

ENVIRONMENTAL EDUCATION

For Class XI



**Assam Higher Secondary Education Council
Bamunimaidam, Guwahati-21**

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PREFACE

As per guidelines of honourable Supreme Court, Assam Higher Secondary Education Council has introduced a new subject i.e. Environmental Studies for higher secondary First Year from the session 2012-13 with the aim of creating awareness and interest among the students.

Again as per indication of honourable Supreme Court "Road Safety" issue and as per indication of government of Assam, "Disaster Management". These two new units are incorporated in Environmental Studies book in view of the importance and significance of the two topics as per decision of Assam Higher Secondary Education Council. These two new chapters are included in the Environmental Studies to bring a fresh look.

Any undesired mistake pointed out by respected teachers and experts related to the subject, will be corrected in the subsequent editions.

At last, all are requested to take part and put forward a helping hand to make the subject full fledged.

Secretary
Assam Higher Secondary Education Council
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**Syllabus on Environmental Education
(For Class XI)**

Marks Distribution

Full Marks : 50

Total Marks in Theory (Written Examination) : 40

Unit-I : Environmental Education
Mark : 20

Unit-II : Disaster Management
Mark : 10

Unit-III : Road Safety
Mark : 10

Marks in Project : 10

PROJECT (Total Marks - 10)

Each student should carry out and submit a project under the supervision of a teacher. Ten marks allotted for the project is to be credited in the final examination of Environmental Studies.

Students may perform their projects on anyone of the following topics. Besides students may also perform their projects under the guidance of teacher on topics related to the subject matter.

- (a) To collect data by visiting a local environmental resource like– River / Forest / Grassland / Agriculture land / Hill.
- (b) To prepare a note by visiting some polluted areas like– city, village, industrial area etc.
- (c) To prepare a list on daily basis by observing a nearby plant / insect / bird / animal for three months enlisting their changes, movements and impacts on environment.
- (d) Submit a report by visiting a particular place during summer vacation and note down its natural environment, natural resources, environment dependent economy, social issues related to conservation of environment.
- (e) Prepare a first-aid-box to be used during a disaster.
- (f) Prepare a list of emergency service related phone numbers and addresses like – Police Station, Fire Station, Hospital, Disaster Management divisional office, Municipal office, Deputy Commissioner's office, Block Development office etc.
- (g) Prepare a report by visiting disaster affected neighbouring area with details of causes, results, measures for rescue operations and steps to neutralize future probabilities.
- (h) Prepare a pictorial table on mandatory / alarming road symbols as per traffic rules.
- (i) Prepare a pictorial note on movement of traffic, around your school and rules to be followed to make the institution pollution free and maintain a healthy environment.
- (j) To form eco club in the school and celebrate various environment related programmes / World Environment Day / Road Safety Week / National Disaster Management Day (29 October) etc.

UNIT -1 BASIC CONCEPT OF ENVIRONMENT

Environment.

The term environment means surroundings. It comes from the French word environner (to encircle or to surround). It is a composite term for the conditions in which organisms live and thus consists of air, water, soil and sunlight which are the basic needs of all living beings and plant life to carry on their life functions. The environment also includes temperature, wind, energy etc. Thus it consists of both biotic and abiotic components. Environment creates favourable conditions for the existence and development of living things.

Environment may be defined in a number of ways –

- It can be defined as the circumstances or conditions that surround an organism or a group of organisms.
- Environment is the sum of all social, economical, biological, physical or chemical factors which constitute the surroundings of man, who is both the creator and moulder of his environment.

Components of Environment :

Environment consists of the following three components

1. Abiotic component or non-living component
2. Biotic component or living component
3. Energy component

The abiotic or physical environment is subdivided into three categories

- i. Lithosphere (solid)
- ii. Hydrosphere (liquid)
- iii. Atmosphere (gas)

The biotic component consists of flora and fauna including man.

The energy component includes solar energy, geothermal energy, hydroelectrical energy, atomic energy etc.

Environmental Segments :

There are four segments of the environment.

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

1. Atmosphere :

The earth is the only planet in the solar system capable of supporting life. The supporting property of our planet is due to its unique atmosphere. It is the protective blanket of gases surrounding the earth which sustains life on earth and saves it from the hostile environment of the outer space. It absorbs most of the cosmic rays from the outer space and a major portion of the electromagnetic radiation from the sun. It filters out tissue damaging ultra violet radiations.

The atmosphere plays a key role in maintaining the heat balance of the earth through absorption of infra red radiation emitted by the sun and reemitted from the earth.

Composition of the atmosphere :

<u>Major components</u>	Nitrogen, N ₂ (78.09 %) Oxygen, O ₂ (20.94 %)
<u>Minor components</u>	Argon, Ar (9.34 x 10 ⁻¹ %) Carbon dioxide, CO ₂ (3.25 x 10 ⁻² %)
<u>Trace gases</u>	Neon, helium, methane, water vapour, krypton, nitrous oxide, xenon, hydrogen, sulphurdioxide, ozone, ammonia, carbon monoxide, nitrogen dioxide etc.

The atmosphere is the source of oxygen, essential for life on earth. The atmosphere is the source of carbon dioxide, essential for

plant photosynthesis. The atmosphere also supplies nitrogen to yield chemically bound nitrogen (protein) essential for life.

The atmosphere may be broadly classified into four regions.

Region	Altitude range (Km)	Temp. range (°C)	Important chemical species
Troposphere	0 – 11	15 to –56	N_2, O_2, CO_2, H_2O
Stratosphere	11 – 50	–56 to –2	O_3
Mesosphere	50 – 85	–2 to –92	O_2^+, NO^+
Thermosphere	85 – 500	–92 to 1200	O_2^+, O^+, NO^+

The ozone (O_3) present in the stratosphere plays an important role for us. It acts as a protective shield for life on earth from the injurious effects of the sun's ultra violet radiations.

2. Hydrosphere :

The hydrosphere includes all types of water resources – oceans, seas, rivers, lakes, reservoirs, glaciers, polar icecaps and ground water (water below the earth's surface). Earth is flooded with water, a total volume of about 1400 million cubic kilometres cover 71% of earth's surface. Yet, in many locations, it is still difficult to obtain desired amount of water of suitable quality. About 97% of the earth's water supply is in the ocean, which is unfit for human consumption and other uses because of its salinity. Only 3% is fresh water. 79% of this 3% is locked in the polar icecaps and glaciers, 20% is locked as underground water and only 1% is readily available water (found in rivers, lakes, streams, reservoirs) for direct human use.

3. Lithosphere :

This is the outer mantle of the solid earth consisting of minerals and soil. Soil comprises a complex mixture of minerals, organic matters, air and water. The soil is the most important part of the lithosphere. The soil is a storehouse of minerals, reservoir of water,

conservator of soil fertility, producer of crops, home of wildlife and livestock.

