed from raw waters by screens, gravel filters, slow sand, rapid gravity filters or cartridge filters. The difference between slow and rapid sand filtration is not a simple matter of the speed of filtration, but in the underlying concept of the treatment process. Slow sand filtration is essentially a biological process whereas rapid sand filtration is a physical treatment process. Many small private water supplies will rely on cartridge filters consisting of a woven or spun filter within a standard housing.

d) Screens : Screens are effective for the removal of particulate material and debris from raw water and are used on many surface water intakes. Coarse screens will remove weeds and debris while band screens or micro strainers will remove smaller particles including fish and may be effective in removing large algae.

Micro strainers are used as a pre-treatment to reduce solids loading before coagulation or subsequent filtration. A micro strainer may consist of a rotating drum fitted with very fine mesh panels, or may be a fixed mesh that the water flows through. The mesh will ensure that suspended solids, including algae, are retained. The extent of solids removal will be determined by the mesh size and the nature of the raw water.

i) **Gravel filters :** Gravel filters may be used to remove turbidity and algae. A larger gravel filter may consist of a rectangular channel or tank divided into several sections and filled with graded gravel (size range 4 to 30mm). The raw water enters through an inlet distribution chamber and flows horizontally through the tank, encountering first the coarse and then the finer gravel. The filtered water is collected in an outlet chamber. Solids removed from the raw water accumulate on the floor of the filter. Gravel filters can operate for several years before cleaning becomes necessary. The size of a gravel filter will depend on water quality, flow rate and size of gravel. A filter can be up to 12m long, 2 to 5m wide and 1 to 1.5m deep. The filter should normally be sized for a flow rate of between 0.5 to 1.0 cubic meters per square meter of filter surface area per hour. A gravel filter will need subsequent treatment downstream, and should only be considered as a preliminary treatment stage.

ii) **Slow sand filters :** Slow sand filters, sometimes preceded by micro strainers or coarse filtration, are used to remove turbidity, algae and microorganisms. Slow sand filtration is a simple and reliable process and is therefore often suitable for the treatment of small supplies provided that sufficient land is available. Slow sand filters usually consist of tanks containing sharp sand (size range 0.15-0.30mm) to a depth of between 0.5 to 1.5m. For small supplies, modular units of 1.25m diameter are available tandem installation would occupy a concrete apron of about 8 to 10 m2. The raw water flows downwards and turbidity and microorganisms are removed by filtration in the top few centimeters of the sand. A biological layer of sludge, known as the schmutzdecke, develops on the surface of the filter that can be effective in removing microorganisms. Treated water is collected in under drains or pipework at the bottom of the filter. The top few centimeters of sand containing the accumulated solids are removed and replaced periodically. Filter runs of between 2 and 10 weeks are possible, depending on raw water quality and flow rate. Slow sand filters are often operated in tandem; one in service whilst the other is cleaned and time allowed for the schmutzdecke to re-establish.

iii) **Pressure filters :** Pressure filters are sometimes used where it is necessary to maintain hydraulic head in order to eliminate the need for additional pumping. The filter bed is enclosed in a cylindrical shell. Small pressure filters capable of treating up to approximately15m^3/h can be manufactured in glass reinforced plastics. Larger pressure filters are manufactured in specially coated steel. Operation and performance are generally as described for the rapid gravity filter and similar facilities are required for backwashing and disposal of the dilute sludge. A similar range of contaminants can be removed depending on the filter medium

e) **Aeration :** Aeration processes are designed to achieve efficient mass transfer of oxygen into water and removal of gases and volatile compounds by air stripping. Oxygen transfer can usually be achieved using a simple cascade or diffusion of air into water, without the need for elaborate equipment. Stripping of gases or volatile compounds, however, may require specialized plant that provides a high degree of mass transfer. To achieve air stripping various techniques can be used including counter current cascade aeration in packed towers, diffused aeration in basins and spray aeration. Packed tower aerators are most commonly used because of their high energy efficiency and compact design.

4.3.5.1 Chemical Treatment

a) **Control of pH- :** The pH value of water may need to be adjusted during treatment and before distribution for several reasons, including to ensure that the pH value meets the water quality standards to control corrosion in the distribution system and consumers' installations or to reduce plumb solvency to improve the effectiveness and efficiency of disinfection to facilitate the removal of iron and manganese to facilitate the removal of color and turbidity by chemical coagulation.

b) **Iron and manganese removal :** In groundwater, iron is usually present as dissolved ferrous compounds. To remove iron in this form, it is necessary to oxidize ferrous iron, usually by aeration, to the insoluble ferric hydroxide and to remove the precipitated material in a subsequent filtration stage. It is important to ensure that oxidation does not give rise to colloidal species which may pass through the filters. If the iron is present as an organic complex, a strong oxidant such as chlorine or potassium permanganate must be used. Manganese is usually present as dissolved manganese compounds. Removal is achieved by oxidation to insoluble manganese dioxide using catalytic filters or potassium permanganate followed by filtration, or by coagulation at high pH followed by filtration.

c) **Taste and odour removal :** Taste and odour can be removed by several methods, including aeration, ozonation and adsorption on activated carbon. The method used will depend on the source of the taste and odor. Adsorption on activated carbon is generally the most effective method for the removal of earthy or muddy taste and odor. Powdered activated carbon can be dosed directly to the water before coagulation and then subsequently removed by sedimentation. Powdered activated carbon is generally used as a one off treatment. Where regular treatment is required, granular activated carbon (GAC) is the preferred solution and this may be used as a filter medium replacing sand in existing filters or alternatively in a post-filtration adsorption stage. In this arrangement, GAC will need to be periodically removed and regenerated, often by the manufacturer and typically once every 12-24 months.

d) **Nitrate removal :** Nitrate removal is usually achieved by ion-exchange. Water is passed through a column of synthetic resin beads that remove anions including nitrate and exchange them for equivalent amounts of chloride. When the capacity for exchange is exhausted, the resin is regenerated by backwashing with a concentrated solution of sodium chloride. This restores the resin to its initial chloride form. The bed is then rinsed with clean water and returned to service. The waste solution and rinse waters, containing high concentrations of sodium chloride, as well as nitrate, are collected for disposal. Nitrate can also be removed by some membrane processes and by biological denitrification. Membrane processes are described in Section 5.8. Resins are available for removal of many anions and cations and have been successfully used at a small scale for removal of color.

e) **Disinfection :** Surface waters including those feeding springs and shallow wells may contain between a few tens of E. coli per 100ml in a source derived from a protected upland catchment to many thousands of E. coli per 100ml in a source derived from a lowland river containing treated sewage effluents. Groundwater is generally less microbiologically active, although contamination may occur through geological features like swallow holes, fissures or through poor construction and protection of borehole headwork. Several disinfection methods are used in water treatment. Disinfection with chlorine is the most widely used method for large water supplies but its application is less common in small supplies. Ultraviolet irradiation is the most common disinfection method found in private supplies.

f) **Ultraviolet irradiation :** Ultraviolet (UV) irradiation is the preferred method for disinfection of small supplies with small distribution networks or retention time. Chlorination may be more suitable for larger schemes in which it is necessary to maintain a residual

disinfectant during storage and distribution. UV disinfection efficiency is particularly affected by water quality and flow rate. The water to be disinfected must be of good quality and particularly low in colour and turbidity. The usual measure for the suitability of treatment by UV disinfection is UV254 absorbance, which may be measured with online monitors or sampled and analysed at a laboratory. UV254 can often vary with levels of colour and organic matter in the water and manufacturers of UV disinfection equipment will be able to advise on the suitability for particular waters. However, pre-filtration is almost always required prior to UV disinfection, especially if Cryptosporidium is likely to be present.

g) **Corrosion control :** Corrosion is the partial dissolution of the materials constituting the treatment and supply systems, tanks, pipes, valves, and pumps. It may lead to structural failure, leaks, loss of capacity, and deterioration of chemical and microbiological water quality. The internal corrosion of pipes and fittings can have a direct impact on the concentration of some water constituents, including lead, copper and nickel. Corrosion control is therefore an important aspect of the management of a water supply system. Corrosion control involves many parameters, including the concentrations of calcium, bicarbonate, carbonate, and dissolved oxygen, as well as pH. The detailed requirements differ depending on water quality and for each distribution system material. The pH controls the solubility and rate of reaction of most of the metal species involved in corrosion reactions.

h) **Particulate filters :** There are several types of particulate filters using different media to remove suspended matter from water in the range 0.5 to 50 μm, or greater. Particulate filters may be used to reduce turbidity and microorganisms, or to remove specific inorganic particulates such as iron, aluminium or manganese compounds. Many particulate filters are incorporated into proprietary point-of-use devices to protect subsequent processes such as activated carbon filtration, reverse osmosis or UV disinfection.

4.3.6 Water Conservation

Water conservation includes all the policies, strategies and activities to sustainably manage the natural resource of fresh water, to protect the hydrosphere, and to meet the current and future human demand. Population, household size, and growth and affluence all affect how much water is used. Factors such as climate change have increased pressures on natural water resources especially in manufacturing and agricultural irrigation.

4.3.6.1 Need of Water Conservation

- It Minimizes the Effects of Drought and Water Shortages.
- It Guards Against Rising Costs and Political Conflict.
- It Helps to Preserve Our Environment.
- It Makes Water Available in the Future for Recreational Purposes.
- It Builds Safe and Beautiful Communities.

4.4 Wastewater - Generation, Impacts, Flow diagram of Sewage Treatment Plant, CPCB Norms of Sewage Discharge.

4.4.1 Wastewater - Generation

It is estimated that 22,900 million liters per day (MLD) of domestic wastewater is generated from urban centers against 13,500 MLD industrial wastewater. The treatment capacity available for domestic wastewater is only for 5,900 MLD, against 8,000 MLD of industrial wastewater. Thus, there is a big gap in treatment of domestic wastewater. Govt. of India is assisting the local bodies to establish sewage treatment plants under the Ganga Action Plan and subsequently under the National River Action Plan. Since the task is massive, it may take long time to tackle the treatment of entire wastewater. Domestic human waste includes human excreta, urine and the associated sludge (collectively known as black water), and waste water generated through bathing and kitchen (collectively known as grey water). Households may produce wastewater from flush toilets sinks, dishwashers, washing machines, bath tubs, and showers. Households that use dry toilets produce less wastewater than those that use flush toilets. Wastewater may be conveyed in a

sanitary sewer which conveys only sewage. Alternatively, it can be transported in a combined sewer which includes storm water runoff and industrial wastewater. After treatment at a wastewater treatment plant, the treated wastewater (also called effluent) is discharged to a receiving water body. The terms "wastewater reuse" or "water reclamation" apply if the treated waste is used for another purpose. Wastewater that is discharged to the environment without suitable treatment causes water pollution.

4.4.2 Impacts of Wastewater

Improper disposal of waste water and the problems of addressing challenges from wastewater discharge into water bodies have led to an increase in the rate of wastewater generation. Abattoir wastes, industrial wastes from breweries, agricultural runoffs, and waste water from car wash located close to the River have adverse effects on the water quality. High levels of pollutants in river cause an increase in Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Dissolved Solids (TDS), and Total Suspended Solids (TSS). Toxic metals such as Cd, Cr, Ni and Pb make such water unsuitable for drinking, irrigation, aquatic life and even pose a great risk to human health.

4.4.3 Sewage Treatment Plant

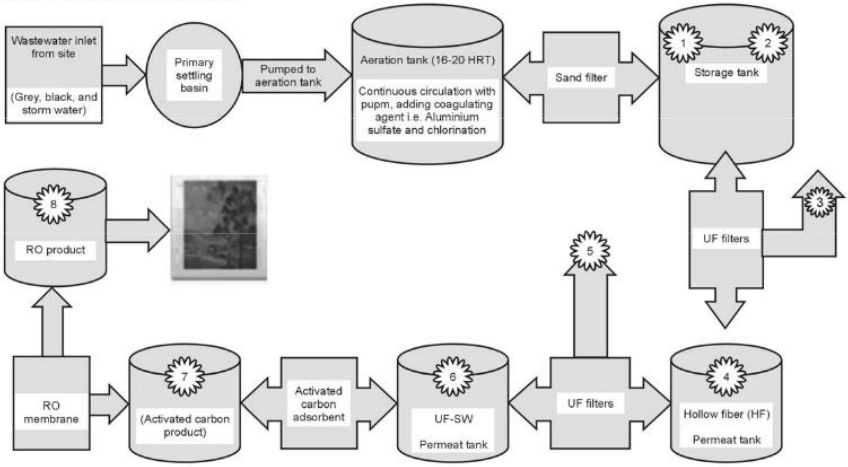


Fig. 4.4.1

4.4.3.1 Basic Terms in Sewage Treatment

- Sedimentation, also known as settling, may be defined as the removal of solid particles from a suspension by settling under gravity.
- Clarification is a similar term, which usually refers specifically to the function of a sedimentation tank in removing suspended matter from the water to give clarified effluent. In a broader sense, clarification could include flotation and filtration.

- Thickening in sedimentation tanks is the process whereby the settled impurities are concentrated and compacted on the floor of the tank and in the sludge-collecting hoppers.
- Concentrated impurities withdrawn from the bottom of sedimentation tanks are called sludge, while material that floats to the top of the tank is called scum.

4.4.3.2 Stages of Sewage Treatment

1. **Primary Sewage Treatment :** The usual first step in sewage treatment is called primary sewage treatment. In this process, large floating materials in incoming wastewater are screened out, the sewage is allowed to flow through settling chambers to remove sand and similar gritty material, skimmers remove floating oil and grease, and floating debris is shredded and ground. After this step, the sewage passes through sedimentation tanks, where more solid matter settles out. Sewage solids collecting on the bottom are called sludge at this stage, primary sludge. About 40-60% of suspended solids are removed from sewage by this settling treatment, and flocculating chemicals that increase the removal of solids are sometimes added at this stage. Biological activity is not particularly important in primary treatment, although some digestion of sludge and dissolved organic matter can occur during long holding times. The sludge is removed on either a continuous or an intermittent basis, and the effluent (the liquid flowing out) then undergoes secondary treatment.

Biochemical Oxygen Demand

An important concept in sewage treatment and in the general ecology of waste management, biochemical oxygen demand (BOD) is a measure of the biologically degradable organic matter in water. Primary treatment removes about 25-35% of the BOD of sewage. BOD is determined by the amount of oxygen required by bacteria to metabolize the organic matter.

2. **Secondary Sewage Treatment :** After primary treatment, the greater part of the BOD remaining in the sewage is in the form of dissolved organic matter. Secondary sewage treatment, which is predominantly biological, is designed to remove most of this organic matter and reduce the BOD. In this process, the sewage undergoes strong aeration to encourage the growth of aerobic bacteria and other microorganisms that oxidize the dissolved organic matter to carbon dioxide and water. Two commonly used methods of secondary treatment are activated sludge systems and trickling filters.

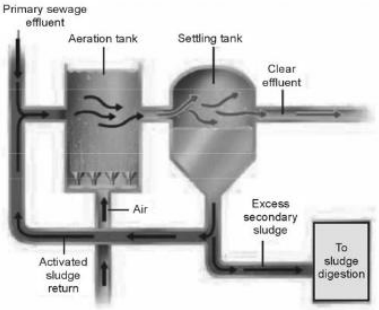


Fig. 4.4.2

In the aeration tanks of an activated sludge system, air or pure oxygen is passed through the effluent from primary treatment. Trickling filters are the other commonly used method of secondary treatment. In this method, the sewage is sprayed over a bed of rocks or molded plastic.