4. Biosphere :

Biosphere is the layer on the earth in which life can exist. The layer extends about 6 - 8 km up into the atmosphere and as much as 8 - 10 km below into the depth of the sea. Thus it denotes the realm of living organisms and their interactions with the environment i.e. atmosphere, hydrosphere and lithosphere. The biosphere and the environment are influenced considerably by each other.

Environmental Education :

There was a time when everything around us was pure and safe. The air, water and soil were in balanced condition. The nature itself was very much enjoyable. In primitive days, the limited needs of man did not disturb the harmony with nature. Because population was less. But in subsequent years, the population has increased manifold. Science and technological advancement accelerated and the environmental degradation started. With the increase in population, the attempts to make life more and more comfortable, man destroys the forests thoughtlessly, pollutes air and water recklessly, spoils the nature ruthlessly.

Environmental problems have attracted the attention of a wide section of people all over the world during the last few decades. People are becoming increasingly conscious of the variety of environmental problems today. Nature's precious resources are getting depleted because of indiscriminate and unplanned activities of man.

World educators and the environmental specialists have repeatedly pointed out that any solution to the environmental crisis will require environmental awareness and clear understanding of the problem and hence the answer of all these is the Environmental Education .

Education always plays a vital role for creating healthy attitude, skills and dissemination of knowledge. That is why the Stockholm

conference on human environment in 1972 emphasized the need for environmentally oriented education. It is not a new discipline and should not be treated as new discipline rather a new dimension in education system.

In short, it can be said that environmental education is education through environment, about environment and for the environment.

Environmental education is the educational process dealing with man's relationship with his natural and man-made surroundings and includes the relation of population, pollution, resource allocation and depletion, conservation, transportation technology and urban and rural planning to the total human environment. Environmental education is the process of recognizing values and clarifying concepts in order to develop skills and attitudes necessary to understand and appreciate the interrelatedness among man, his culture and his biophysical surroundings.

The report of the first intergovernmental conference of environmental education held at Tbilisi (USSR, 1977) is the single most important document which provides broad guidelines for environmental education. The declaration decreed that environmental education should :

- be interdisciplinary in its approach
- consider the holistic environment
- be continuous, beginning at preschool level and continuing through all the formal and non formal stages
- examine the major environmental issues critically from the local, regional, national and international points of view
- dwell on the current and future environmental trends and scenario
- help learners discover the symptoms and real causes of environmental problems and plan accordingly
- finally strive to promote the value and necessity of local, national and international cooperation in solving environmental problems.

The objectives and the guiding principles for environmental education are -

1. **Awareness** and sensitivity to the environment and environmental challenges
2. **Knowledge** and understanding of the environment and environmental challenges
3. **Attitude** of concern for the environment and motivation to improve or maintain environmental quality
4. **Skills** to identify and help resolve environmental challenges
5. **Participation** in activities that lead to the resolution of environmental challenges.

Multidisciplinary nature :

Environmental education is a multidisciplinary subject. In order to know the environment and its different complex phenomena, one requires knowledge from various disciplines. Subjects like botany, zoology, biotechnology, bioengineering, microbiology, genetics, biochemistry etc. help in understanding biotic components and their interactions. The basic knowledge of physics, chemistry, mathematics, statistics help in understanding the different phenomena in the environment. Computer science and information technology is a part and parcel of environmental education. Similarly, for control of pollution, environmental engineering is essential. Other branches of engineering e.g. chemical, civil, mechanical including new innovative technologies have been involved in protecting the environment. Green chemistry finds its distinct and well specific role in protecting the degraded environment. Subjects like sociology, economics, education, philosophy are involved in a number of ways. Environmental laws are always enacted for the protection of the environment. So environmental education carries the multidisciplinary nature where different aspects are dealt with holistic approach.

Need for environmental awareness :

The world today is confronted with the great problem of environmental degradation and pollution. Different types of pollution, fast depleting forest resources, rapid population explosion, expanding industrialization, unplanned urbanization, mining, soil erosion etc have created ecological imbalances in recent years. Man's quest for economic development has been mainly responsible for the ruthless exploitation of natural resources. Moreover highly materialistic, greedy and luxurious life style attitude of human race indiscriminately exploited or imprudently destroyed the natural resources. All these activities have become a threat to the very existence of a number of living organisms So creation of public awareness is must to protect the environment from further deterioration. Environmental problems can be best addressed if the people become environmentally aware. No Government can solve these problems by simply implementing certain environmental protection rules if people are not co-operating. People are to be environmentally educated. They should be able to learn that if we degrade our environment today, we will have to suffer tomorrow and our future generation will be in great danger. We are a part of the environment and it is our duty to protect it.

Questions

1. What is environment ?
2. What are the different components of the environment ?
3. What are the different segments of the environment ?
4. Mention the major components of the atmosphere.
5. What is the role of ozone present in the stratosphere ?
6. What do you mean by environmental education ?
7. What are the broad guidelines of environmental education ?
8. Mention the basic principles of environmental education.
9. Discuss the multidisciplinary nature of environmental education.
10. How do environmental awareness help to protect our environment ?

Meaning of ecology and ecosystem

The word ‘ecology’ is derived from the Greek words *oikos* (means- home) and *logos* (means – study). So ecology deals with the study of organisms in their natural homes interacting with their surroundings or environment. In other words, ecology is the study of the interconnections and interdependence of plants, animals and their environment. The essence of ecology lies in the study of togetherness of everything – plants, animals, micro-organisms and their environment.

There are intricate connections between the various components of nature. For instance, green plants take nutrients and water from the soil. Their leaves, fruits and other parts may then be eaten by a bird or a deer. When these die, a part of their dead remains are eaten up by bacteria, fungi, etc., while the remainder is broken down into smaller elements like nitrogen, carbon, sulphur, etc., and goes back to the soil, thus connecting them all.

The best way to understand ecology is to look at it from the levels (hierarchy) of organization that ecology focuses on. These levels are : organisms, species, population, communities and ecosystems. Interactions with the physical environment (energy and matter) at each level produces characteristic functional systems.

Organisms

An organism is any form of life. A wide range and variety of organisms are present on the earth –from the single-celled amoeba to huge sharks, from microscopic blue green algae to massive banyan trees.

Species

Groups of organisms that resemble one another in appearance, behaviour, chemistry and genetic structure form a species. Organism of the same species can breed with one another and produce fertile offspring under natural conditions. For instance, all human beings (*Homo sapiens*) resemble one another in their body structure, body systems, and they all have similar genetic structure. They are thus grouped together under the species *sapiens*.

Population

A population is a group of individuals of the same species occupying a given area at a given time. For example, the *Rhinoceros unicornis* in the Kaziranga National Park, Assam, make a population.

Communities

Populations of various species occupying a particular area and interacting with each other make a community. For example, when we say ‘ the community of the Kaziranga National park’, we refer to the rhino population, the elephant population, the cattle population, the grass population and populations of all kinds of life forms present there. Thus a community comprises several species interacting with each other.

Ecosystem

An ecosystem is a community of organisms involved in a dynamic network of biological, chemical and physical interactions between themselves and with the non-living components. Such interactions sustain the system and allow it to respond in changing conditions. Thus, an ecosystem includes the biological components , the non-living components (physical environment) and their interactions. The Kaziranga ecosystem will thus include the various life forms found in the park (the community) and also the non-living components of the park, like the soil, rocks, water, etc., and even the solar energy that is captured by the plants and the interactions.

According to Odum (1963), ecosystem is the main active unit of ecology.

Types of Ecosystem

Ecosystem is of two major types

- a) Natural ecosystem :
- b) Artificial or man-made ecosystem
- a) Natural ecosystem is again divided into
 - i) Terrestrial ecosystem (for example - forest ecosystem, grassland ecosystem, desert ecosystem) and
 - ii) Aquatic ecosystem can be fresh water ecosystem and marine ecosystem. Fresh water ecosystem may be lotic (free flowing type, e.g. rivers) or lentic (standing type, e.g. ponds, lakes).
- b) Man-made ecosystem : These ecosystems are created by man. For example – cropland ecosystem, fisheries etc.

a) Natural ecosystem

This is an ecosystem that is found in nature, where there is no interaction with humans. It is a system where everything is in balance and if one component is removed, the system will fall apart. Natural ecosystems are defined by their habitat. The two major categories are terrestrial and aquatic. Deserts, forests, meadows, prairies and jungles are terrestrial ecosystems, while aquatic ecosystems include all marine and freshwater systems.

b) Artificial ecosystem

Artificial ecosystems are constructed in some fashion by humans. For example, a pond is built, plants are physically planted surrounding the pond and varieties of fish species are released into the pond. To keep the constructed wetland in balance, human intervention is needed to maintain the ecosystem. Ponds must be kept filled with water so that plants and fish will thrive, invading weeds must be controlled and predators need to be controlled. So it

is not a natural ecosystem. Other artificial ecosystems are orchards, large or small gardens and farms.

Structure of ecosystem

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

Biotic structure

The plants, animals and the micro-organisms present in an ecosystem form the biotic component. Depending upon the different nutritional behaviour, biotic components may be divided into

a) Autotrophs and b) Heterotrophs

a) **Autotrophs** : They are known as producers. They can produce their food themselves by making use of carbon dioxide present in air and water in presence of sunlight by involving chlorophyll, the green pigment present in leaves of plants, through the process of photosynthesis. There are some micro-organisms which can produce organic matter through oxidation of certain chemicals in absence of sunlight.

b) **Heterotrophs** : Organisms of this class can not produce their food by themselves. They get their organic food from the producers. So they are called consumers. The consumers are of two types – macro consumers and micro consumers.

Macro consumers : The animals that consume the producers either directly or indirectly are called macro consumers. These can be divided into four types-

- i) **Herbivores**: Animals that directly consume producers are called herbivores or primary consumers. Examples – cows, deer, goat etc.
- ii) **Carnivores**: They feed on other consumers. If they feed on herbivores, they are called secondary consumers. Examples

- frog. If they feed on other carnivores, then they are known as tertiary consumers. Example – snake, big fish.
- iii) Omnivores: They feed on both plants and animals. Example – man, fox, rat etc.
- iv) Detrivores : They generally feed on the dead animals, partially decomposed matter, wastes of other living organisms. Examples –beetle, ants, earthworms etc.

Micro consumers : There are certain living organisms that derive their nutrients by decomposing or breaking down dead plants and biotic compounds in the environment. They are called decomposers or micro consumers. Examples – bacteria, fungus.

Abiotic Structure

The physical and chemical components of an ecosystem constitute the abiotic structure. It includes all kinds of physical factors like sunlight, latitude and longitudes, average temperature, rainfall pattern, wind velocity etc. as well as edaphic (soil) factors.

Under chemical components, major nutrients like carbon, nitrogen, phosphorous, oxygen, potassium etc, compounds like carbohydrates, proteins, nucleic acid, various other organic matters present in soil and water influence the functioning of the ecosystem.

Function of an ecosystem

The ecosystems perform their functional attributes in a systematic way under natural conditions. It receives energy from the sun and passes it into the different components at different levels. The function of an ecosystem can only be considered as a whole, as every part of the ecosystem has a functional effect on another. The major functional characteristics of an ecosystem may be described in terms of food chain, food webs and trophic levels, energy flow, nutrient cycles etc.

Food chain, food web and trophic levels

Food chain

In an ecosystem, the sequential chain of eating and being eaten is called a food chain. The common examples of food chain are–

Grasses –cattle – tiger (the chain consists of three links)

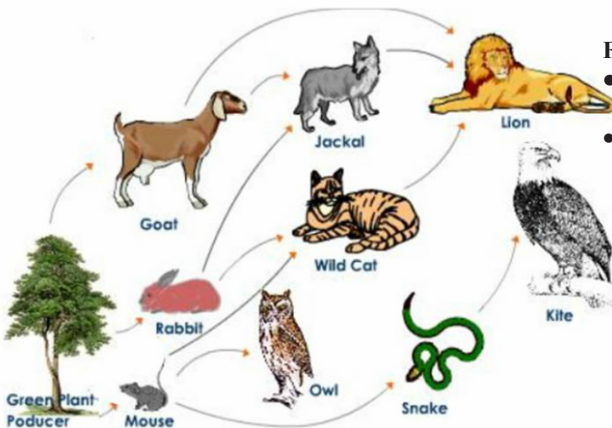
Grasses – grasshopper – birds – hawks (the chain consists of four links)

Phytoplankton – water fleas – small fish – tuna

Two types of food chain can be found in natural ecosystem. One type starts from green plants (autotrophs) constituting the first trophic level, the herbivores form the second trophic level and predators form the third trophic level. They are referred to as grazing food chain. The other type starts with debris detritus produced by green plants is termed as detritus food chain. Food chain is always unidirectional.