Disinfection and Release

Treated sewage is disinfected, usually by chlorination, before being discharge. The discharge is usually into an ocean or into flowing streams, although spray irrigation fields are sometimes used to avoid phosphorus and heavy metal contamination of waterways.

Sludge Digestion

Primary sludge accumulates in primary sedimentation tanks; sludge also accumulates in activated sludge and in trickling filter secondary treatments. For further treatment, these sludges are often pumped to anaerobic sludge digesters. The process of sludge digestion is

carried out in large tanks from which oxygen is almost completely excluded.

Septic Tanks

Homes and businesses in areas of low population density that are not connected to municipal sewage systems often use a septic tank, a device whose operation is similar in principle to primary treatment . Sewage enters a holding tank, and suspended solids settle out. The sludge in the tank must be pumped out periodically and disposed off.

Oxidation Ponds

Many industries and small communities use oxidation ponds, also called lagoons or stabilization ponds, for water treatment.

3. **Tertiary Sewage Treatment :** Primary and secondary treatments of sewage do not remove all the biologically degradable organic matter. Amounts of organic matter that are not excessive can be released into a flowing stream without causing a serious problem. Eventually, however, the pressures of increased population might increase wastes beyond a body of water's carrying capacity, and additional treatments might be required. Even now, primary and secondary treatments are inadequate in certain situations, such as when the effluent is discharged into small streams or recreational lakes. Some communities have therefore developed tertiary sewage treatment plants.

4.4.4 CPCB Sewage Discharge Standards

Central Pollution Control Board (CPCB) is the regulatory authority and mandates the treated water quality for any STP in India. The sewage discharge norms are :

Parameter	Units	City	Outside Capital City
pH		6.5 to 9.0	6.5 to 9.0
BOD	Mg/L	< 20	< 20
TSS	Mg/L	< 50	< 100
Fecal Coliform	MPN	< 1000	< 100

4.5 Air Pollution - Causes, Effects, Prevention, Ambient Air Quality standards

Air pollution is the contamination of the indoor or outdoor air by a range of gasses and solids that modify its natural characteristics. Key health-harmful pollutants include particulate matter (PM2.5 and PM10)1, carbon monoxide (CO),ozone (O3), black carbon (BC), sulfur dioxide and nitrogen oxides (NOx).

4.5.1 Causes : Factors Responsible for Air Pollution

Causes of air pollution

1. **Natural sources**
   - Volcanic eruptions
   - Forest fires
   - Pollen grains of flowers
2. **Man-made sources**
   - Increase in pollution
   - Deforestation
   - Burning of fossil fuels and fires
   - Emission from vehicles
   - Rapid industrialization
   - Wars

Air pollution can result from both human and natural actions. Natural events that pollute the air include forest fires, volcanic eruptions, wind erosion, pollen dispersal, evaporation of organic compounds and natural radioactivity. Sources of air pollution refer to the various locations, activities or factors which are responsible for the releasing of pollutants into the atmosphere Man-made sources mostly related to burning different kinds of fuel.

i) **"Stationary Sources"** include smoke stacks of power plants, manufacturing facilities (factories) and waste incinerators, as well as furnaces and other types of fuel-burning heating devices. In developing and poor countries, traditional biomass burning is the major source of air pollutants; traditional biomass includes wood, crop waste and dung.

ii) **"Mobile Sources"** include motor vehicles, marine vessels, aircraft and the effect of sound etc.

iii) Chemicals, dust and controlled burn practices in agriculture and forestry management. Controlled or prescribed burning is a technique sometimes used in forest management, farming, prairie restoration or greenhouse gas abatement. Fire is a natural part of both forest and grassland ecology and controlled fire can be a tool for foresters. Controlled burning stimulates the germination of some desirable forest trees, thus renewing the forest.

iv) Fumes from paint, hair spray, varnish, aerosol sprays and other solvents.

v) Waste deposition in landfills, which generate methane. Methane is highly flammable and may form explosive mixtures with air.

vi) Military, such as nuclear weapons, toxic gases, germ warfare and rocketry.

4.5.1.1 Natural sources

- Dust from natural sources, usually large areas of land with few or no vegetation.
- Methane, emitted by the digestion of food by animals, for example cattle.
- Radon gas from radioactive decay within the Earth's crust. Radon is a colorless, odorless, naturally occurring, radioactive noble gas that is formed from the decay of radium. It is considered to be a health hazard. Radon gas from natural sources can accumulate in buildings, especially in confined areas such as the basement and it is the second most frequent cause of lung cancer, after cigarette smoking.
- Smoke and carbon monoxide from wildfires.
- Vegetation, in some regions, emits environmentally significant amounts of VOCs on warmer days. These VOCs react with primary anthropogenic pollutants - specifically, NO_x, SO_2, and anthropogenic organic carbon compounds - to produce a seasonal haze of secondary pollutants.
- Volcanic activity, which produce sulphur, chlorine, and ash particulates.
- A lack of ventilation indoors concentrates air pollution where people often spend the majority of their time. Radon (Rn) gas, a carcinogen, is exuded from the Earth in certain locations and trapped inside houses. Building materials including carpeting and plywoodemit formaldehyde (H_2CO) gas. Paint and solvents give off volatile organic compounds (VOCs) as they dry. Lead paint can degenerate into dust and be inhaled. Intentional air pollution is introduced with the use of air fresheners, incense, and other scented items.
- Controlled wood fires in stoves and fireplaces can add significant amounts of smoke particulates into the air, inside and out. Indoor pollution fatalities may be caused by using pesticides and other chemical sprays indoors without proper ventilation.
- Carbon monoxide (CO) poisoning and fatalities are often caused by faulty vents and chimneys, or by the burning of charcoal indoors.
- Biological sources of air pollution are also found indoors, as gases and airborne particulates. Pets produce dander, people produce dust from minute skin flakes and decomposed hair, dust mites in bedding, carpeting and furniture produce enzymes and micrometer-sized fecal droppings, inhabitants emit methane, mold forms in walls and generates mycotoxins and spores, air conditioning systems can incubate Legionnaires' disease and mold, and houseplants, soil and surrounding gardens can produce pollen, dust, and mold. Indoors, the lack of air circulation allows these airborne pollutants to accumulate more than they would otherwise occur in nature.

4.5.2 Consequences : Effects of Air Pollution

4.5.2.1 Health Effects

Air pollution is a significant risk factor for multiple health conditions including respiratory infections, heart disease, and lung cancer, according to the WHO. The health effects caused by air pollution may include difficulty in breathing, wheezing, coughing, asthma and aggravation of existing respiratory and cardiac conditions. These

effects can result in increased medication use, increased doctor or emergency room visits, more hospital admissions and premature death. The human health effects of poor air quality are far reaching, but principally affect the body's respiratory system and the cardiovascular system. Individual reactions to air pollutants depend on the type of pollutant a person is exposed to, the degree of exposure, the individual's health status and genetics. The most common sources of air pollution include particulates, ozone, nitrogen dioxide, and sulfur dioxide. Both indoor and outdoor air pollution have caused approximately 3.3 million deaths worldwide. Children aged less than five years that live in developing countries are the most vulnerable population in terms of total deaths attributable to indoor and outdoor air pollution. The World Health Organization states that 2.4 million people die each year from causes directly attributable to air pollution, with 1.5 million of these deaths attributable to indoor air pollution.

Around the world, children living in cities with high exposure to air pollutants are at

increased risk of developing asthma, pneumonia and other lower respiratory infections. Because children are outdoors more and have higher minute ventilation they are more susceptible to the dangers of air pollution. Risks of low initial birth weight are also heightened in such cities.

4.5.2.2 Environmental Effects

Poisonous air pollutants (toxic chemicals in the air) can form acid rain. It can also form dangerous ground level ozone. These destroy trees, crops, farms, animals and continue to make water bodies harmful to humans and animals that live and depend on water.

4.5.2.3 Economical Effects

The effect of air pollution on the economy may be a derived one. In simple language, the economy thrives when people are healthy, and business that depends on cultivated raw materials and natural resources are running at full efficiency. Air pollution reduces agricultural crop and commercial forest yields by billions of money each year. This in addition to people staying off work for health reasons can costs the economy greatly.

4.5.3 Control : Measures to Reduce Air Pollution

Prevention interventions are always a better way of controlling air pollution. These prevention methods can either come from government (laws) or by individual actions. In many big cities, monitoring equipment have been installed at many points in the city. Authorities read them regularly to check the quality of air.

4.5.3.1 Government (or Community) Level Prevention

- Governments throughout the world have already taken action against air pollution by introducing green energy. Some governments are investing in wind energy and solar energy, as well as other renewable energy, to minimize burning of fossil fuels, which cause heavy air pollution.
- Governments are also forcing companies to be more responsible with their manufacturing activities, so that even though they still cause pollution, they are a lot controlled.
- Companies are also building more energy efficient cars, which pollute less than before.

4.5.3.2 Individual Level Prevention

- Encourage your family to use the bus, train or bike when commuting. If we all do this, there will be fewer cars on road and less fumes.
- Use energy (light, water, boiler, kettle and fire woods) wisely. This is because lots of fossil fuels are burned to generate electricity, and so if we can cut down the use, we will also cut down the amount of pollution we create.
- Recycle and re-use things. This will minimize the dependence of producing new things. Remember manufacturing industries create a lot of pollution, so if we can re-use things like shopping plastic bags, clothing, paper and bottles, it can help.

4.5.3.3 Air Pollution Control Devices

The following items are commonly used as pollution control devices by industry or transportation devices. They can either destroy contaminants or remove them from an exhaust stream before it is emitted into the atmosphere.

i) Mechanical collectors (dust cyclones, multi-cyclones)

ii) **Electrostatic precipitators :** An electrostatic precipitator (ESP), or electrostatic air cleaner is a particulate collection device that removes particles from a flowing gas (such as air) using the force of an induced electrostatic charge. Electrostatic precipitators are highly efficient filtration devices that minimally impede the flow of gases through the device, and can easily remove fine particulates such as dust and smoke from the air stream.

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

iv) **Particulate scrubbers** : Wet scrubber is a form of pollution control technology. The term describes a variety of devices that use pollutants from a furnace flue gas or from other gas streams. In a wet scrubber, the polluted gas stream is brought into contact with the scrubbing liquid, by spraying it with the liquid, by forcing it through a pool of liquid, or by some other contact method, so as to remove the pollutants.

4.5.4 Ambient Air Quality Standards in India

The Air (Prevention and Control of Pollution) Act 1981 was enacted by the Central Government with the objective of arresting the deterioration of air quality. The Air (Prevention and Control of Pollution) Act 1981 describes the main functions of the Central Pollution Control Board (CPCB) as follows :

- To advise the Central Government on any matter concerning the improvement of the quality of the air and the prevention, control and abatement of air pollution.
- To plan and cause to be executed a nation-wide programme for the prevention, control and abatement of air pollution.
- To provide technical assistance and guidance to the State Pollution Control Board.
- To carry out and sponsor investigations and research related to prevention, control and abatement of air pollution.
- To collect, compile and publish technical and statistical data related to air pollution; and
- To lay down and annul standards for the quality of air

The mandate provided to the CPCB under the Air (Prevention and Control of Pollution) Act empowers it to set standards for the quality of air.

Pollutant	Time Weighted Average	Concentration in Ambient Air	
		Industrial, Residential, Rural and Other Areas	Ecologically Sensitive Area (notified by Central Government)
Sulphur Dioxide (SO_2), $\mu g/m^3$	Annual* 24 hours**	50 80	20 80

Nitrogen Dioxide (NO_2), $\mu g/m^3$	Annual* 24 hours**	40 80	30 80
Particulate Matter (size less than 10 µm) or PM10 $\mu g/m^3$	Annual* 24 hours**	60 100	60 100
Particulate Matter (size less than 2.5 µm) or PM2.5 $\mu g/m^3$	Annual* 24 hours**	40 60	40 60
Ozone (O_3) $\mu g/m^3$	8 hours* 1 hour**	100 180	100 180
Lead (Pb) $\mu g/m^3$	Annual* 24 hours**	0.50 1.0	0.50 1.0
Carbon Monoxide (CO) mg/m^3	8 hours* 1 hour**	02 04	02 04
Ammonia (NH_3) $\mu g/m^3$	Annual* 24 hours**	100 400	100 400
Benzene (C_6H_6) $\mu g/m^3$	Annual*	5	5
Benzo(a)Pyrene (BaP)-particulate phase only, ng/m^3	Annual*	1	1
Arsenic(As), ng/m^3	Annual*	6	60
Nickel (Ni), ng/m^3	Annual*	20	20

* Annual arithmetic mean of minimum 104 measurements in a year at a particular site taken twice a week 24 hourly at uniform intervals.

** 24 hourly or 8 hourly or 1 hourly monitored values, as applicable, shall be complied with 98% of the time; they may exceed the limits but not on two consecutive days of monitoring.

Table 4.5.1 : National ambient air quality standards

4.6 Noise Pollution - Sources, Effects, Prevention, Noise Level at Various Zones of the City

Sound, a normal feature of our life, is the means of communication and entertainment in most animals, including human beings. It is also a very effective alarm system. A low sound is pleasant whereas a loud sound is unpleasant and is commonly referred to as 'noise'. Noise can be defined as an unpleasant and unwanted sound.

4.6.1 Sources of Noise Pollution

i) **Industrial Sources :** Progress in technology (industrialization) has resulted in creating noise pollution. Textile mills, printing presses, engineering establishments and metal works etc. contribute heavily towards noise pollution. In industrial cities like Kolkata, Ludhiana, Kanpur etc., often the industrial zones are not separated from the residential zones of the city especially in the case of small scale industries.

These operate from workshops located on the ground floors of the residential areas and cause annoyance, discomfort and irritation to the residents exposed to the noise that is inevitably produced. The situation is much better in modern planned cities like Chandigarh where the industrial area is kept away from the residential areas and both are separated from each other by a sufficiently wide green belt.

ii) Transport Vehicles : Automobile revolution in urban centers has proved to be a big source of noise pollution. Increasing traffic has given rise to traffic jams in congested areas where the repeated hooting of horns by impatient drivers pierces the ears of all road users.

Noise from airplanes constitutes an increasing serious problem in big cities like Delhi & Mumbai. Airport situated in the vicinity of population centers and the air planes pass over residential areas. Heavy trucks, buses trains, jet-planes, motor-cycles, scooters, mopeds, jeeps-the list of vehicles is endless but the outcome is same - noise pollution.

iii) Household : The household is an industry in itself and is a source of many indoor noises such as the banging of doors, noise of playing children, crying of infants, moving of furniture, loud conversation of the inhabitants etc. Besides these are the entertainment equipment in the house, namely the radio, record-players and television sets. Domestic gadgets like the mixer-grinders, pressure cookers, desert coolers, air-conditioners, exhaust fans, vacuum cleaners, sewing and washing machines are all indoor sources of noise pollution.

iv) Public Address System : In India people need only the slightest of an excuse for using loud speakers. The reason may be a religious function, birth, death, marriage, elections, demonstration, or just commercial advertising. Public system, therefore, contributes in its own way towards noise pollution.

v) Agricultural Machines : Tractors, thrashers, harvesters, tube wells, powered tillers etc. have all made agriculture highly mechanical but at the same time highly noisy. Noise level 90 dB to 98 dB due to running of farm machines have been recorded in the state of Punjab.

vi) Defense Equipment : A lot of noise pollution is added to the atmosphere by artillery, tanks, launching of rockets, explosions, exercising of military airplanes and shooting practices. Screams of jet engines and sonic booms have a deafening impact on the ears and in extreme cases have been known to shatter the window panes and old dilapidated buildings.

vii) Miscellaneous Sources : The automobile repair shops, construction-works, blasting, bulldozing, stone crushing etc. are other sources of noise pollution.