Food web

A number of food chains interwoven with one another give rise to a structure similar to the web of a spider. These interlocking patterns formed by several food chains that are linked together are called food webs. So food web is a network of food chains where different



Food web are :

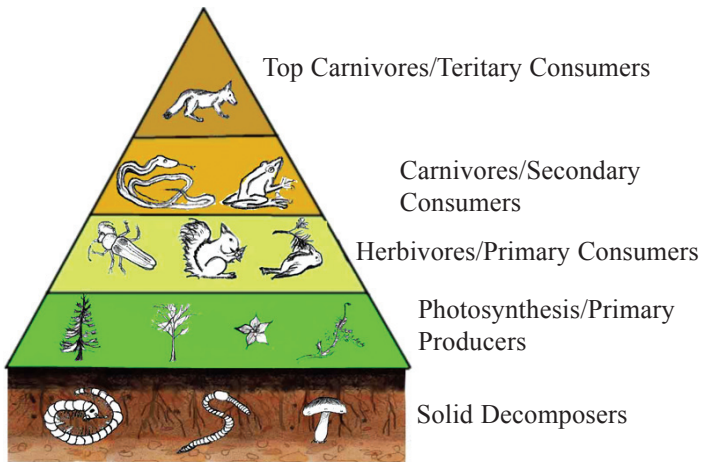
- nterconnected food chains
- They show the feeding relationships in an ecosystem

types of organisms are connected at different trophic levels, so that there are a number of options of eating and being eaten at each trophic level.

The two most important functions of the ecosystem i.e. energy flow and nutrient cycling take place through them.

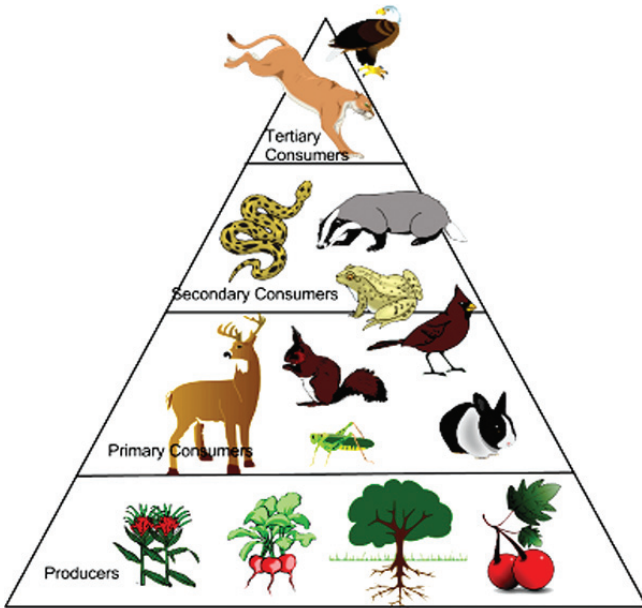
Trophic level

Every organism in an ecosystem can be assigned a feeding level, referred to as the trophic level. The living organisms which derive energy from the same source are said to belong to the same trophic level. Thus the green plants would be grouped in the first trophic level (producers), herbivores in the second trophic level (primary consumers), carnivores in the third (secondary consumers), and so on.



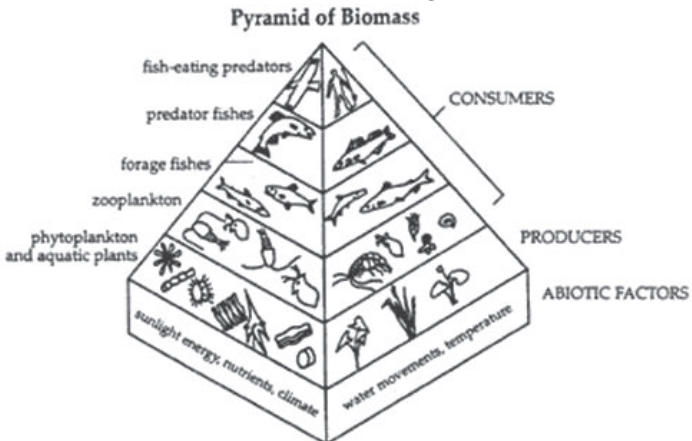
Ecological Pyramids

The graphical representation of the trophic structure and functions of an ecosystem with producers at the base and successive trophic levels of consumers forming the higher layers (apex) is known as ecological pyramids. Ecological pyramids are of three basic types:



The pyramid of numbers : Here the numbers of individual organisms are depicted;

The pyramid of biomass : based on the total dry weight or other measures of the total amount of living matter;



The pyramid of energy : in which the energy assimilated and/or productivity at successive trophic levels is shown. Ecological pyramids are used for comparing biomass and energy flow between trophic levels. Such comparisons can be used for identifying / comparing which ecosystems and communities are more efficient in terms of energy transfer.



Questions

1. Define the term ecology.
2. What do you mean by ecosystem?
3. Classify the ecosystems.
4. What are lotic and lentic ecosystems ? Give examples.
5. What are producers, consumers and decomposers ?
6. Write briefly on structure and functions of an ecosystem.
7. What are food chain and food web ?
8. What is trophic level.
9. What do you mean by ecological pyramids? Name the different types of ecological pyramids.
10. Mention the main characteristics of food chain and food web.

The term Biodiversity

The term ‘biological diversity’ commonly shortened to biodiversity refers to the number, variety, and variability of all life forms on earth. These include millions of plants, animals and micro-organisms, the genes they contain, and the intricate ecosystems of which they are a part. Biodiversity is usually described at three levels: genetic, species and ecosystem diversity.

Genetic biodiversity

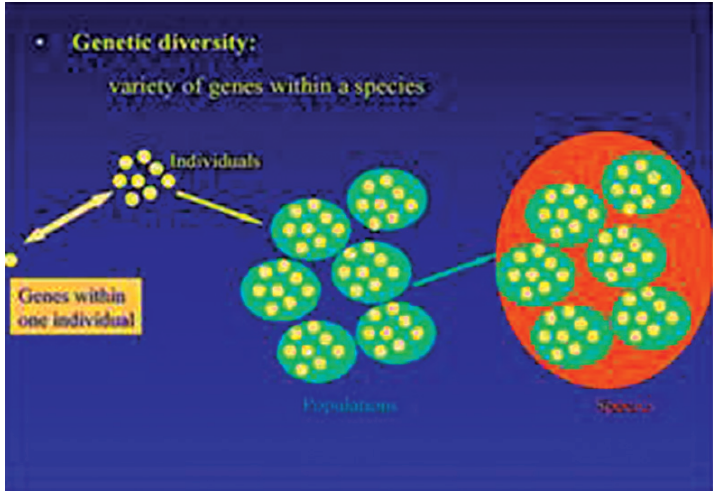
This is the diversity of genes within a species, which are passed down the generations. It is this type of diversity that gives rise to the varieties of species. For example, basmati rice is distinct from joha rice. Some variations are easy to see, such as, size or colour. Taste or flavor can be perceived by other senses.

Species biodiversity

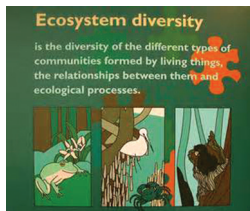
Species is the unit used to classify the millions of life forms on earth. Each species is distinct from every other species. Horses and donkeys are distinct species, as are lions and tigers. What unites members of a species is the fact that they are genetically so similar that they can produce fertile offspring. Species diversity is usually measured in terms of the total number of species within a defined area.

Ecosystem biodiversity

An ecosystem is a set of life forms (plants, animals micro-organisms) interacting with one another and with non-living elements (soil, air, water minerals, etc). Ecosystem diversity is, therefore, the diversity of habitats which include the different life forms within



*Species
Diversity*



itself. It is also used to refer to the variety of ecosystems found within a biogeographical or political boundary.

Value of biodiversity

Biodiversity may sound like an abstract concept, but in reality it touches almost every aspect of our life. The earth has an enormous variety of plants and animals, both domesticated and wild, as also a

wide array of habitats and ecosystems. This diversity meets the food, medicinal, clothing, shelter, spiritual as well as the recreational needs of millions of people around the world. It also ensures that ecological functions such as the supply of clean water, nutrient cycling and soil protection are maintained. In fact, biodiversity loss would mean a threat to the survival of the human race itself.

Consumptive use

We have noticed that the biodiversity products like fuel, food, drugs, fibres etc. have been used by man from time immemorial. About 90 per cent of the world's food comes from plant species. Genetic diversity is important in breeding crops and livestock. Crop breeders need a diversity of crop varieties in order to breed new varieties that resist evolving pests and disease. The loss of diversity in crop species has severe implications for global food security. A single pest invasion or disease could wipe out all standing crop or a particular livestock.

About 80 per cent of the people in developing countries depend for primary healthcare on traditional medicine, most of which is derived from plants, and some from animal and mineral sources. We get penicillin used as antibiotic from a fungus called *penicillium*. Similarly we get tetracycline from a *bacterium*, aspirin from the plant *Filipendulaulmaria*, and quinine from the bark of *cinchona* tree. The fuel wood, fossil fuels (like coal, petroleum) natural gas, minerals etc have been used by all of us.

Productive use

These are the commercial products manufactured or prepared from the different resources of biodiversity. Even today a large number of traditional communities depend wholly or partially, on the surrounding natural resources for their daily needs of food, shelter, clothing, household goods, medicines, fertilizers and entertainment. The tusks of elephants, silk from silk worm, wool from sheep, lac from lac insect are obtained from the animal diversity. Many industries

depend largely on plant materials e.g. paper and pulp industry, sugar industry, plywood industry, railway sleeper etc.

Social use

In India, many plants and animals have ritual significance and are associated with religious, spiritual and other cultural uses. Among the auspicious flowers offered in temples are hibiscus, offered to the goddess Kali, and *datura* flowers offered to Shiva. Similarly different parts of mango, tulsi, lotus, bel tree etc are in use for different purposes. Various animal species like cow, goat, buffalo are considered sacred on account of their association with different deities. Some animal species are believed to be the *vahanas* or vehicles of the deities and are hence venerated.

In India and several other countries, pockets of forests have traditionally been set aside because they are believed to be the abode of a particular god. Over the ages, local communities have protected these areas which are called sacred groves. As a result of the protection, these areas are preserved as pockets of rich biodiversity.

Ethical use

Each species is unique and has a right to exist. Humans do not have the right to eliminate any species. Ethics provide the basis for deciding what is right or wrong, good or bad. The world charter for nature, adopted by the United Nations in 1982, states that 'every form of life is unique warranting respect regardless of its worth to man, and to accord other organisms such recognition, man must be guided by a moral code of action.'

Aesthetic use

Each species and ecosystem adds to the richness and beauty of life on earth. Perhaps no artificial medium can match the sheer joy of watching a sunset over an ocean, the sight of leaping deer, the sound

of a singing bird, or the smell of wet earth after the first rains. A natural ecosystem, once destroyed, is impossible to recreate. The number of people who visit a natural site is an indication of its aesthetic value. No one of us want to visit a barren land but we generally try to enjoy the natural beauty by visiting national parks, wildlife sanctuaries or even the forest area.

Threats to biodiversity

Extinction or elimination of species is a natural process of evolution. But in recent past, the elimination of innumerable species have been talked about in different national and international forums. The changing attitude of human society to the environment in general and biodiversity in particular has reached such a level that the conservation of biodiversity has become a great challenge. There have been threats to biodiversity from different angles such as

- a) Habitat destruction
- b) Overgrazing
- c) Poaching
- d) Natural calamities
- e) Climate change and global warming
- f) Biopiracy

a) Habitat destruction

Destruction of natural habitats through commercial felling of trees, encroachment of forests for settlement and agriculture, jhum cultivation in the hill slopes and various other developmental activities have put serious threat to biodiversity. Construction of roads and railways, construction of industries, construction of mega dams etc have immense impact on biodiversity.

b) Overgrazing

Uncontrolled grazing by livestock is also a major problem specially on the grasslands. Since most of the grasslands are confined to a small area, so the pressure on it is not negligible. It also accelerates top soil erosion and thereby destroys the biodiversity.

c) Poaching

After loss of habitat, poaching is another major threat to biodiversity. Species such as elephants, rhinos, tigers are poached regularly for international trades. A large number of rhinoceros in Assam have been killed for its horn. Despite ban on trade in products from endangered species, smuggling of wildlife items like fur, hides, horn, tusks are going in full swing.

d) Natural calamities

Natural calamities like floods, earthquakes, tsunamis, storm etc cause irreparable loss to biodiversity.



Photograph : A rhinoceros with its calf at Flood effected Kaziranga.

e) Climate change and global warming

Climate change is often cited as a serious threat to biodiversity. Due to change in climatic pattern, many species can not tolerate it and hence die. There are different views regarding the effect of climate change and global warming on agriculture. Tropical and sub tropical regions will be more affected since the average temperature in these regions is on the warmer side. Soil moisture will decrease and evapotranspiration will increase which may have affect on production of certain agro products. The effects of global warming adds a catastrophic threat toward mass extinction of global biological diversity. The extinction threat is estimated to range from 15 to 30 per cent of all species over the next 50 - 60 years.

f) Biopiracy

Biopiracy is a kind of procurement of biological resources from a country or a place and the subsequent patentisation of their products. The indigenous people of some countries are the treasure house of knowledge and beliefs. Agents of some companies or other middle persons collect their knowledge and valuable living materials and subsequently proceed for patentisation on their own. Thus through unethical means they acquire rights of marketing these products. A number of such cases are found to occur in different countries. Biopiracy of certain high valued bioresources has been a major threat to biodiversity.