4.6.2 Effects of Noise

Noise is generally harmful and a serious health hazard. It has far-reaching consequences and has many physical, physiological as well as psychological effects on human beings.

i) Physical Effects : The physical manifestation of noise pollution is the effect on hearing ability. Repeated exposure to noise may result in temporary or permanent shifting of the hearing threshold of a person depending upon the level and duration of exposure. The immediate and acute effect of noise pollution is impairment of hearing (i.e. total deafness.)

Human ears have sensory cells for hearing. If these cells are subjected to repeated sounds of high intensity before they have an opportunity to recover fully, they can become permanently damaged leading to impairment of hearing. Besides the sensory cells, the delicate tympanic membrane or the ear drum can also be permanently damaged by a sudden loud noise such as an explosion.

ii) Physiological Effects : The physiological manifestations of noise pollution are several as mentioned below :

a) Headache by dilating blood vessels of the brain.

b) Increase in the rate of heart-beat.

c) Narrowing of arteries.

d) Fluctuations in the arterial blood pressure by increasing the level of cholesterol in the blood.

e) Decrease in heart output.

f) Pain in the heart.

g) Digestive spasms through anxiety and dilation of the pupil of the eye, thereby causing eye-strain.

h) Impairment of night vision.

i) Decrease in the rate of colour perception.

j) Lowering of concentration and affect on memory,

k) Muscular strain and nervous breakdown.

l) Psychological Effect

iii) Psychological Effects : The psychological manifestations of noise pollution are:

a) Depression and fatigue which considerably reduces the efficiency of a person.

b) Insomnia as a result of lack of undisturbed and refreshing sleep.

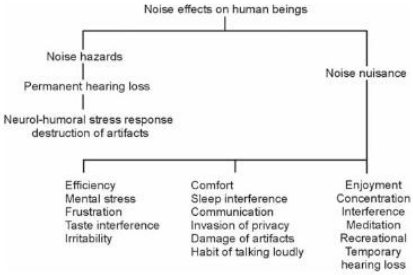
c) Straining of senses and annoyance as a result of slow but persistent noise from motorcycles, alarm clocks, call bells, telephone rings etc.

d) Affecting of psychomotor performance of a person by a sudden loud sound

e) Emotional disturbance

For a talkative person, the most important effect of noise pollution would invariably be that noise interferes with our conservation. So, noise is annoying and the annoyance depends on many factors not merely the intensity of the sound but also repetition, because even a sound of small intensity (e.g. dripping tap or clicking of clock) may become annoying, simply by repetition.

Some of the well- known effects of noise on human beings and the relation of noise pollution level and its harmful effects are shown in Table



Level (in db)	Effects
up to 23	No disturbance
30-60	Stress, tension, psychological (illness, heart attact) effects especially at upper range.
60-90	Damage to health, psychological and vegetative (disturbance in stomach-gall function, pains in muscles, high blood pressure, disturbance in sleeping)
60-120	Damages to health and ontological (ear diseases) effects
Above 120	Painful effects in long run.

Table 4.6.1 : Noise pollution level and its harmful effects

4.6.3 Prevention of Noise Pollution

- Turn off Appliances at Home and offices.
- Shut the Door when using noisy Machines.
- Use Earplugs.
- Lower the volume.
- Stay away from Noisy area.
- Follow the Limits of Noise level.
- Control Noise level near sensitive areas.
- Go Green by planning trees.

4.6.4 Noise Levels at Various Zones of City

Sr.No	Type of Area	Environmental Noise Standards (Leq) in d B (A).	
		Day time	Night time
1	Industrial area	75	65
2	Commercial area	65	55
3	Residential area	55	45
4	Silence zone	50	40

4.7 Municipal Solid Waste, Bio-medical Waste and E-waste - Sources, Generation, Characteristics, Effects and Methods to Manage

4.7.1 Solid Waste Characteristics

Physical and chemical composition of solid wastes vary depending on sources and types of solid wastes

Determination of Characteristics in the Field :

- Solid wastes are complex, multiphase mixtures.
- Because of the heterogeneous nature of solid wastes, determination of composition is not easy. Statistical procedures are difficult and usually procedures based on random sampling techniques are used to determine composition.
- To obtain a sample for analysis the waste is reduced to about 100 kg by coning and quartering.

Physical Characteristics

1. Density/Specific weight
2. Color
3. Moisture content
4. Voids Particle size
5. Shape of components
6. Size distribution
7. Optical property
8. Field capacity
9. Magnetic properties
10. Compacted waste porosity
11. Electric properties

Chemical Characteristics

1. Proximate analysis
2. Fusing point of ash
3. Ultimate analysis
4. Energy content

4.7.2 Solid Waste Management

"Solid-waste management, the collecting, treating, and disposing of solid material that is discarded because it has served its purpose or is no longer useful. Improper disposal of municipal solid waste can create unsanitary conditions, and these conditions in turn can lead to pollution of the environment and to outbreaks of vector-borne disease-that is, diseases spread by rodents and insects.

i) **Incineration :** Incineration is a waste treatment process that involves the combustion of organic substances contained in waste materials. Incineration and other high-temperature waste treatment systems are described as "thermal treatment". Incineration of waste materials converts the waste into ash, flue gas and heat. The ash is mostly formed by the inorganic constituents of the waste and may take the form of solid lumps or particulates carried by the flue gas. The flue gases must be cleaned of gaseous and particulate pollutants before they are dispersed into the atmosphere. In some cases, the heat generated by incineration can be used to generate electric power.

ii) **Refuse-derived fuel (RDF) :** RDF is the product of processing municipal solid waste to separate the noncombustible from the combustible portion, and preparing the combustible portion into a form that can be effectively fired in an existing or new boiler.

iii) **Sanitary landfills :** Are sites where waste is isolated from the environment until it is safe. It is considered when it has completely degraded biologically, chemically and physically. Sanitary landfills are a method of waste disposal where the waste is buried either underground or in large piles. For sanitary landfills, the process starts by digging a large hole in the ground that is then lined with thick plastic (normally 2-4 feet thick) and a layer of impervious clay.

4.7.3 Biomedical Waste

Any waste which is generated during the diagnosis, treatment or immunization of human beings or animals or in research activities pertaining thereto or in the production or testing of biological.

Sources

- Hospitals
- Nursing homes
- Clinics

- Medical laboratories
- Blood banks
- Mortuaries
- Medical research & training centers
- Biotechnology institution/production units
- Animal houses etc.
- Such a waste can also be generated at home if health care is being provided there to a patient (e.g. injection, dressing material etc.)

Management :

The latest guidelines for segregation of bio-medical waste recommend the following color coding

Red Bag - Syringes (without needles), soiled gloves, catheters, IV tubes etc should be all disposed of in a red colored bag, which will later be incinerated.

Yellow Bag - All dressings, bandages and cotton swabs with body fluids, blood bags, human anatomical waste, and body parts are to be discarded in yellow bags.

Cardboard box with blue marking - Glass vials, ampules, and other glass ware is to be discarded in a cardboard box with a blue marking/sticker.

White Puncture Proof Container (PPC) - Needles, sharps, blades are disposed of in a white translucent puncture proof container.

Black Bags - These are to be used for non-bio-medical waste. In a hospital setup, this includes stationary, vegetable and fruit peels, leftovers, packaging including that from medicines, disposable caps, disposable masks, disposable shoe-covers, disposable tea cups, cartons, sweeping dust, kitchen waste etc.

Methods to manage Biomedical Waste :

i) **Autoclave :** Autoclaves are closed chambers that apply both heat and pressure, and sometimes steam, over a period of time to sterilize medical equipment. Autoclaves have been used for nearly a century to sterilize medical instruments for reuse. Autoclaves are used to destroy microorganisms that may be present in medical waste before disposal in a traditional landfill. Autoclaves can be used to process up to 90% of medical waste, and are easily scaled to meet the needs of any medical organization. Small counter-top autoclaves are often used for sterilizing reusable medical instruments while large autoclaves are used to treat large volumes of medical waste. Steam sterilization is most effective with low-density material such as plastics, metal pans, bottles, and flasks. High-density polyethylene and polypropylene plastic should not be used in this process because they do not facilitate steam penetration to the waste load. Plastic bags should be placed in a rigid container before steam treatment to prevent spillage and drain clogging. Bags should be opened and caps and stoppers should be loosened immediately before they are place in the steam sterilizer. Care should be taken to separate infectious wastes from other hazardous wastes. Infectious waste that contains noninfectious hazards should not be steam-sterilized. Waste that contains anti neoplastic drugs, toxic chemicals, or chemicals that would be volatilized by steam should not be steam-sterilized.

ii) **Thermal inactivation :** Thermal inactivation involves the treatment of waste with high temperatures to eliminate infectious agents. This method is usually used for large volumes. Liquid waste is collected in vessel and heated by heat exchangers or a steam jacket surrounds the vessel. The types of pathogens in the waste determine the temperature and duration of treatment. After treatment, the contents can be discharged into the sanitary sewer in a manner that complies with State, Municipal, and local requirements. This method requires higher temperatures and longer treatment cycles than steam treatment.

iii) **Gas/vapor sterilization :** Gas/vapor sterilization uses gaseous or vaporized chemicals as the sterilizing agents. Ethylene oxide is the most commonly used agent, but should be used with caution since it is a suspected human carcinogen. Because ethylene oxide may be adsorbed on the surface of treated materials,

the potential exists for worker exposure when sterilized materials are handled.

iv) **Chemical disinfection :** Chemical disinfection is the preferred treatment for liquid infectious wastes. Consider the following: Type of microorganism, Degree of contamination, Amount of proteinaceous material present, Type of disinfectant, Contact time, and other relevant factors such as temperature, pH, mixing requirements, and the biology of the microorganism. Ultimate disposal of chemically treated waste should be in accordance with State and local requirements.

4.7.4 E-Waste

Rapid growth of technology, up gradation of technical innovations, and a high rate of obsolescence in the electronics industry have led to one of the fastest growing waste streams in the world which consist of end of life electrical and electronic equipment product such as: Refrigerator, Washing machines, Computers and Printers, Televisions, Mobiles, IPods etc. Many of which contain toxic materials.

E - Waste Generation :

- There are 10 states that contribute to 70% of the total E-Waste generated in the country.
- 65 cities generate more than 60% of the total E-Waste in India
- Among the top ten cities generating E-Waste, Mumbai ranks first followed by Delhi, Bengaluru, Chennai, Kolkata, Ahmedabad, Hyderabad, Pune, Surat & Nagpur.
- Main source of electronic waste in India are the government, public and private (Industrial) sectors - 70% -
- Contribution of individual house holds - 15% -
- Rest being contributed by manufacturers.
- Annual growth rate of E-Waste generation - 10% -

Table 4.7.1 : The environmental impact of the processing of different electronic waste components

E-Waste Component	Process Used	Potential Environmental Hazard
Cathode ray tubes (used in TVs, computer monitors, ATM, video cameras, and more)	Breaking and removal of yoke, then dumping	Lead, barium and other heavy metals leaching into the ground water and release of toxic phosphor
Printed circuit board (image behind table - a thin plate on which chips and other electronic components are placed)	De-soldering and removal of computer chips; open burning and acid baths to remove metals after chips are removed.	Air emissions and discharge into rivers of glass dust, tin, lead, brominated dioxin, beryllium cadmium, and mercury
Chips and other gold plated components	Chemical stripping using nitric and hydrochloric acid and burning of chips	PAHs, heavy metals, brominated flame retardants discharged directly into rivers acidifying fish and flora. Tin and lead contamination of surface and groundwater. Air emissions of brominated dioxins, heavy metals, and PAHs
Plastics from printers, keyboards, monitors, etc.	Shredding and low temp melting to be reused	Emissions of brominated dioxins, heavy metals, and hydrocarbons
Computer wires	Open burning and stripping to remove copper	PAHs released into air, water, and so

Recycling of E-waste

One of the major challenge is recycling the printed circuit boards from the electronic wastes. The circuit boards contain such precious metals as gold, silver, platinum, etc. and such base metals as copper, iron, aluminum, etc. One way e-waste is processed is by melting circuit boards, burning cable sheathing to recover copper wire and open-pit acid leaching for separating metals of value. Conventional method employed is mechanical shredding and separation but the recycling efficiency is low. Alternative methods such as cryogenic decomposition have been studied for printed circuit board recycling, and some other methods are still under investigation. Properly disposing of or reusing electronics can help prevent health problems, reduce greenhouse-gas emissions, and create jobs. Reuse and refurbishing offer a more environmentally friendly and socially conscious alternative to down cycling processes.

Multiple Choice Questions

Q.1 When did the Central Pollution Control Board established ?

[a] 1970 [b] 1972
[c] 1974 [d] 1976

Q.2 Which one of the following is the apex organization in country in the field of pollution control ?

[a] Water Pollution Control Board
[b] State Pollution Control Board
[c] Central Pollution Control Board
[d] Air pollution Control Board

Q.3 Who appoint the chairman of the Central Pollution Control Board ?

[a] Central Government [b] State Government
[c] Governor of the State [d] President of India

Q.4 Where is the head office of the Central Pollution Control Board ?

[a] Mumbai [b] Raipur
[c] Mysore [d] New Delhi

Q.5 What is the full form of NAMP ?

[a] National Air Quality Monitoring Program
[b] National Air Quality Measuring Program
[c] National Air Quantity Monitoring Program
[d] National Air Quality Monitoring Protocol

Q.6 In how many tier programs the inland water quality monitoring network is operating ?

[a] One [b] Two
[c] Three [d] Four

Q.7 When did the National Green Tribunal Act constituted ?

[a] 2000 [b] 2005
[c] 2010 [d] 2015

Q.8 Which of the following is the physical monitoring of the lake ?

[a] PH [b] COD
[c] BOD [d] Turbidity

Q.9 Pollution enters into the water system in ___ ways.

[a] 1 [b] 2
[c] 3 [d] 4

Q.10 A large amount of soil can move with the run off called _____.

[a] soil erosion [b] soil conservation
[c] soil pollution [d] soil moving

Q.11 What is the full form of GAP ?

[a] Ganga Action Pre Distribution
[b] Ganga Action Plan
[c] Ganga Affected Plan
[d] Ganga Affected Pre Distribution

Q.12 Coastal water shows major differences in _____.

[a] pollution [b] sewage
[c] salinity [d] conductivity

Q.13 Mostly pollution of rivers takes place by discharge sewage.

[a] True [b] False

Q.14 Control of river pollution can be done by providing the extra _____ during dry season.

a Water b Nitrogen
c Carbon dioxide d Oxygen

Q.15 Determination of flow increase is used for the monitoring of _____.

a sea pollution b river pollution
c lake pollution d tank pollution

Q.16 Which of the following does not include in the monitoring of river pollution ?

a Assessing the immediate water quality
b Development activities in the region
c Determination of flow increase
d Colour of the water

Q.17 When did the Noise Pollution Regulations and Control Rule established in India ?

a 2000 b 2004
c 2005 d 2007

Q.18 What timings loud speakers shouldn't use in public areas ?

a 10:00 pm to 5:00 am b 1:00 am to 7:00 am
c 11:00 pm to 6:00 am d 10:00 pm to 6:00 am

Q.19 When can a person complaint to the police regarding noise pollution level ?

a When the ambient noise standards exceeds by 10 dB
b When the ambient noise standards exceeds by 20 dB
c When the ambient noise standards exceeds by 30 dB
d When the ambient noise standards exceeds by 50 dB

Q.20 What is the meaning of silence zone for noise pollution ?

a Area comprising more than 100 meters around hospitals and educational institutes
b Area comprising not less than 100 meters around hospitals and educational institutes
c Area comprising more than 100 meters around clubs and commercial streets
d Area comprising not less than 100 meters around clubs and commercial streets

Q.21 Which Ministry published a draft of Noise Pollution Rules ?

a Ministry of Foreign Affaires
b Ministry of Pollution Control
c Ministry of Industries
d Ministry of Environment and Forests

Q.22 One of the efficient ways to control aircraft noise is _____.

a building aircrafts with old technologies
b maximize the passengers to 100
c increase the amount of pressure it can withstand
d constructing aerodromes far away from the residential areas

Q.23 In which section if a person violates the noise pollution regulations is liable for penalty ?

a Section 12 b Section 15
c Section 18 d Section 19

Q.24 What is the db level for heavy vehicles in India ?

a 70 b 75
c 77 d 80

Q.25 What are the ambient air quality standards in industrial area during day time ?

a 75 db b 80 db
c 85 db d 100 db

Q.26 In which Act, noise is included as an environmental pollutant ?

a 1974 b 1981
c 1988 d 1994

Q.27 State true or false. Loud speakers cause noise.

a True b False

Q.28 Which gas is mainly produced due to incomplete burning of wood ?

a CO b SO_2

c NO_2 d NO_3

Q.29 Which of the following is involved in production of carboxyl hemoglobin ?

a CO b SO_2

c NO_2 d NO_3

Q.30 Which of the following is a liquid form of aerosol ?

a Fume b Dust

c Mist d Smoke

Q.31 X ray films are a source of which of the following gas ?

a SO_2 b CO_2

c NO_2 d SO_3

Q.32 Which of the following leads to a disease called broncho spasm ?

a SO_2 b SO_3

c SO_4 d CO_2

Q.33 The minimum size of smoke particle is ____.

a 0.2µm b 1µm

c 0.8µm d 0.5µm

Q.34 Which of the following is a secondary air pollutant ?

a SPM b PAN

c SO_2 d NO_2

Q.35 The permissible concentration of PM 10 in the air is _____.

a $60\mu g/m^3$ b $40\mu g/m^3$

c $50\mu g/m^3$ d $20\mu g/m^3$

Q.36 Which of the following is not a part of photochemical smog ?

a NO_2 b O_3

c PAN d SPM

Q.37 Which of the following air pollutant effects plants the most ?

a Fluorine b SO_2

c PAN d HCl

Q.38 Which of the following gas is not colorless ?

a NO b O_3

c Pb d SO_3

Q.39 What is the minimum height of the chimney in a thermal power plant of capacity 350MW ?

a 100m b 220m

c 380m d 60m

Q.40 How can we achieve the prevention of environmental degradation ?

a By relying on government to do all the jobs

b By killing all animals in the forest

c By creating public awareness among people about the importance of environment

d By causing more and more pollution

Q.41 What is called for the pollution that can be traced directly to industrial activity ?

a Soil pollution b Water pollution

c Air pollution d Industrial pollution

Q.42 Which of the following are the largest contributors to the global pollution ?

a Soil pollution b Industrial pollution

c Radioactive pollution d Water pollution

Q.43 Which of the following is the consequence of industrial pollution ?

a Increase in the water level in seas

b Releases of the hazardous radiations

c Increase in the animals in forests

d Global warming

Q.44 How do industrial pollution results in the water pollution ?

a Dumping of various waste products from industries

b Taking water bodies places to built industries

[c] Industries which uses all the water from the water bodies and cause scarcity of water

[d] Building of purification unit in the industries

Q.45 State true or false. Industrial pollution doesn't contribute for air pollution.

[a] True [b] False

Q.46 Which one of the following is the prime factor towards soil pollution ?

[a] Soil erosion

[b] Floods

[c] Dumping of industrial wastes

[d] Using land for irrigation

Q.47 Which one of the following industries produced Sulfur dioxide and flu ash as pollutants ?

[a] Textile industries [b] Cottage industries

[c] Thermal industries [d] Coal industries

Q.48 Which one of the following is a mechanical means of treating industrial effluents ?

[a] Oxidation [b] Chlorination

[c] Recycling of waste [d] Sedimentation

Q.49 Which one of the following is not normally a pollutant ?

[a] Carbon dioxide [b] Carbon monoxide

[c] Sulphur dioxide [d] Hydrocarbons

Q.50 Why industries pollute water ?

[a] Because they use water in large quantities

[b] Because they release all the pollutants to water

[c] Because industries don't use water

[d] Because water is an universal solvent

Q.51 Which one of the following is the cause of the industrial pollution ?

[a] Modern technologies

[b] Efficient waste disposal

[c] Efficient government policies

[d] Unplanned industrial growth

Q.52 State true or false. Industries require raw materials to be extracted from the ground such minerals cause soil pollution.

[a] True [b] False

Q.53 Who prepared the Ganga Action Plan ?

[a] Department of Pollution

[b] Department of Environment

[c] Department of Rivers

[d] Department of Industries

Q.54 Which state has the highest number of towns selected for Ganga Action Plan 1 ?

[a] West Bengal [b] Uttar Pradesh

[c] Bihar [d] Haryana

Q.55 In how many cities Rajiv Gandhi launched the creation of Ganga Action Plan when he was The Prime Minister of India.

[a] Three [b] Five

[c] Seven [d] Ten

Q.56 What is the effect of warmer temperature to the fishes ?

[a] Increase the metabolism

[b] Decrease the metabolism

[c] Stabilize the metabolism

[d] Increase the solubility of oxygen

Q.57 How does soil erosion cause thermal pollution ?

[a] By making natural water bodies to hold in its normal level

[b] By polluting the water bodies

[c] By avoiding sunlight to fall on the water bodies

[d] By making natural water bodies to rise beyond their normal level

Q.58 How does an artificial lake help in solving thermal pollution ?

[a] It stores heated water

[b] It gives a good aesthetic view

[c] It helps to breed fishes

[d] It is used during the summer season where water scarcity cause

Q.59 pH sensor must remain clean for an accurate reading.

[a] True [b] False

Q.60 _____ is suited for open channel monitoring applications.

[a] pH sensor [b] Ultrasonic technology
[c] Infrared technology [d] Monitoring meters

Q.61 What is the maximum percentage of saturation for dissolved oxygen analyser ?

[a] 98.9% [b] 99.2%
[c] 99.8% [d] 99.9%

Q.62 Corrosion is the deterioration of materials by chemical interaction with their environment.

[a] True [b] False

Q.63 What is pH range for oxygen removal ?

[a] 3.5-4.5 [b] 6.5-8.5
[c] 10-12 [d] 12-13.5

Q.64 When can we classify waste as hazardous ?

[a] When waste won't cause any mortality
[b] When waste increase mortality
[c] When waste decrease mortality
[d] When waste decompose itself without any aid

Q.65 What is a toxic waste ?

[a] Substances those are not poisonous
[b] Substances those are poisonous only when it taken in large quantity
[c] Substances those are poisonous only when it taken in small quantity
[d] Substances which work as an antidote for toxic materials

Q.66 Which of the following have a tendency to react vigorously with water or air ?

[a] Toxic waste [b] Reactive waste
[c] Corrosive waste [d] Infectious waste

Q.67 How do PCBs impact on birds ?

[a] They decrease the memory
[b] They cause reproductive failure
[c] They cause bird flu
[d] They cause indigestion

Q.68 Vinyl chloride is widely used in the manufacture of _____.

[a] glass [b] agricultural chemicals
[c] storage of aquatic foods [d] plastics

Q.69 In order to dispose hazardous waste where there are no abundant lands which method is used ?

[a] Land disposal [b] Burning
[c] Floats in water bodies [d] Incineration

Q.70 Which was the first city to an established system of waste removal ?

[a] Lahore [b] Athens
[c] Paris [d] London

Q.71 Why burning waste is not an acceptable practice of solid waste management ?

[a] Because it is very costly
[b] Because it requires modern technologies
[c] Because it cause several environmental issues
[d] Because it requires lot of space

Q.72 What plan should we make to the disposal of solid waste ?

[a] Integrated waste management plan
[b] Recycling of waste management plan
[c] Reducing of waste management plan
[d] Use of waste management plan

Q.73 The term 'Municipal Solid Waste' is used to describe which kind of solid waste ?

[a] Hazardous [b] Toxic
[c] Non hazardous [d] Non toxic

Q.74 How many main components are there in integrated waste management ?

[a] One [b] Two
[c] Three [d] Four

Q.75 Municipal Solid Waste (MSW) contains a wide variety of materials.

a True b False

Q.76 Which of the integrated waste management is reduced on an individual level ?

a Source reduction b Recycling

c Disposal d Burning

Q.77 Which of the following can be recycled many times ?

a Plastic b Wood

c Organic materials d Aluminum

Q.78 Why plastics are difficult to recycle ?

a Because it is very hard material

b Because it is very adhesive in its nature

c Because of different types of polymer resins

d Because of different sizes of plastic

Q.79 How many key characteristics of a municipal sanitary landfill are there ?

a One b Two

c Three d Four

Q.80 How does organic material in the buried solid waste will decompose ?

a By the action of oxidation

b By the action of microorganisms

c By the flow of water

d By the soil particles

Q.81 What is called for the process of burning municipal solid waste in a properly designed furnace under suitable temperature and operating conditions ?

a Landfill b Recycling

c Vermicomposting d Incineration

Q.82 Land filling is an economic alternative for solid waste disposal and it can be implemented easily.

a True b False

Q.83 Which of the below is not an idea behind solid waste management ?

a Control of waste generation

b Storage and collection

c Disposal

d Stop waste generation

Q.84 The term ISWM refers to :

a International Solid Waste Management

b Integrated Solid Waste Management

c Integrated Solid Waste Machine

d International Solid Waste Mechanism

Q.85 Under which rule of Government, guidelines for solid waste management are followed today ?

a Municipal Solid Waste Rules, 2000

b Municipal Solid Waste Rules, 2016

c Solid Waste Rules, 2000

d Solid Waste Rules, 2016

Q.86 The average composition of Municipal solid waste is :

a 41% organic, 40% inert & 19% recyclable

b 20% organic, 60% inert & 20% recyclable

c 30% organic, 20% inert & 50% recyclable

d 19% organic, 41% inert & 40% recyclable

Q.87 Bio-medical waste can be effectively managed by thermal process.

a True b False

Q.88 The WHO has classified the bio-medical waste into _____ categories.

a 5 b 4

c 3 d 2

Q.89 Which gas produced in open dumps from decomposition of biodegradable waste ?

a Ethane b Methane

c Propene d Ethane

Q.90 Carbon footprint can be measured by :

a carbon dating

b instruments

c carbon accounting
d Formula

Q.91 Which of the below is a global scale environmental issue ?

a Eutrophication b Regional ozone
c Climate change d Pollution

Q.92 The quantity of sanitary sewage entering the sewers would be _____ the total quantity of water supplied.

a less than b equal to
c more than d greater than

Q.93 The quantity of sanitary sewage directly depends on _____.

a rate of water supply b area
c population d precipitation

Q.94 What is the lowest wastewater flow in hospitals ?

a 50 gpcd b 700 lpcd
c 900 lpcd d 40 lpcd

Q.95 The maximum desirable limit Bureau of Indian Standards (BIS) of lead in the drinking water is _____.

a 0.05mg/l b 0.09mg/l
c 0.1mg/l d 1.0 mg/l

Q.96 Zeolite softening process removes

a only temporary hardness of water
b only permanent hardness of water
c both temporary and permanent hardness of water
d the dissolved gases in permanent hard water

Q.97 Conventional tertiary treatment is _____.

a chemical coagulation and flocculation
b filtration
c sedimentation
d none of these

Q.98 The maximum desirable limit (BIS) of total hardness (as CaCo3) in drinking water is _____.

a 600 ppm b 300ppm
c 500 ppm d 1000 ppm

Q.99 The chemical oxygen demand (COD)measures the _____.

a Amount of oxygen required for growth of microorganisms in water
b Amount of oxygen that would be removed from the water in order to oxidize pollution
c Amount of oxygen required to oxidize the calcium present in waste water
d None of the above

Q.100 Hardness of water does not _____.

a have any bad effect in boiler
b make cooking of foods difficult
c make it unfit for drinking
d cause difficulty in the washing of clothes with soaps

Q.101 Permanent hard water may be softened by passing it through _____.

a sodium silicate
b sodium bicarbonate
c sodium hexametaphosphate
d sodium phosphate

Q.102 Secondary treatment uses _____ to consume wastes.

a micro-organisms b chemicals
c filtration d none of these

Q.103 According to BIS the maximum permissible limit of dissolved solids in drinking water is

a 1000 mg/l b 500 mg/l
c 2000 mg/l d 1500 mg/l

Q.104 Which of the following chemical is sometime added in the process of coagulation and flocculation ?

a Aluminum sulphate b Aluminum oxide
c Calcium chloride d None of these

Q.105 The common methods used for disinfection in waste water treatment plants are _____.

a chlorination b UV light
c both (a) and (b) d phenolic solvent

Q.106 Inhibitors are used along with sanitizer to ____.

a improve their action b to prevent corrosion
c both (a) and (b) d none of these

Q.107 The maximum permissible limit (BIS) of turbidity in drinking water is ____.

a 5 NTU b 10 NTU
c 15 NTU d 20 NTU

Q.108 Sedimentation is a physical process used in wastewater treatment to ____>

a remove particles that are less dense than water
b remove particles that are denser than water
c remove the pertinacious material from the water
d none of the above

Q.109 BOD stands for _____.

a Biochemical Oxygen Demand
b British Oxygen Demand
c British Oxygen Depletion
d Biological Oxygen Depletion

Q.110 What is noise ?

a Desirable sound
b Desirable and unwanted sound
c Undesirable and unwanted sound
d Undesirable and wanted sound

Q.111 In which unit sound is measured ?

a Kilometer b Pascal
c Kilogram d Decibel

Q.112 Which pollution cause hearing loss in organisms ?

a Air pollution b Noise pollution
c Water pollution d Soil pollution

Q.113 What is the ambient noise level in the residential one during night time ?

a 40 dB b 45 dB
c 50 dB d 55 dB

Q.114 What is the permissible noise limit of 120 db ?

a 30 minutes b 2 minutes
c 1 minute d 30 seconds

Q.115 At what level a sound becomes physical pain ?

a Above 50 dB b Above 70 dB
c Above 80 dB d Above 100 dB

Q.116 Consider following statements

- (A) Air pollutants known as "PM2.5" increase the chances of heart diseases.
- (R) These microparticles can penetrate deep in lungs and enter in blood circulation.

a Both correct and R explains A
b Both correct but R doesn't explain A
c A correct but R Wrong
d R correct but A wrong.