Conservation of biodiversity

Biodiversity is recognized as a global wealth to which no value can be put. Conservation of biodiversity means the proper protection and management of biological wealth with its ecosystems for the benefit of all kinds of living organisms including man. Measures have been taken at an international as well as national level to tackle this issue. Conservation of biodiversity is of two types

- a) In-situ Conservation
- b) Ex-situ Conservation

a) In-situ Conservation:

In-situ conservation is conservation of wild species of flora and fauna in their natural habitat i.e. on site preservation. e.g. biosphere reserves, national parks, wildlife sanctuaries, reserve forests etc. India has a long tradition of such conservation. It has continued this through the establishment of a network of protected areas throughout the country. Today, India has over 533 national parks and sanctuaries. These protected areas cover about 4.5 per cent of the country's territory and have helped in conserving habitats and their biodiversity. Several special projects have also been launched to save certain animal species which have been identified as needing concerted protection effort. Assam has now 5 national parks and 22 wildlife sanctuaries. Kaziranga National Park and Pobitora wildlife sanctuary are involved in the protection of Asiatic Rhino. Kaziranga is also the home of swamp deer, hog deer and elephants. The biosphere reserve, Manas National Park is the home of golden langur and pigmy hog.

b) Ex-situ Conservation:

Ex- situ conservation is the conservation of plants and animals away from their natural habitat. This could be in zoological parks and botanical gardens or through the forestry institutions and agricultural research centres. A lot of effort is under way to collect and preserve the genetic material of crops, animal, bird, and fish species. This work is being done by institutions such as the National Bureau of Plant Genetic Resources, New Delhi, the National Bureau of Animal Genetic Resources, Karnal, etc.

National Conservation Strategies:

India has several Acts in force which have a bearing on the conservation of biodiversity. Some of these Acts are:

Environment Protection Act, 1986: This act relates to general measures to protect the environment, such as restriction on industrial and other processes or activities in specified areas. It also deals with prevention of and control over the manufacture, use, release and movement of hazardous substances.

Forest (Conservation) Act, 1980: This act primarily focuses on prohibiting or regulating non forest use of forest lands.

Wildlife (Protection) Act, 1972, and Wildlife (Protection) Amendment Act, 1991: These deal with restriction and prohibition of hunting of animals, and with the protection of specified plants. They also deal with the setting up and management of sanctuaries and national parks, setting up of the central zoo authority, control of zoos and captive breeding. They also control trade and commerce in wild animals, animal articles and trophies.

Questions

1. Define the term biodiversity.
2. Explain with suitable examples – genetic diversity, species diversity and ecosystem diversity.
3. What are value of biodiversity ?
4. What is consumptive value ?
5. What is productive value ?
6. What are major threats to biodiversity ?
7. What are Ex-situ and In-situ conservation of biodiversity ? Give examples of each.
8. What is biopiracy ?
9. Mention two conservation strategies in our country.
10. In which year the Earth Summit was held ?

Natural Resources

The world we live in is full of variety of resources. The welfare and development of human civilization largely depend upon these resources. Since these resources are obtained from nature, so they are called natural resources. It is possible to obtain valuable goods from any resource. Thus land, water, air, minerals, coal, forest, wildlife etc are natural resources.

The natural resources are of two kinds:

- a) Renewable resources
- b) Non-renewable resources

a) Renewable resources: Renewable resources are resources that are in-exhaustive and can be regenerated within a given span of time e.g. solar energy, forest, wildlife etc. Though many renewable resources do not have a rapid recovery rate, these resources are susceptible to depletion by over-use e.g. forest, groundwater etc

b) Non-renewable resources: Non renewable resources are resources that are available only in finite quantities e.g. fossil fuel like coal, petroleum, minerals etc. Once we exhaust these resources, the same can not be replenished.

Different types of natural resources

The different types of natural resources are -

- 1) Forest resources
- 2) Water resources
- 3) Land resources
- 4) Mineral resources
- 5) Food resources
- 6) Energy resources

1) Forest resources

About 1/3rd of the world's land area is covered by forests. The green forest not only provides us all sorts of essential commodities but gives us a number of ecological services. Forests provide us with commercial goods like timber, wood, food items, fuel, fodder, medicines, drugs and many more. But we have to acknowledge the non commercial services offered by the green forests.

- The green forests produce oxygen by photosynthesis which is very vital for life on earth.
- During photosynthesis, green plants absorb carbon dioxide from the atmosphere and thus reduce the global warming problem.
- The forests give shelter to millions of life forms starting from the insects to the huge wild animals.
- It retards soil erosion.
- It regulates local climatic condition and hydrological cycle.
- There are certain plants which can absorb many toxic gases and act as pollution indicators.

Major causes of deforestation in NE India

- 1) Timber industry
- 2) Conversion from forest to agricultural land
- 3) Infrastructure development like roads, bridges, industries etc
- 4) Encroachment by illegal immigrants
- 5) Illegal extraction of forest products
- 6) Poaching of wild animals in the forest.

2) Water resource

Water can be regarded as the most important resource on earth because life is impossible without water. The earth has a reserve of

75% water of which 97% is of saline nature and only 3% is fresh water. Of this small fraction, most of this fresh water is locked in the polar ice caps and only 0.003% is readily available to us in the form of groundwater and surface water.

Water resource of North east India

North east India is relatively rich in fresh water resource. Average annual surface water potential of 585.6 km³ has been assessed in this region, which is highest among all the river systems in India and fifth in the world. Out of this, 24.0 km³ is utilizable water and is merely 4.1% of annual surface water potential. North-East India receives high rainfall of an average of 2000 mm a year with a maximum of 11000 mm in Cherrapunjee, Meghalaya. Although monsoon rainfall is heavy, the people of the northeast also suffer from acute water shortages in dry season every year. The geological formations often do not retain water, runoff is rapid, and springs and small streams soon dry up when there is no rain.

Ground water resource is high only in the plains. Ground water of both shallow and deeper aquifers is suitable for irrigational and industrial purposes. It has low content of dissolved minerals. Assam has the highest groundwater potential among the northeastern states.

All the perennial rivers of NE India originates from the Himalayan glaciers including the mighty Brahmaputra. These rivers with its hundreds of tributaries are a major source of fresh water in the hilly terrains of the NE. NE India also has large amount of wetlands. More than 3,500 wetlands cover 101,232 hectares in the Brahmaputra valley. In Manipur, there are about 155 wetlands covering an area of 52,959 hectares, of which Loktak Lake (6,475 hectares) is one of the largest freshwater lakes in India. The Barak valley has a number of floodplain wetlands harbouring a great variety of aquatic macrophytes. There are more than 10 natural lakes in Sikkim.

Conservation of water

Water being the one of the most precious and indispensable natural resources, appropriate techniques should be adopted for its conservation. The following steps may be taken in this regard -

1. Rainwater harvesting
2. Decreasing runoff losses
3. Reducing evaporation losses
4. Reuse of water
5. Preventing wastage of water
6. Controlling water pollution
7. Implementation of strict laws
8. Organization of awareness programmes

3) Land Resource

Land is a finite and valuable resource upon which we depend for our food, fibre and fuel wood, the basic amenities of life. About 200-1000 years are needed for the formation of one inch or 2.5 cm of soil.