Q.117 Find incorrect statements about Phthalates

a They're used in air-fresheners for their fruity-fragrance.
b They enhance androgenic hormones. Hence used in drugs to cure Turner's syndrome.
c Both A and B
d Neither A nor B

Q.118 Find correct statements about national air-quality index

a Monitors eight pollutants and classifies the air quality of given city into one of the eight categories.
b Will be implemented in all cities and towns of India from 2015 onwards.
c Both A and B
d Neither A nor B

Q.119 Which of the following pollutants, will not be monitored in the national air quality index

1. Ozone 2. Lead
3. Nitrous Oxide 4. Sulfur Oxide

a Only 1 and 2 b Only 2 and 4
c Only 1 d Only 3 and 4

Q.120 Which of the following are correctly matched ?

1. Ozone : Photochemical smog
2. Sulfur Dioxide : Stiffness in flowerbuds
3. Carbon Monoxide : Abortion

a Only 1 and 2 b Only 2 and 3
c Only 1 and 3 d All of them

Q.121 Which of the following can help reducing smog issue in Indian cities ?

1. Deploying drones to spray special chemicals to freeze PM2.5 particles in the air.
2. Putting ban on Diwali crackers.
3. Plantation of Pinus, Juniparus, Quercus, Pyrus and Vitis.

a Only 1 and 2 b Only 2 and 3
c Only 1 and 3 d All of them

Answer Keys for Multiple Choice Questions

Q.1	c	**Q.2**	c	**Q.3**	a
Q.4	d	**Q.5**	a	**Q.6**	c
Q.7	c	**Q.8**	d	**Q.9**	d
Q.10	a	**Q.11**	b	**Q.12**	c
Q.13	a	**Q.14**	d	**Q.15**	b
Q.16	d	**Q.17**	a	**Q.18**	d
Q.19	a	**Q.20**	b	**Q.21**	d
Q.22	d	**Q.23**	b	**Q.24**	d
Q.25	a	**Q.26**	b	**Q.27**	a
Q.28	a	**Q.29**	a	**Q.30**	c
Q.31	c	**Q.32**	b	**Q.33**	d
Q.34	b	**Q.35**	a	**Q.36**	d
Q.37	a	**Q.38**	a	**Q.39**	b
Q.40	c	**Q.41**	d	**Q.42**	b
Q.43	d	**Q.44**	a	**Q.45**	b
Q.46	c	**Q.47**	c	**Q.48**	d
Q.49	a	**Q.50**	b	**Q.51**	d
Q.52	a	**Q.53**	b	**Q.54**	a
Q.55	b	**Q.56**	a	**Q.57**	d
Q.58	a	**Q.59**	a	**Q.60**	b
Q.61	d	**Q.62**	a	**Q.63**	d
Q.64	b	**Q.65**	c	**Q.66**	d
Q.67	b	**Q.68**	d	**Q.69**	d
Q.70	b	**Q.71**	c	**Q.72**	a
Q.73	a	**Q.74**	c	**Q.75**	a
Q.76	a	**Q.77**	d	**Q.78**	c
Q.79	c	**Q.80**	b	**Q.81**	d
Q.82	a	**Q.83**	d	**Q.84**	b
Q.85	d	**Q.86**	a	**Q.87**	a
Q.88	b	**Q.89**	b	**Q.90**	c
Q.91	c	**Q.92**	a	**Q.93**	c
Q.94	b	**Q.95**	a	**Q.96**	c
Q.97	a	**Q.98**	b	**Q.99**	b
Q.100	c	**Q.101**	c	**Q.102**	a
Q.103	c	**Q.104**	a	**Q.105**	c
Q.106	b	**Q.107**	b	**Q.108**	b
Q.109	a	**Q.110**	c	**Q.111**	d
Q.112.	b	**Q.113**	b	**Q.114**	d
Q.115	c	**Q.116**	a	**Q.117**	c
Q.118	d	**Q.119**	d	**Q.120**	d
Q.121	d				

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Notes

UNIT - V

5 Social Issues and Environmental Education

5.1 Article (48-A) and (51-A(g)) of Indian Constitution Regarding Environment, Environmental Protection and Prevention Acts, CPCB and MPCB Norms and Responsibilities, The Role of NGO's

The main attention in the education on environment is as below :

i) Over-population and the ways to check its rapid growth.

ii) Afforestation as a preventive to soil erosion and water pollution.

iii) Methods to prevent air pollution, insisting on smokeless cooking.

iv) Discipline in playing radio and television sets and a ban on use of loudspeaker.

v) Elementary knowledge of the scientific and philosophical basis of man and the environment.

vi) Rules regarding disposal of household waste.

vii) General principles of sanitation.

5.1.1 Environment and Constitution of India

To protect and improve the environment is a constitutional mandate. It is a commitment for a country wedded to the ideas of a welfare State. The Indian Constitution contains specific provisions for environment protection under the chapters of Directive Principles of State Policy and Fundamental Duties. The absence of a specific provision in the Constitution recognizing the fundamental right to clean and wholesome environment has been set off by judicial activism in the recent times.

Articles 48-A and 51-A. Clause (g) :

Initially, the Constitution of India had no direct provision for environmental protection. Global consciousness for the protection of environment in the seventies, Stockholm Conference and increasing awareness of the environmental crisis prompted the Indian Government to enact 42nd Amendment to the Constitution in 1976. The Constitution was amended to introduce direct provisions for protection of environment. This 42nd Amendment added Article 48-A to the Directive Principles of State Policy.

Article 51-A, Clause (g) :

Article 51-A (g) which deals with Fundamental Duties of the citizens states :

"It shall be the duty of every citizen of India to protect and improve the natural environment including forests, lakes, rivers and wildlife and to have compassion for living creatures."

Thus, protection and improvement of natural environment is the duty of the State (Article 48-A) and every citizen (Article 51- A (g)).

Directive Principles of State Policy

Article 48(A)

48A. Protection and improvement of environment and safeguarding of forests and wild life The State shall endeavor to protect and improve the environment and to safeguard the forests and wild life of the country.

The citizens of the country have a fundamental right to a wholesome, clean and decent environment. The Constitution of India, in terms of **Article 48A**, mandates that the State is under a Constitutional obligation to protect and improve the environment and to safeguard the forest and wild life in the country. By 42nd Amendment to the Constitution, the Parliament, with an object of

sensitizing the citizens of their duty, incorporated **Article** 51A in the Constitution, interalia, requiring a citizen to protect and improve the natural environment including the forests, lakes, rivers and wild life and to have a compassion for living creatures. The legislative intent and spirit under **Articles 48A** and 51A(g) of the Constitution find their place in the definition of 'environment' under the Environment (Protection) Act, 1986 (for short the 'Act of 1986'). The legislature enacted various laws like the Air (Prevention and Control of Pollution) Act, 1981, Water (Prevention and Control of Pollution) Act, 1974 and the Wildlife (Protection) Act, 1972, the Forest (Conservation) Act, 1980, the Indian Forest Act, 1927 and the Biological Diversity Act, 2002 and other legislations with the primary object of giving wide dimensions to the laws relating to protection and improvement of environment.

Article 51

Promotion of international peace and security The State shall endeavor to

a) Promote international peace and security;
b) Maintain just and honorable relations between nations;
c) Foster respect for international law and treaty obligations in the dealings of organized peoples with one another; and encourage settlement of international disputes by arbitration PART IVA FUNDAMENTAL DUTIES.

Article 51(A)

Fundamental duties It shall be the duty of every citizen of India

a) To abide by the Constitution and respect its ideals and institutions, the national Flag and the National Anthem;
b) To cherish and follow the noble ideals which inspired our national struggle for freedom;
c) To uphold and protect the sovereignty, unity and integrity of India;
d) To defend the country and render national service when called upon to do so;
e) To promote harmony and the spirit of common brotherhood amongst all the people of India transcending religious, linguistic and regional or sectional diversities; to renounce practices derogatory to the dignity of women;
f) To value and preserve the rich heritage of our composite culture;
g) To protect and improve the natural environment including forests, lakes, rivers and wild life, and to have compassion for living creatures;
h) To develop the scientific temper, humanism and the spirit of inquiry and reform;
i) To safeguard public property and to abjure violence;
j) To strive towards excellence in all spheres of individual and collective activity so that the nation constantly rises to higher levels of endeavor and achievement.

5.1.2 Agencies for Making Environment Laws and their Enforcement in India

In 1972, a National Council of Environment Planning and Co-ordination was set-up at the Department of Science and Technology. Another committee was set-up in 1980 for reviewing the existing legislations and administrative machinery for environmental protection and for recommending ideas to strengthen the existing laws and environmental agencies in India. In 1980, a separate Department of Environment was set-up which was upgraded to full-fledged Ministry of Environment and Forests in 1985.

Ministry of Environment and Forests (MoEF) of Government of India serves as the nodal agency for the planning, promotion, making of environment laws and their enforcement in India. Following are the other important agencies which help the MoEF in carrying out environment related activities :

1. Central Pollution Control Board
2. State Pollution Control Boards
3. State Departments of Environment
4. Union Territories (UT) Environmental Committees
5. The Forest Survey of India

6. The Wildlife Institute of India
7. The National Afforestation and Eco-development Board
8. The Botanical and Zoological Survey of India, etc.

5.1.3 Environmental Laws and Rules

Major environmental laws dealing with protection of environment can be divided into following categories

a) Water pollution
b) Air pollution
c) Environment protection
d) Public liability insurance
e) National environment appellate authority
f) National environment tribunal
g) Animal welfare
h) Wildlife
i) Forest conservation
j) Biodiversity
k) Indian forest service.

a) Water Pollution

i. Act
   1. No.36 of 1977, [7/12/1977] - The Water (Prevention and Control of Pollution) Cess Act, 1977, amended 1992. 1. No. 19 of 2003, [17/3/2003] - The Water (Prevention and Control of Pollution) Cess (Amendment) Act, 2003.
   2. No.6 of 1974, [23/3/1974] - The Water (Prevention and Control of Pollution) Act, 1974, amended 1988.

ii. Rules
   1. G.S.R.378 (E), [24/7/1978] - The Water (Prevention and Control of Pollution) Cess Rules, 1978.
   2. G.S.R.58 (E), [27/2/1975] - The Water (Prevention and Control of Pollution) Rules, 1975.
   3. Central Board for the Prevention and Control of Water Pollution (Procedure for Transaction of Business) Rules, 1975 amended 1976.

b) Air Pollution

i. Act
   1. No.14 of 1981, [29/3/1981] - The Air (Prevention and Control of Pollution) Act 1981, amended 1987.

ii. Rules
   1. G.S.R.6 (E), [21/12/1983] - The Air (Prevention and Control of Pollution) (Union Territories) Rules, 1983.
   2. G.S.R.712 (E), [18/11/1982] - The Air (Prevention and Control of Pollution) Rules, 1982.

c) Environment Protection

i. Act
   1. No.29 of 1986, [23/5/1986] - The Environment (Protection) Act, 1986, amended 1991.

ii. Rules
   1. S.O.844 (E), [19/11/1986] - The Environment (Protection) Rules, 1986.
   2. G.S.R.448 (E), [12/07/2004] - The Environment (Protection) Second Amendment Rules, 2004.
   3. S.O.470 (E), [21/6/1999] - Environment (Siting for Industrial Projects) Rules, 1999.

d) Public Liability Insurance

i. Act
   1. No.6 of 1991, [22/1/1991] - The Public Liability Insurance Act, 1991, amended 1992.

ii. Rule
   1. S.O.330 (E), [15/5/1991] - The Public Liability Insurance Rules, 1991, amended 1993.

e) National Environment Appellate Authority

i. Act
   1. NO.22 of 1997, [26/3/1997] - The National Environment Appellate Authority Act, 1997.

f) National Environment Tribunal

i. Act
   1. No.27 of 1995, [17/6/1995] - The National Environment Tribunal Act, 1995.

g) ANIMAL WELFARE

i. Act

1. No.59 of 1960 - The Prevention of Cruelty to Animals Act, 1960.

ii. Rules

1. S.O.1256 (E), [24/12/2001] - The Animal Birth Control (Dogs) Rules, 2001.
2. S.O.267 (E), [26/3/2001] - The Performing Animals (Registration) Rules, 2001.

h) Wildlife

i. Act

1. No. 16 of 2003, [17/1/2003] - The Wild Life (Protection) Amendment Act, 2002.
2. The Indian Wildlife (Protection) Act, 1972, amended 1993.

ii. Rules

1. S.O.1092 (E), [22/9/2003] - The National Board for Wild Life Rules, 2003.
2. S.O.445 (E), [18/4/2003] - The Declaration of Wild Life Stock Rules, 2003.
3. G.S.R.350 (E), [18/4/1995] - The Wildlife (Specified Plant Stock Declaration) Central Rules, 1995.

i) Forest Conservation

i. Acts

1. Forest (Conservation) Act, 1980, amended 1988.
2. The Indian Forest Act, 1927.

ii. Rules

1. G.S.R.23 (E) - Forest (Conservation) Rules, 2003.
2. G.S.R.719 - Forest (Conservation) Rules, 1981, amended 1992.

j) Biodiversity

i. Act

1. NO. 18 of 2003, [5/2/2003] - The Biological Diversity Act, 2002.

i. S.O. (E), [01/07/2004]- Coming in to force of sections of the Biodiversity Act, 2002.

ii. S.O.497 (E), [15/04/2004]- Appointment of non-official members on NBA from 1st October, 2003.

iii. S.O.1147 (E)- Establishment of National Biodiversity Authority from 1st October, 2003.

iv. S.O.1146 (E)- Bringing into force Sections 1 and 2; Sections 8 to 17; Sections 48,54,59,62,63,64 and 65 w.e.f. 1st October, 2003.

ii. Rule

1. G.S.R.261 (E), [15/04/2004] - Biological Diversity Rules, 2004.

k) IFS (Indian Forest Service)

i. Rule

1. NO.17011/03/200-IFS-II, [10/2/2001] - Rules for a competitive examination to be held by the UPSC for the IFS.

5.1.4 Major Environmental Laws

I. The Water (Prevention and Control of Pollution) Act,1974

- This act provides for the prevention and control of water pollution and the maintenance or restoration of wholesomeness of water.
- As such, all human activities having a bearing on water quality are covered under this Act.
- Subject to the provisions in the Act, no person without the pervious consent of the State Pollution Control Board (SPCB) can establish any industry, operation or any treatment and disposal system or an extension or addition there to which is likely to discharge sewage or trade effluent into a stream or well sewer or on hand and have to apply to the SPCB concerned to obtain the 'consent to establish' as well as the 'consent to operate' the industry after establishment.

II. The water (Prevention and control of Pollution) CESS Act, 1977

- The main purpose of this Act is to levy and collect cess on water consumed by certain categories of industry specified in the schedule appended to the Act.
- The money thus collected is used by CPCB and SPCBs to prevent and control water pollution.

III. The Air (Prevention and Control of Pollution) Act,1981

- The objective of the Air Act 1981 is to prevent, control and reduce air pollution including noise pollution.
- Under provisions of this Act, no person shall, without previous consent of the SPCB, establish or operate any industrial plant in air pollution control area the investor has to apply to the SPCB/Pollution Control Committee (PCB) to consent.
- No person operating any industrial plant shall emit any air pollution in excess of the standards laid down by the SPCB and have to comply with the stipulated conditions.

IV. The Environment (Protection) Act, 1986

- This is an umbrella Act for the protection and improvement of environment and for matters connected, which provides that no person carrying on any industry, operation or process should discharge or emit or permit to discharged or emitted any environmental pollutant in excess of such standards as may be prescribed.
- Several rules relative to various aspects of management of hazardous chemicals, wastes, etc. have been notified. Under this Act, Central Govt. has rusticated, prohibited location of industries in different areas so as to safeguard the environment.
- Many standards for air emissions, discharge of effluent and noise have been evolved and notified.
- Subject to the provision of this Act, Central Govt. has the power to take all measures as it deemed necessary for the purpose of protection and improving the environment.
- Procedures, safeguards, prohibition and restriction on the handling of hazardous substances along with the prohibition and restriction on the location of industries in different areas have notified.

V. The Hazardous wastes (Management and Handling) Rules, 1989 and 2000

- Hazardous wastes have been categories in 18 categories.
- Under this rule, project proponent handling hazardous waste must report to the concerned authorities regarding handling of wastes, obtain authorization for handling wastes, maintain proper records, file annual returns, label all packages, consignments etc., report any accident immediately in for report import-export of hazardous waste.
- MOEF notified the HW (M&H) Amendment Rules in January 6, 2000 (MOEF, 2000a). Under this rule, toxic chemicals, flammable chemicals and explosive have been redefined to be termed as 'hazardous chemical'. As per new criteria, 684 hazardous chemicals.

VI. The Manufacture, Storage and Import of Hazardous Chemical Rules, 1989 and 2000

- Under these rules, project proponents of any kind of hazardous industry have to identify likely hazard and their anger potential. They also have to take adequate steps to prevent and limit the consequences of any accident at site.
- Material safety Data Sheets (MSDS) for all the chemicals in handling has to be prepared. Workers on site are required to be provided with information, training and necessary equipment to ensure their safety.
- Onsite Emergency Plan is to be prepared before initiating any activity at the site. Off-site Emergency Plan is to be prepared by the District Controller in close collaboration with the project proponents for any accident envisaged on site.
- The public in the vicinity of the plant should be informed of the nature major accident that may occur on site and Do's and Don'ts to be followed in case of such an occurrence.
- Import of hazardous chemicals is to be reported to the concerned authority within 30 days from the data of import.
- MOEF made significant amendments in the MSIHC Rules, 1989 on January 20, 2000.
- Under new amendments, new schedule-I is incorporated with the increase in the number of hazardous chemicals.

- Renewal of authorization will be subject to submission of 'Annual Returns' for disposal of hazardous waste; reduction in the waste generated or recycled or reused; fulfillment of authorization conditions and remittance processing and analysis fee.
- State government as well as occupier or its association shall be responsible for the identification site for common waste disposal facility. Public hearing is also made mandatory to be conducted by the state government before notifying any common hazardous waste disposal site.
- Central/State government will provide guidance for the design, operation and closure of common waste facility/landfill site. It is mandatory to obtain prior approval from the SPCB for design and layout the proposed hazardous waste disposal facility.

VII. Public Liability Insurance Act, 1991

- This Act, unique to India, on the owner the liability to immediate relief in respect of death or to any person or damage to any property resulting from an accident while handling hazardous any of the notified hazardous chemicals.
- This relief has to be provided on 'no fault' basis.
- The owner handling hazardous chemical has to take an insurance policy to meet this liability of an amount equal to its "Paid up capital" or up to ₹ 500 millions, whichever less. The policy has to be renewed every year.
- New undertaking will have to take this policy before starting their activity. The owner also has to pay an amount equal to its annual premium to the Central Government's Environment Chief Fund (ERF). The reimbursement of medical expenses up to ₹ 12,500/-. The liability of the insurance is tiedto ₹ 50 million per accident up to ₹ 150 million per year or up to the tenure of the policy.
- Any claims process to this liability will be paid from the ERF. In case the award still exceeds, the remaining amount shall have to be met by the owner.
- The payment under the Act is only for the immediate relief; owners shall have to provide
- The compensation if any, arising out of legal proceeding.

VIII. The National Environment Tribunal Act, 1995.

- The National Environment Tribunal Act, 1995 is enacted to provide for strict liability for damages arising out of indents occurring during handling of hazardous substances and for establishment of National Environment Tribunal effective and expunction disposal of cases arising from such accidents, with a view to giving relief and compensation damages to person, and the environment.

IX. The Chemical Accidents (Emergency Planning, Preparedness and Response Rules, 1996.

- These rule provided a statutory backup for setting up of a Crisis Group in districts and states, which have Major Accident Hazard (MAH) installations for providing information to the public.
- The rules define the MAH installations, which include industrial activity, transport and isolated store at a site handing hazardous chemicals in quantities specified.
- As per the rules, GOI has constituted a Central Crisis Group (CCG) for the management of chemical accidents a set up an alert system.
- The Chief Secretaries of all the States have also constituted Standing State Crisis Groups (SSCG) to plan and response to chemical accidents in the state.
- The District Controller has to constitute District as Local Central Crisis Groups (DCG and LCG).
- The CCG is the apex body in the country to deal with and provide expert guidance for planning and handling major chemical accidents. It continuously monitors the post-accident saturation and suggests measures for prevention occurrence of such accidents.
- MOEF, GOI has published a state-wise list of experts and concerned officials. The is the apex body of the state chaired by the Chief Secretary Consisting of GOI officials, technical experts and industry representatives

and deliberates on planning, preparedness and mitigation of chemical accidents to reduce the loss of life, property and ill-health.

- The SSCG reviews all the District off-site Emergency plants for its adequacy.
- District Collector is the Chairman of DCG serving as apex body at the district level. DCG will prepared by the occupier of the MAH installations and conduct one full-scale of the off-cist Emergency plan at a site each year.
- These rules enable preparation of on and off-site emergency plans, updation and conduction of mock drills.

X. The Biomedical Wastes (Management and Handling) Rules, 1998

- The Biomedical Waste (Management and Handling) Rules, 1998 regulates the disposal of biomedical wastes including anatomical waste, blood, body fluids medicines, glass wares and animals wastes by the health care institution (i.e. nursing homes, clinics, dispensaries, veterinary institutions, animal houses pathological laboratories and banks etc. in the cities having population more than 30 Lakh or all the hospitals with bed strength more than 500.
- They are required to install and commission requisite facilities like incinerators, autoclaves, microwave system etc. the treatment of biomedical waste.
- All the persons handling such sides are required to obtain permission from the Appropriate Authority.
- Segregation of biomedical waste at source been made mandatory for all the institutions and organizations dealing with them. These rules make the generator of biomedical wastes liable to segregate, pack, store, transport, treat and dispose the biomedical waste in an environmentally sound manner.

XI. Municipal Wastes (Process and Disposal) Draft Rules, 1999.

- Under these rules, municipal authority is made responsible for implementation of the provisions of these rules and for any in structural development for collection, storage, segregation transportation, processing and disposal of MSW and to comply with these rules.
- Annual report is to be submitted by Municipal authority in From-I to the District Magistrate/Deputy Commissioner who shall have the power to enforce these rules. We shall be managed as per Schedule-II.
- Disposal of MSW shall be through landfill as per specifications and standards laid down in schedule-III.
- The standards for compost and disposal of treated leachate shall be followed by Municipal Authorities as per Schedule-IV.

XII. The Recycled Plastic Manufacture and Usage Rules, 1999.

- Under these rules, use of carry bags or containers made of recycled plastics for storing, carrying dispensing or packaging of foodstuffs is prohibited.
- Carry bags or containers made of plastics can be manufactured only when (i) Virgin plastic in its natural shade or white is used and (ii) Recycled plastic is used for purposes other than storing and packaging foodstuff using pigments and colorants as per IS: 9833: 1981.
- Recycling of plastics is to be undertaken strictly in accordance with the Bureau of Indian standards Specification IS: 14534: 1998 entitled "The Guideline for Recycling of Plastics".
- Manufacture has to print on each packet of carry bags as 'Made of Recycled Material' or 'Virgin Plastic'. The minimum thickness of carry bags should not be less than 20 microns.
- Finally, Plastic Industry Association through their member units has to undertake self-regulatory measures.

XIII. The Fly Ash Notification, 1999.

- The notification to conserve topsoil and prevent the dumping and disposal of fly ash discharged from coal or lignite based thermal power plants have been issued on September 14, 1999.

- Under these directives it is mandatory for every brick manufacture within a radius of 50 km from coal or lignite based thermal power plant to mix at least 25 % of ash (fly ash/bottom ash/pond ash) with soil on weight-to-weight basis to manufacture clay bricks or tiles or blocks used in construction activities.
- Every coal or lignite based thermal power plant has to make available ash, for at least ten years from the date of publication of this notification, without any payment or any other consideration, for the purpose of manufacturing ash-based products.
- Every coal or lignite based thermal power plant commissioned subject to environmental condition stipulating the submission of an action plan has to achieve the same within 9 years (15 years for plants not covered by environmental clearance).
- As per the directive, Central and state Govt. Agencies, the State Electricity Boards, NTPC and the management of thermal power plants have to facilitate utilization of ash and ash-based products in their respective schedule of specifications.
- All the local authorities have also to specify in their respective building bye-laws and regulations about the use of ash and ash-based products.

XIV. The Batteries (Management and Handling (Draft) Rules, 2000.

- The MOEF issued the Batteries (M&H) (Draft) Rules, 2000 to control the hazard associated with backyard smelting and unauthorized reprocessing of lead acid batteries. The lead acid batteries are widely used automobiles such as cars, trucks, buses, two-wheelers and inverters.
- As per the provision, battery manufactures importers, assemblers and re-conditioned have to collect old batteries on a one to one basis against the sale of new batteries.
- The batteries so collect have to be sent to recyclers, registered with MOEF for recycling them in eco-friendly manner, unless battery manufactures them have such recycling facilities.
- Registration is accorded by the MOEF to only those units, which have in place appropriate manufacturing technology, pollution prevention systems and suitable arrangements for waste disposal.
- Importers of new batteries, dealers as well as organization auctioning used batteries have been brought under the purview of these rules.
- Only those re-processors registered with MOEF would be able to participate in sale by auction or contract. As a result, middlemen and backyard smelters are debarred from participation in any auction within the country.
- Manufactures have to incorporate suitable provisions for buyback, in case of bulk sale of batteries by the manufacturers to bulk consumers.
- Recycling of ferrous metals such as lead and zinc helps to save energy vis-à-vis primary metal production and is environment-friendly if reprocessing is done with suitable arrangements for pollution a control and waste disposal. They also help conserving precious metal resources.

5.1.5 Role of NGOs

- Non-governmental organizations, or NGOs, were first called such in Article 71 in the Charter of the newly formed United Nations in 1945. While NGOs have no fixed or formal definition, they are generally defined as nonprofit entities independent of governmental influence (although they may receive government funding).
- As one can tell from the basic definition above, the difference between nonprofit organizations (NPOs) and NGOs is slim. However, the term "NGO" is not typically applied to U.S.-based nonprofit organizations. Generally, the NGO label is given to organizations operating on an international level although some countries classify their own civil society groups as NGOs.
- NGO activities include, but are not limited to, environmental, social, advocacy and human rights work. They can work to promote social or political change on a broad scale or very locally. NGOs play a critical part in developing society, improving communities, and promoting citizen participation.

5.2 Sustainable Development, EIA

5.2.1 Sustainable Development

- "Economic development that is conducted without depletion of natural resources."
- **Sustainable Development** is the organizing principle for meeting human development goals while at the same time sustaining the ability of natural systems to provide the natural resources and ecosystem services upon which the economy and society depend. The desired result is a state of society where living conditions and resource use continue to meet human needs without undermining the integrity and stability of the natural system. Sustainable development can be classified as development that meets the needs of the present without compromising the ability of future generations.
- While the modern concept of sustainable development is derived mostly from the 1987 Brundtland Report, it is also rooted in earlier ideas about sustainable forest management and twentieth century environmental concerns. As the concept developed, it has shifted to focus more on economic development, social development and environmental protection for future generations. It has been suggested that "the term 'sustainability' should be viewed as humanity's target goal of human-ecosystem equilibrium (homeostasis), while 'sustainable development' refers to the holistic approach and temporal processes that lead us to the end point of sustainability". The modern economies are endeavoring to reconcile ambitious economic development and obligations of preserving the natural resources and ecosystem, the two are traditionally seen as of conflicting nature.
- The ecological stability of human settlements is part of the relationship between humans and their natural, social and built environments. Also termed human ecology, this broadens the focus of sustainable development to include the domain of human health. Fundamental human needs such as the availability and quality of air, water, food and shelter are also the ecological foundations for sustainable development; addressing public health risk through investments in ecosystem services can be a powerful and transformative force for sustainable development which, in this sense, extends to all species.
- Environmental sustainability concerns the natural environment and how it endures and remains diverse and productive. Since natural resources are derived from the environment, the state of air, water, and the climate are of particular concern. The IPCC Fifth Assessment Report outlines current knowledge about scientific, technical and socio-economic information concerning climate change, and lists options for adaptation and mitigation. Environmental sustainability requires society to design activities to meet human needs while preserving the life support systems of the planet. This, for example, entails using water sustainably, utilizing renewable energy, and sustainable material supplies (e.g. harvesting wood from forests at a rate that maintains the biomass and biodiversity).
- An unsustainable situation occurs when natural capital (the sum total of nature's resources) is used up faster than it can be replenished. Sustainability requires that human activity only uses nature's resources at a rate at which they can be replenished naturally. Inherently the concept of sustainable development is intertwined with the concept of carrying capacity. Theoretically, the long-term result of environmental degradation is the inability to sustain human life. Such degradation on a global scale should imply an increase in human death rate until population falls to what the degraded environment can support. If the degradation continues beyond a certain tipping point or critical threshold it would lead to eventual extinction for humanity.

Sr. No.	Consumption of natural resources	State of environment	Sustainability
1.	More than nature's ability to replenish	Environmental degradation	Not sustainable
2.	Equal to nature's ability to replenish	Environmental equilibrium	Steady state economy
3.	Less than nature's ability to replenish	Environmental renewal	Environmentally sustainable

- Pollution of the public resources is really not a different action; it just is a reverse tragedy of the commons, in that instead of taking something out,

something is put into the commons. When the costs of polluting the commons are not calculated into the cost of the items consumed, then it becomes only natural to pollute, as the cost of pollution is external to the cost of the goods produced and the cost of cleaning the waste before it is discharged exceeds the cost of releasing the waste directly into the commons. So, the only way to solve this problem is by protecting the ecology of the commons by making it, through taxes or fines, more costly to release the waste directly into the commons than would be the cost of cleaning the waste before discharge.

5.2.2 Environmental Impact Assessment (EIA)

Environmental Impact Assessment (EIA) is a process of evaluating the likely environmental impacts of a proposed project or development, taking into account inter-related socio-economic, cultural and human-health impacts, both beneficial and adverse.

Environmental Impact Assessment (EIA) is a tool for sustainable development. Sustainable development integrates the principles of environmental protection with public participation and economic prosperity.

Filling/gas stations are business outlets for marketing and distributing oil and oil products. Despite their local economic potentials and social impacts, their environmental performances are rarely assessed.

What is the purpose of Environmental Impact Assessment ?

- The aim of Environmental Impact Assessment is to protect the environment by ensuring that a local planning authority when deciding whether to grant planning permission for a project, which is likely to have significant effects on the environment, does so in the full knowledge of the likely significant effects, and takes this into account in the decision making process. The regulations set out a procedure for identifying those projects which should be subject to an Environmental Impact Assessment, and for assessing, consulting and coming to a decision on those projects which are likely to have significant environmental effects.
- The aim of Environmental Impact Assessment is also to ensure that the public are given early and effective opportunities to participate in the decision making procedures.
- Environmental Impact Assessment should not be a barrier to growth and will only apply to a small proportion of projects considered within the town and country planning regime. Local planning authorities have a well-established general responsibility to consider the environmental implications of developments which are subject to planning control. The 2017 Regulations integrate Environmental Impact Assessment procedures into this framework and should only apply to those projects which are likely to have significant effects on the environment. Local planning authorities and developers should carefully consider if a project should be subject to an Environmental Impact Assessment. If required, they should limit the scope of assessment to those aspects of the environment that are likely to be significantly affected. Pre-application engagement can also play a role in identifying when a proposal should be subject to environmental impact assessment.