Causes of degradation of soil

- 1) Soil erosion: Loss of top soil
- 2) Waterlogging: Accumulation of excess water under the ground
- 3) Salinization: It is the accumulation of soluble salts of sodium, magnesium and calcium in soil to the extent that soil fertility is severely affected.
- 4) Contamination of soil with industrial waste like heavy metals, pesticides, fertilizers etc

Conservation of land resources

- 1) Soil erosion can be minimized by afforestation in the hilly slopes

- 2) Use of pesticides and fertilizers should be banned and organic fertilizers should be encouraged
- 3) Proper disposal of industrial waste is a must
- 4) Cultivation of traditional crops variety in a region should be encouraged

4) Mineral Resources

Minerals are naturally occurring inorganic, crystalline solids having definite chemical composition and characteristic physical properties. The most common minerals of our daily use are iron, coal, zinc etc. It is used in several purposes like industrial plants and machineries, generation of energy (coal, uranium), construction purposes, jewellery etc.

Minerals can be of three types

- 1) Metallic minerals: e.g. bauxite, copper pyrites, haematite, galena, zinc blende etc
- 2) Non metallic minerals: e.g. graphite, diamond, quartz, feldspar etc.
- 3) Energy generating minerals: Coal, petroleum and uranium.

India's mineral resource is sufficiently rich and can provide the country with strong industrial base. India is rich in metallic minerals of the ferrous group such as iron-ore, manganese, chromite and titanium. But the reserves of petroleum and some other non ferrous metallic minerals e.g. copper, lead, tin, graphite, zinc are inadequate.

Mineral resources of NE India

North eastern region of India is a treasure home of valuable mineral resources. Meghalaya is famous for uranium, coal and limestone. Assam is widely known for its mineral resources. The exploration of minerals in the state comprises mainly petroleum

(crude), natural gas, coal and limestone. Oil and Natural Gas Commission (ONGC) is the most profitable public sector organization in the State. Assam is endowed with varieties of other minerals such as sillimanite, base-metals, beryl, building and road metals, asbestos, fire clay, kaolin, fuller's earth, mica, quartz, dolomite etc. But the extraction of most of these minerals is not economically viable at present. The gold extraction from the river Subansiri dates back to earlier than eighteenth century.

Conservation of natural resources

Continuous increase in population causes an increased demand for resources. This creates a situation where the valuable resources may come to an end after some decades. Conservation means the use of natural resources frugally and without wastage. It is the use of resources prudently avoiding overuse, misuse and untimely use.

Questions

1. What do you mean by natural resources ?
2. What are the different types of natural resources ?
3. What are renewable and non-renewable natural resources ?
Give examples.
4. Mention the ecological services of the green plants.
5. Name the national parks of Assam.
6. Give 5 names of wildlife sanctuaries of Assam.
7. Name the great wetland of Manipur.
8. Mention two conservation measures for land resources.
9. Mention the mineral resources of NE India.
10. Mention a few water conservation measures.

Introduction

The world today is confronted with the great problem of environmental degradation and pollution. Different types of pollution, fast depleting forest resources, rapid population explosion, expanding industrialization, unplanned urbanization, mining, soil erosion etc have created ecological imbalances in recent years. Man's quest for economic development has been mainly responsible for the ruthless exploitation of natural resources.

The environmental pollution, in fact, started with the increase of human population and considering the mythological suggestion that the process of Adam and Eve who ate an apple and threw away the peels, which led to the beginning of environmental pollution. Subsequently it accelerated with the development of socioeconomic activities such as industrialization, urbanization, transportation, modern agricultural practices etc. With growing population, requirement of foodgrains and other consumer items increased greatly leading to vast environmental degradation. As long as the assimilation capacity of receiving water system, land, air etc was more than the population load, the importance of environmental pollution was not really appreciated. But today, the situation has been completely reversed. The rapid strides in technology and unprecedented population growth have depleted the earth's natural resources with respect to quality and quantity. The unchecked population growth and increasing demands consequently taxing more and more the finite or limited resources of the earth. This also leads to environmental pollution. Moreover highly materialistic, greedy and luxurious life style attitude of human race indiscriminately exploited or imprudently destroyed the natural resources.

The term pollution:

The word pollution derived from the Latin word pollutionem (meaning to make dirty) is the unfavourable alteration of our environment largely because of the anthropogenic or human activities. More precisely, pollution is an undesirable change in physical, chemical and biological characteristics of air, water and soil that may harmfully affect man, animal, other living organisms or property.

Different types of pollution:

1. According to environment – When different segments of the environment are affected by pollution, they may be categorized as
 - a. Air pollution
 - b. Water pollution
 - c. Soil pollution
2. According to pollutant – Pollution caused by pollutants may be of different types such as
 - a. Thermal pollution
 - b. Noise pollution
 - c. Radioactive pollution
 - d. Solid waste pollution
 - e. Oil pollution
 - f. Industrial pollution
 - g. Marine pollution

Pollutant and contaminant

Pollutant : A substance present in nature, in greater than natural abundance due to human activities, which ultimately has a detrimental effect on the environment. Examples – Carbon monoxide, sulphur dioxide, arsenic, fluorides, lead, cadmium etc

Classification of pollutants

Pollutants may be of two types – primary and secondary on the basis of their forms they exist in environment after their release.

Primary pollutants : These pollutants are released directly from an identifiable source and exist as such in the environment. Examples - oxides of sulphur, oxides of nitrogen, hydrocarbons etc

Secondary pollutants - These pollutants are derived from the primary pollutants by chemical reactions or by natural causes. Example – hydrocarbons and nitrogen oxides react in presence of sunlight to form peroxy acetyl nitrate (PAN) as secondary pollutant.

Contaminant : A substance which does not occur in nature, but is introduced by human activities into the environment. Contaminant is also a pollutant. Example - Fluorine from chlorofluorocarbons, food additives, paints etc.

Causes of environmental Pollution

Both natural and anthropogenic activities are responsible for environmental pollution, but the impact of the latter is severe and sometimes irreversible. Sometimes the natural causes may also be more dangerous.

Natural	Earthquake, volcanoes, eruption, excessive rainfall (flood), landslides, storms, weathering of rocks etc.
Anthropogenic or Man made	Population increase, deforestation, industrial and automobile exhausts, burning of fossil fuel, war, construction works

Air pollution

Air pollution may be defined as the presence of one or more pollutants/contaminants like dust, smoke, mist, odour, suspended particulate matter (SPM) etc in the atmosphere which are injurious to human being, plants and other animals or which unreasonably obstruct the comfortable enjoyment of life and property.