What are the stages of environmental impact assessment ?

a) Screening
b) Scoping
c) Preparing an Environmental Statement
d) Making a planning application and consultation
e) Decision making.

5.3 Management Measures - Rain Water Harvesting, Green Water Recharge, Green Belt Development, Use of Renewable Energy, Water Shade Management, Interlinking of Rivers

5.3.1 Rain Water Harvesting

- We use water for drinking, irrigation, industry, transport and for the production of hydro-electricity. Water is a cyclic resource which can be used again and again after cleaning.
- A large quantity of water is used for irrigation and there is an urgent need for proper water management in irrigation sector.
- Rain water harvesting is one of the most effective methods of water management and water conservation. It is the term used to indicate the collection and storage of rain water used for human, animals and plant needs.

It involves collection and storage of rain water at surface or in sub-surface aquifer, before it is lost as surface runoff. The augmented resource can be harvested in the time of need.

Need :

i. To overcome the inadequacy of surface water to meet our demands.
ii. To arrest decline in ground water levels.
iii. To enhance availability of ground water at specific place and time and utilize rain water for sustainable development.
iv. To increase infiltration of rain water in the subsoil this has decreased drastically in urban areas due to paving of open area.
v. To improve ground water quality by dilution.
vi. To increase agriculture production.
vii. To improve ecology of the area by increase in vegetation covered.

Advantages :

i. The cost of recharge to sub-surface reservoir is lower than surface reservoirs.
ii. The aquifer serves as a distribution system also.
iii. No land is wasted for storage purpose and no population displacement is involved.
iv. Ground water is not directly exposed to evaporation and pollution.
v. Storing water under ground is environment friendly.
vi. It increases the productivity of aquifer.
vii. It reduces flood hazards.
viii. Effects rise in ground water levels.
ix. Mitigates effects of drought.
x. Reduces soil erosion.

Potential Areas :

i. Where ground water levels are declining on regular basis.
ii. Where substantial amount of aquifer has been de-saturated.
iii. Where availability of ground water is inadequate in lean months.
iv. Where due to rapid urbanization, infiltration of rain water into subsoil has decreased drastically and recharging of ground water has diminished.

5.3.2 Groundwater Recharge

Groundwater recharge or deep drainage or deep percolation is a hydrologic process where water moves downward from surface water to groundwater. Recharge is the primary method through which water enters an aquifer (An aquifer is an underground layer of water-bearing permeable rock, rock fractures or unconsolidated materials). This process usually occurs in the vadose zone below plant roots and is often expressed as a flux to the water table surface. Recharge occurs both naturally (through the water cycle) and through anthropogenic processes (i.e., "artificial groundwater recharge"), where rainwater and or reclaimed water is routed to the subsurface.

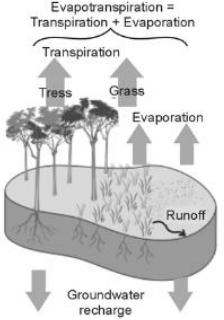


Fig. 5.3.1

Process

Groundwater is recharged naturally by rain and snow melt and to a smaller extent by surface water (rivers and lakes). Recharge may be impeded somewhat by human activities including paving, development, or logging. These activities can result in loss of topsoil resulting in reduced water infiltration, enhanced surface runoff and reduction in recharge. Use of groundwaters, especially for irrigation, may also lower the water tables. Groundwater

recharge is an important process for sustainable groundwater management, since the volume-rate abstracted from an aquifer in the long term should be less than or equal to the volume-rate that is recharged.

Recharge can help move excess salts that accumulate in the root zone to deeper soil layers, or into the groundwater system. Tree roots increase water saturation into groundwater reducing water runoff.Flooding temporarily increases river bed permeability by moving clay soils downstream, and this increases aquifer recharge

Methods and Techniques :

The methods of ground water recharge mainly are :

Urban Areas :

Roof top rain water/storm runoff harvesting through

i) Recharge Pit

ii) Recharge Trench

iii) Tube well

iv) Recharge Well

Rural Areas :

Rain water harvesting through

i) Gully Plug

ii) Contour Bund

iii) Gabion Structure

iv) Percolation Tank

v) Check Dam/Cement Plug/Nala Bund

vi) Recharge Shaft

vii) Dugwell Recharge

viii) Ground Water Dams/Subsurface Dyke

5.3.3 Green Belt

- A green belt is a policy and land use zone designation used in land use planning to retain areas of largely undeveloped, wild, or agricultural land surrounding or neighboring urban areas. Similar concepts are greenways or green wedges which have a linear character and may run through an urban area instead of around it. A green belt is an invisible line designating a border around a certain area, preventing development of the area and allowing wildlife to return and be established.

Objectives of green belt policy are to :

- Protect natural or semi-natural environments;
- Improve air quality within urban areas;
- Ensure that urban dwellers have access to countryside, with consequent educational and recreational opportunities; and protect the unique character of rural communities that might otherwise be absorbed by expanding suburbs.

The green belt has many benefits for people :

- Walking, camping, and biking areas close to the cities and towns.
- Contiguous habitat network for wild plants, animals and wildlife.
- Cleaner air and water.
- Better land use of areas within the bordering cities.

5.3.4 Use of Renewable Energy Sources

- Renewable energy sources and technologies have potential to provide solutions to the long-standing energy problems being faced by the developing countries. The renewable energy sources like wind energy, solar energy, geothermal energy, ocean energy, biomass energy and fuel cell technology can be used to overcome energy shortage in India. To meet the energy requirement for such a fast growing economy, India will require an assured supply of 3-4 times more energy than the total energy consumed today. The renewable energy is one of the options to meet this requirement.
- Renewable energy in India comes under the purview of the Ministry of New and Renewable Energy (MNRE). India was the first country in the world to set up a ministry of non-conventional energy resources, in the early 1980s. Solar Energy Corporation of India is responsible for the development of solar energy industry in India. Hydroelectricity is administered separately by the Ministry of Power and not included in MNRE targets. India is running one of the largest and most ambitious renewable capacity expansion programs in the world.

Installed grid interactive renewable power capacity (excluding large hydropower) as of 31 March 2018

Source	Total Installed Capacity (MW)	2022 Target (MW)
Wind power	34,046	60,000
Solar power	21,651	100,000
Biomass power (Biomass & Gasification and Bagasse Cogeneration)	8,701	10,000
Waste-to-Power	138	
Small hydropower	4,486	5,000
TOTAL	**69,022**	**175,000**

Grid connected installed capacity from all sources as of 31 May 2018

Source	Installed Capacity (MW)	Share
Coal	196,957.50	57.27 %
Large hydro	45,403.42	13.20 %
Other renewables	69,022.39	20.07 %
Gas	24,897.46	7.23 %
Diesel	837.63	0.24 %
Nuclear	6,780.00	1.97 %
Total	**343,898.39**	**100.00 %**

5.3.5 Watershed Management

- Watershed is defined as a geo-hydrological unit draining to a common point by a system of drains. All lands on earth are part of one watershed or other. Watershed is thus the land and water area, which contributes runoff to a common point.
- A watershed is an area of land and water bounded by a drainage divide within which the surface runoff collects and flows out of the watershed through a single outlet into a lager river or lake. Watershed technology is used in Rain fed areas.

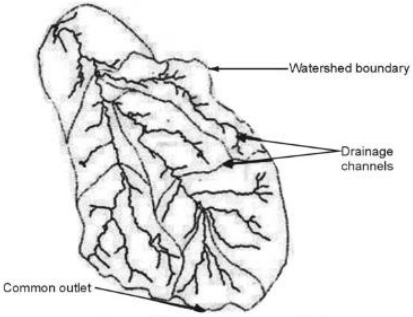


Fig. 5.3.2 Diagram of a watershed

- Watershed management implies an effective conservation of soil and water resources for sustainable production with minimum non-point resources (NFS) pollutant losses. It involves management of land surface and vegetation so as to conserve the soil and water for immediate and long term benefits to the farmers, community and society as a whole.

5.3.5.1 Objectives of Watershed Management

a. Production of food, fodder, fuel.
b. Pollution control.
c. Over exploitation of resources should be minimized.
d. Water storage, flood control, checking sedimentation.
e. Wild life preservation.
f. Erosion control and prevention of soil, degradation and conservation of soil and water.
g. Employment generation through industrial development dairy fishery production.
h. Recharging of ground water to provide regular water supply for consumption and industry as well as irrigation.
i. Recreational facility.

5.3.5.2 Main Components of Watershed

a. Soil and water conservation,
b. Water harvesting and water management,
c. Alternate land use system.

5.3.6 Interlinking of Rivers

The **Indian Rivers Inter-link** is a proposed large-scale civil engineering project that aims to effectively manage water resources in India by linking Indian rivers by a network of reservoirs and canals and so reduce persistent floods in some parts and water shortages in other parts of India

The Inter-link project has been split into three parts

i) Northern Himalayan rivers inter-link component,

ii) Southern Peninsular component

iii) Intrastate rivers linking component

5.3.6.1 Need

a) **Drought, floods and shortage of drinking water :** Despite abundant rains during July-September, some regions in other seasons see shortages of drinking water. Some years, the problem temporarily becomes too much rainfall, and weeks of havoc from floods. This excess-scarcity regional disparity and flood-drought cycles have created the need for water resources management. Rivers inter-linking is one proposal to address that need.

b) **Population and food security :** River inter-linking is claimed to be a possible means of assured and better irrigation for more farmers, and thus better food security for a growing population.

c) **Salt export needs :** Interlinking water surplus rivers with water deficit rivers is needed for the long term sustainable productivity of the river basins and for mitigating the anthropogenic influences on the rivers by allowing adequate salt export to the sea in the form of environmental flows.

d) **Navigation :** India needs infrastructure for logistics and movement of freight. Using connected rivers as navigation is a cleaner, low carbon footprint form of transport infrastructure, particularly for ores and food grains.

e) **Current reserves and loss in groundwater level :** India currently stores only 30 days of rainfall, while developed nations strategically store 900 days worth of water demand in arid areas river basins and reservoirs. India's dam reservoirs store only 200 cubic meters per person. India also relies excessively on groundwater, which accounts for over 50 percent of irrigated area with 20 million tube wells installed. About 15 percent of India's food is being produced using rapidly depleting groundwater.

5.4 Role of Information Technology in Environment and Human Health

5.4.1 Role of Information Technology in Environment and Human Health

The emerging growth of the internet services and facilities, geographic information system or GIS, and the data that gets transmitted through satellites, etc. have generated a higher affluence of the updated information on several aspects of the environment as well as health.

Database on the Environment System

It is a collection of connected data on some subjects. It comes in a computerized form, and you can retrieve the data at any hour of the day whenever needed. The information of database can easily extract in a computer. When it comes to comprehensive databases, things that include in it are wildlife database, forest cover database, and conservation database, etc. the databases are also available for some diseases which include malaria, fluorosis, HIV/AIDS, etc.

- National Management Information System (NMIS).
- Environmental Information System (ENVIS).
- Remote sensing and Geographical Information System (GIS).
- Geographical Information System (GIS).
- The World Wide Web (WWW).

National Management Information System (NMIS)

According to NMIS of the department of science and technology, it can understand that it has a database compilation that base on research and development projects, as well as information that is related to research scientists and personnel are included.

Environmental Information System (ENVIS)

Its main aim is to provide environmental information to all the decision makers, engineers, scientists, and policy planners that reside in all over the country. The centers of ENVIS implement the work hours in generating a new network for databases in areas such as clean technologies, pollution control, biodiversity, wildlife, environmental management, remote sensing, and renewable energy.

Remote Sensing And Geographical Information System (GIS)

- The process of remote sensing that accesses through satellites can be used to get through the ongoing alterations in the environment as well as to predict the natural hazards before time such as floods, droughts, volcanic eruptions, starvation, etc.

Geographical Information System (GIS)

- It is a process of superimposing different thematic maps with the help of digital data on a large scale of interconnected aspects. The different thematic maps that contain digital information and database on various elements such as forest land, water resources, soil type, cropland, industrial growth, human settlement, and industrial growth, etc. are placed in a layered prospectus in the computer with the help of software.

The World Wide Web (WWW)

- With the availability of resources on every aspect, things like classroom activities, digital files of photos, web-exercises, animations, PowerPoint lecture presentations, and quiz competitions have proved to be more helpful for both the students as well as the teachers who pursue environmental studies.

5.4.2 Formal and Non Formal Education

- Formal education is classroom-based, provided by trained teachers. Informal education happens outside the classroom, in after-school programs, community-based organizations, museums, libraries, or at home.

What are the main differences between the two ?

- In general, classrooms have the same students and the same teachers every day. After-school programs are often drop-in, so attendance is inconsistent, as is leadership.
- Classroom activities can last several days. After-school programs need to complete an activity each day because a different group of kids could be in attendance tomorrow.
- You can assume that classroom-based teachers have a certain level of training in educational philosophy, effective teaching strategies, classroom management, and content. After-school providers, by contrast, vary in experience and knowledge of teaching techniques, content expertise, and group management. Typically, materials for after-school settings need to include a lot more structure.
- Teachers need to meet educational standards and stick to a specified curriculum, which can make it difficult for them to incorporate nontraditional content. After-school programs, on the other hand, can be more flexible with their content.

Multiple Choice Questions

Q.1 The world as World Environmental day is celebrated on :

[a] December 1 [b] June 5
[c] November 14 [d] August 15

Q.2 The provisions for environmental protection in the constitution were made in :

[a] 1976 [b] 1950
[c] 1982 [d] 1960

Q.3 The provisions of environmental protection in the constitution were made under :

[a] Article 5-A
[b] Article 21-B
[c] Article 27-B (h)
[d] Article 48-A and Article 51-A (g)

Q.4 The first of the major environmental protection act to be promulgated in India was :

[a] Water Act [b] Air Act
[c] Environmental Act [d] Noise Pollution Rule

Q.5 The Forest (Conservation) Act was enacted in the year :

[a] 1986 [b] 1974
[c] 1980 [d] 1972

Q.6 The Forest (Conservation) Act extends to the whole of India except :

[a] Uttar Pardesh [b] Karnataka
[c] Jammu and Kashmir [d] Haryana

Q.7 Penalty for conservation of the provisions of the Forest Act is under :

[a] Section 3A [b] Section 4A
[c] Section 12A [d] Section 8A

Q.8 Offences by the Authorities and Government Department in Forest Act is under :

[a] Section 5B [b] Section 5A
[c] Section 3B [d] Section 8A

Q.9 The Wildlife (Protection) Act was enacted in the year :

[a] 1986 [b] 1974
[c] 1994 [d] 1972

Q.10 The power to declare an area as a sanctuary or national park of central Government is Wildlife (Protection) Act is under :

[a] Section 38 [b] Section 39
[c] Section 18 [d] Section 27

Q.11 The Wildlife (Protection) Act contains :

[a] 7 Chapters [b] 6 Chapters
[c] 5 Chapters [d] 8 Chapters

Q.12 The Wildlife (Protection) Act contains :

[a] 66 Sections [b] 6 Sections
[c] 7 Sections [d] 46 Sections

Q.13 The Water (Prevention and Control of Pollution) Act was enacted in the year :

[a] 1986 [b] 1974
[c] 1994 [d] 1975

Q.14 The Water Act contains :

[a] 4 Chapters [b] 5 Chapters
[c] 7 Chapters [d] 8 Chapters

Q.15 The Water Act have :

[a] 64 Sections [b] 68 Sections
[c] 45 Sections [d] 62 Sections

Q.16 The functions of Central Board are given under :

[a] Section 16 [b] Section 19
[c] Section 25 [d] Section 24

Q.17 The functions of State Board are given under :

[a] Section 16 [b] Section 17
[c] Section 21 [d] Section 45

Q.18 Power to give directions are declared under :

[a] Section 16 [b] Section 17
[c] Section 18 [d] Section 25

Q.19 In the Water Act the entire National Capital Territory of Delhi has been declared as water pollution prevention control area under :

[a] Section 21 [b] Section 23
[c] Section 19 [d] Section 24

Q.20 The Air (Prevention and Control of Pollution) Act was enacted in the year :

[a] 1981 [b] 1996
[c] 2000 [d] 1974

Q.21 The Air Act contains _____.

[a] 5 Chapters [b] 6 Chapters
[c] 7 Chapters [d] 8 Chapters

Q.22 The Air Act have _____.

[a] 56 Section [b] 54 Section
[c] 58 Section [d] 62 Section

Q.23 Noise pollution has been inserted as pollution in the Air Act in :

[a] 1981 [b] 1987
[c] 1982 [d] 2000

Q.24 The Environmental (Protection) Act was enacted in the year :

[a] 1986 [b] 1992
[c] 1984 [d] 1974

Q.25 The EPA consists :

[a] 2 Chapters [b] 4 Chapters
[c] 8 Chapters [d] 7 Chapters

Q.26 The EPA contains :

a 25 Sections b 12 Sections
c 26 Sections d 14 Sections

Q.27 NGOs stands for :

a Non-Governmental Organization
b Nine-Governmental Organization
c Non-Gained Organizations
d National-Grade Organization

Q.28 How many Nuclear power stations are there in India ?

a 5 b 6
c 7 d 8

Q.29 Correct examples of nonrenewable resources is _____.

a petrol, coal and gas
b sun, fossil fuels and wind
c water, petrol and coal
d water, wind and sunlight

Q.30 Agricultural activity such as tilling, harvesting, heating and ventilation are direct consumes of :

a energy b air
c sun d heat

Q.31 Which of the following is not the effect of modern agriculture ?

a Nitrate pollution b Eutrophication
c Biomagnification d Ozone depletion

Q.32 Housing affects :

a Neighbourhood b Energy consumption
c Water consumption d All of the above

Q.33 The human activity, among the following, which causes maximum environmental pollution having regional and global impacts, is :

a Urbanization b Industrialisation
c Agriculture d Mining

Q.34 Production, transformation and use of energy are the major problems of :

a industrial activity
b sustainable development
c global warming d acid rain

Q.35 Extraction of mineral and metal form the earth is :

a agriculture b transportation
c mining
d sustainable development

Q.36 Underground and open caste is the methods of :

a agriculture b mining
c housing d transportation

Q.37 In EIA the decision to hold hearing has to made within :

a 5 days b 10 days
c 20 days d 30 days

Q.38 SPCB's are required to give notice in how many newspapers mentioning the date, time and place of public hearing :

a 2 b 4
c 6 d 8

Q.39 'Meeting the needs of the present without compromising the ability of future generation to meet their own need' is given by :

a Brundtland b Mahatma Gandhi
c Maathai d Sunderlal Bahugana

Q.40 The idea of sustainable development was conceived in early :

a 1950 b 1960
c 1970 d 1980

Q.41 How many agreement are there in Agenda – 21 ?

a 4 b 5
c 6 d 7

Q.42 Sustainable development will not aim at :

a Social economic development which optimise the economic and societal benefits available in the present, without spoiling the likely potential for similar benefits in the future
b Reasonable and equitable distributed level of economic well being that can be perpetuated continually
c Development that meets the need of the present without compromising the ability of future generation to meet their own needs

d Maximising the present day benefits through increased resource consumption

Q.43 Which of the following statements in relation to sustainable development is not true ?

a Sustainable development is defined as the development that meets the needs of present without compromising the ability of our future generations to meet their own needs

b Sustainability has the main objective of purely focussing on the natural environment

c Sustainable development of various countries and the entire world is the only solution left with mankind to survive for a longer period on Earth

d Sustainable development not only considers the protection of the environment but also the maintenance of economic viability as well as the social and ethical considerations

Q.44 The maximum number of individuals that can be supported by a given environment is called ____.

a biotic potential b carrying capacity

c environmental resistance d population size

Q.45 Supporting capacity and assimilative capacity are the components of _____.

a carrying capacity b holding capacity

c containing capacity d capturing capacity

Q.46 Social, economical and ecological equity is the necessary condition for achieving _____.

a social development

b economical development

c sustainable development

d ecological development

Q.47 The management of natural resources should take into _____.

a a long term perspective

b environmental pollution

c their equitable distribution

d (a), (b), (c) and safe disposal of wastes

Q.48 Water harvesting is an age-old concept in India. Various methods are used in different regions of India. Khadins water harvesting method is used in _____.

a Rajasthan b Maharashtra

c Bihar d Uttar Pradesh

Q.49 The ancient water harvesting method used in Rajasthan is _____.

a Surangams b Kattas

c Kulhs d Nadis

Q.50 Which of the following river originates as well as ends in the territory of India ?

a Brahmaputra b Indus

c Kosi d Chambal

Q.51 Which of the following river is known as Dakshina Ganga ?

a Krishna b Mahanadi

c Godavari d Cauvery

Q.52 Indira Sagar Dam located in Madhya Pradesh is built on which of the following river ?

a Yamuna b Chambal

c Narmada d Krishna

Q.53 Krishna Raja Sagara Dam, located in Karnataka is built on which of the following river ?

a Cauvery b Godavari

c Krishna d Mahanadi

Q.54 Which of the following river is the home for fresh water dolphins ?

a Brahamaputra b Yamuna

c Ganga d Sabarmati

Q.55 On which of the following river Ajmer is situated ?

a Luni b Ganga

c Teesta d Beas

Q.56 Aizawl is situated on which of the following river bank ?

a Meghna b Tlawng river

c Hwang Ho d Irawadi

Q.57 At which place Alaknanda and Bhagirathi meets and take the name Ganga ?

[a] Devprayag [b] Allahabad
[c] Haridwar [d] Rishikesh

Q.58 Which of the following is the most abundant dissolved ion in the Ocean ?

[a] Chlorine [b] Bromine
[c] Potassium [d] Calcium

Q.59 Which is the longest river in the India ?

[a] Nile [b] Ganga
[c] Hwang Ho [d] Brahmaputra

Q.60 Which of the following is a non-renewable resource ?

[a] Coal [b] Forests
[c] Water [d] Wildlife

Q.61 Which among the following is not a renewable source of energy ?

[a] Solar energy [b] Biomass energy
[c] Hydro-power [d] Geothermal energy

Q.62 Identify the non-renewable energy resource from the following :

[a] Coal [b] Fuel cells
[c] Wind power [d] Wave power

Q.63 Which of the following is a disadvantage of most of the renewable energy sources ?

[a] Highly polluting
[b] High waste disposal cost
[c] Unreliable supply
[d] High running cost

Q.64 Photovoltaic energy is the conversion of sunlight into :

[a] Chemical energy [b] Biogas
[c] Electricity [d] Geothermal energy

Q.65 Horizontal axis and vertical axis are the types of :

[a] Nuclear reactor [b] Wind mills
[c] Biogas reactor [d] Solar cell

Q.66 Which among the following is not an adverse environmental impact of tidal power generation ?

[a] Interference with spawing and migration of fish
[b] Pollution and health hazard in the estuary due to blockage of flow of polluted water into the sea
[c] Navigational hazard
[d] None of the above

Q.67 Steam reforming is currently the least expensive method of producing :

[a] Coal [b] Biogas
[c] Hydrogen [d] Natural gas

Q.68 A fuel cell, in order to produce electricity, burns :

[a] Helium [b] Nitrogen
[c] Hydrogen [d] None of the above

Q.69 Fuel cells are :

[a] Carbon cell [b] Hydrogen battery
[c] Nuclear cell [d] Chromium cell

Q.70 Both power and manure is provided by :

[a] Nuclear plants [b] Thermal plants
[c] Biogas plants [d] Hydroelectric plant

Q.71 The outermost layer of the earth is :

[a] Magma [b] Mantle
[c] Crust [d] Solid iron core

Q.72 Common energy source in Indian villages is :

[a] Electricity
[b] Coal
[c] Sun
[d] Wood and animal dung

Q.73 The one thing that is common to all fossil fuels is that they :

[a] Were originally formed in marine environment
[b] Contain carbon
[c] Have undergone the same set of geological processes during their formation
[d] Represent the remains of one living organisms

Q.74 The process that converts solid coal into liquid hydrocarbon fuel is called :

a Liquefaction b Carbonation
c Catalytic conversion d Cracking

Q.75 Lignite, bituminous and anthracite are different ranks of :

a Nuclear fuel b Coal
c Natural gas d Biogas

Q.76 Cruid oil is :

a Colourless
b Odourless
c Smelly yellow to black liquid
d Odourless yellow to black liquid

Q.77 BTU is measurement of :

a Volume b Area
c Heat content d Temperature

Q.78 The first controlled fission of an atom was carried out in Germany in :

a 1920 b 1928
c 1925 d 1938

Q.79 Boiling water reactor and pressurised water reactors are :

a Nuclear reactor b Solar reactor
c OTEC d Biogas reactor

Q.80 Thousands of mirrors or curved metals are used to focus solar energy to make it very hot, in _____.

a solar cells b solar heater
c solar furnace d solar battery

Q.81 Wind is beneficial resource of energy as it doesn't cause _____.

a pollution b echo
c noise d sound

Q.82 Hot water or steam carrying geothermal energy often comes up to surface in _____.

a New Zealand b Ice land
c Germany d both a and b

Q.83 Black painted panels which are hanged at roofs to trap heat and energy from sun, are _____.

a solar cells b solar heater
c solar furnace d solar battery

Q.84 Force of sea waves as they break against coastline is known as _____.

a Solar energy b Wind energy
c Wave energy d Renewable energy

Q.85 Renewable energy do not contribute to _____.

a global warming b deforestation
c nuclear Waste d none

Q.86 Which energy source is expensive and used in small scales ?

a Solar energy b Wind energy
c Hydro-energy d Geothermal Energy

Q.87 Which source of energy has benefited from improvement in technology ?

a Hydro Energy b Solar energy
c Geothermal Energy d Wind energy

Q.88 Which type of energy has high cost of research into new technology ?

a Non-Renewable energy b Renewable energy
c Solar energy d Hydro energy

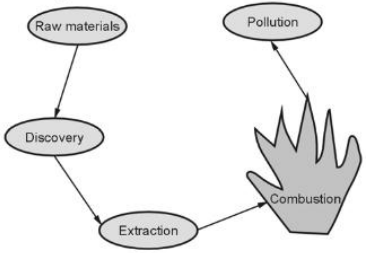
Q.89 A non-renewable resource is a finite resource.

a True b False

Q.90 Which of the below theory is related to non-renewable resources ?

a Game Theory b Phlogiston Theory
c Big Bang Theory d Hotelling's Theory

Q.91 The below schematic diagram represents which life cycle ?



a Carbon Life Cycle
b Earth minerals Life Cycle
c Phosphorus Life Cycle
d Fossil Fuel Life Cycle

Q.92 Which of the following nonrenewable energy is not classified under a fossil fuel ?

a Nuclear b Petroleum
c Oil d Natural gas

Q.93 The major non-renewable energy usage in India is _____.

a Coal
b Petroleum and other liquids
c Natural gas
d Nuclear

Q.94 The Western Ghats Ecology Expert Panel (WGEEP) has classified the _____ taluks in the Western Ghats boundary into Ecologically Sensitive Zones (ESZ) 1, 2 and 3.

a 143 b 142
c 127 d 185

Q.95 Gadgil report recommended that "no new dams based on large-scale storage be permitted in Ecologically Sensitive Zone :

a 1 b 4
c 2 d 3

Q.96 The Western Ghats Ecology Expert Panel (WGEEP) designated the entire hill range as an _____.

a Ecologically Sensitive Area (ESA).
b Ecologically Affected Area (EAA).
c Ecologically Safe Area (ESA).
d Ecologically Balanced Area (EBA).

Q.97 Eutrophication is a _____.

a good sign for ecosystem
b bad sign for ecosystem
c neutral sign for ecosystem
d dual-sided sign for ecosystem

Q.98 Submerged algae and plants die due to _____.

a death of fish on which they feed
b less water available for them
c less oxygen in water
d blockage of sunlight due to profuse growth

Q.99 Profuse growth of bacteria result in _____.

a death of algae
b death of aquatic plants
c death of fish
d lesser nutrients in water

Q.100 Methemoglobinemia is a condition caused by elevated levels of _____ in the blood.

a Iron b Haemoglobin
c Methemoglobin d RBC

Answer Keys for Multiple Choice Questions

Q.1	b	**Q.2**	a	**Q.3**	d
Q.4	a	**Q.5**	c	**Q.6**	c
Q.7	a	**Q.8**	c	**Q.9**	d
Q.10	a	**Q.11**	a	**Q.12**	a
Q.13	b	**Q.14**	d	**Q.15**	a
Q.16	a	**Q.17**	b	**Q.18**	c
Q.19	c	**Q.20**	a	**Q.21**	c
Q.22	b	**Q.23**	b	**Q.24**	a
Q.25	b	**Q.26**	c	**Q.27**	a
Q.28	c	**Q.29**	a	**Q.30**	a
Q.31	d	**Q.32**	d	**Q.33**	b
Q.34	a	**Q.35**	c	**Q.36**	b
Q.37	d	**Q.38**	a	**Q.39**	a
Q.40	d	**Q.41**	b	**Q.42**	d
Q.43	b	**Q.44**	b	**Q.45**	a
Q.46	c	**Q.47**	d	**Q.48**	a
Q.49	d	**Q.50**	d	**Q.51**	c
Q.52	c	**Q.53**	a	**Q.54**	c
Q.55	a	**Q.56**	b	**Q.57**	a
Q.58	a	**Q.59**	d	**Q.60**	a
Q.61	b	**Q.62**	a	**Q.63**	c
Q.64	a	**Q.65**	b	**Q.66**	d

Q.67	c	**Q.68**	c	**Q.69**	b
Q.70	c	**Q.71**	c	**Q.72**	d
Q.73	b	**Q.74**	a	**Q.75**	b
Q.76	c	**Q.77**	c	**Q.78**	d
Q.79	a	**Q.80**	c	**Q.81**	a
Q.82	d	**Q.83**	b	**Q.84**	c
Q.85	a	**Q.86**	a	**Q.87**	d
Q.88	a	**Q.89**	a	**Q.90**	d
Q.91	d	**Q.92**	a	**Q.93**	a
Q.94	b	**Q.95**	a	**Q.96**	a
Q.97	b	**Q.98**	d	**Q.99**	c
Q.100	c				

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Price : ₹ 120/-
ISBN 978-93-89180-37-4

Published by :
TECHNICAL PUBLICATIONS
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