Air pollution may be described as “ the imbalance in quality of air so as to cause adverse effects on the living organisms existing on earth ”

The presence of one or more contaminants in the atmosphere in such quantity and for such duration as is injurious or tends to be injurious to human health or welfare, affect other animal or plant life may be called air pollution.

Sources of air pollution :

Air is never found absolutely clean in nature. Pollution of air started from the very moment when the primitive men knew how to make fire.

Major sources of air pollution can be of two types-

1. Natural sources
 - a. Volcanic eruption : releasing poisonous gases like SO_2 , H_2S , CO etc
 - b. Forest fires: In the areas of tropical region throughout the year forest fire is a common feature. Very large quantities of smoke and particulate matter are liberated during their breakout.
 - c. Decomposition of organic and inorganic substances: Methane gas , carbon dioxide are released into the air
 - d. Dust : Dust is always present in the atmosphere in varying amount.
 - e. Pollen grains of flowers : The pollution is also caused by the production of pollens in the spring season. Pollens or aeroallergens enter the atmosphere from weeds, grasses and trees. They are mainly responsible for causing allergy.

- f. Fungal spores: Micro-organisms such as algae, fungi, bacteria, yeasts, rusts, spores etc are present as variable particles in the atmosphere.
- g. Radioactive materials : The radioactive minerals present in the earth crust and action of cosmic rays from outer space on gaseous constituents of the atmosphere are mainly responsible for radioactivity of the atmosphere

In the lower atmosphere the natural chemical reactions lead to the conversion of gases or vapours into solid and liquid products by oxidation, reduction, combination, combustion, condensation or polymerization processes etc. In the upper atmosphere the photochemical reactions may undergo breakdown to the more complex molecules by absorption of high energy UV solar radiation.

- 2. Man made sources-
 - a. Deforestation
 - b. Burning of fossil fuels
 - c. Emission from vehicles
 - d. Rapid industrialization
 - e. Modern agricultural practices

Deforestation :

Forests are one of the most important natural resources on this earth. Covering the earth like a green blanket, these forests not only produce innumerable material goods but also provide several environmental services which are essential for life.

But it is a matter of concern that almost everywhere the forest cover has declined to a great extent. Deforestation is going on in full swing due to population increase, shifting cultivation, fuel requirements, raw materials for industries, developmental projects, growing food needs, overgrazing etc. which has far reaching consequences such as global warming and climate change, loss of soil fertility, loss of biodiversity etc.

Vehicular emissions :

It is the most dangerous form of air pollution. In spite of introducing stringent laws, adopting new standards, changing the fuel characteristics, modifying the design of vehicles etc studies reveal that vehicular pollution is increasing day by day.

The principal pollutants emitted by vehicles are –

Carbon monoxide (CO)

Hydrocarbons (HC)

Oxides of nitrogen (NO_x) and

Suspended particulate matter (SPM)

Petroleum based vehicles also emit polynuclear aromatic hydrocarbons and aldehydes in trace amounts. Depending upon the sulphur content of the fuel, varying amount of sulphur dioxide (SO₂) may also be emitted. In addition the exhaust gases from petrol based fuel vehicles also contain lead particles and sometimes lead compounds because of the addition of tetraethyl lead. Diesel vehicles contribute more NO_x and particulate matter.

The pollution load from vehicular exhausts depends on

- characteristics of the fuel
- efficiency of combustion
- types of engine used
- age of the vehicle
- congested traffic
- poor road condition
- outdated automotive technology etc

Prevention & Control of Vehicular Pollution :

- Upgrading the fuel quality and use of cleaner fuel
- Reduction of lead content in motor fuel
- Enforcement of emission standards for vehicles
- Public transport facilities
- Improvement of roads and traffic systems
- Modification of internal combustion engines (high technology)

Burning of fossil fuels :

The industries need fossil fuels like coal, wood and petroleum for energy which is used to drive machines and for many other purposes. The imperfect burning of these fuel produces smoke which contains

- Fine particles less than 100 μ in diameter : These are carbon particles, metallic dust particles, resins, tars, aerosols, solid oxides, sulphates, nitrates etc.
- Coarse particles which are over 200 μ in diameter
- Nitrogen oxides

- Halogens
- Radioactive substances.

Major fuel burning sources are automobiles, thermal power plants, industrial processes etc. Burning of fossil fuels such as coal, petrol, diesel in thermal power plants produce about 2/3 rd of sulphur dioxide present in air.

Rapid industrialization :

Industrial processes like chemical plants, metallurgical plants, smelters, pulp and paper mills, cotton and textile mills, petroleum refineries, synthetic rubber manufacturing plants etc produce about 20 % of air pollution.

In factories and mines around the world hundreds of thousands of workers are daily exposed to a large variety of toxic or poisonous substances that lead to deadly diseases as silicosis, foetal disorders, paralysis, skin allergies, pneumoconiosis etc. In textile industries workers constantly inhale cotton dust. Similarly in a flour mill,



workers constantly inhale flour dust, asbestos dust in asbestos manufacturing mills, silica dust in factories making bangles and glass wares etc.

Sinks of atmospheric gases:

Oceans as well as vegetation are the most important sinks for most atmospheric gases. Sink is a medium which is capable of retaining and interacting with a long lived pollutant, though not necessarily indefinitely. The gases widely dispersed in the troposphere, find oceans as the ready sinks. The gases diffuse to the surface of the oceans cross the gas liquid interface and finally go into the bulk of the oceans.

Plants (vegetation) are also capable of taking up the atmospheric gases without active metabolism. Some plants have the capacity to metabolise the gas resulting in creating an optimum concentration gradient for further absorption. In addition, there are a number of other sinks also. For example, limestone acts as the sink for atmospheric acids. Major carbon monoxide (CO) sinks are some soil micro-organisms.

Classification of air pollutants:

Air pollutants are generally classified into the following categories –

Pollutants	Sub classes	Examples
1. Gases (inorganic)	Oxides of nitrogen	Nitric oxide (NO), nitrous oxide (N ₂ O), nitrogen dioxide (NO ₂)
	Oxides of Sulphur	Sulphur dioxide (SO ₂), sulphur trioxide (SO ₃)
	Oxides of Carbon	Carbon dioxide (CO ₂), carbon monoxide (CO)

	Other inorganic compounds	Hydrogen sulphide, ammonia, chlorine etc.
Gases (organic)	Hydrocarbons	methane, ethane, ethene, ethyne, benzene etc
	Aldehydes & Ketones	formaldehyde, acetone etc
	Other organic compounds	Chlorinated hydrocarbons, alcohols etc
2. Particulates	Solid	Dust, smoke, fumes, flyash
	Gases	Mist, spray

Outdoor air pollutants :

- Vehicles are the sources of the highest amount of pollutants
- Immoderate chemical substances
- Particulates
- Sulphur-di-oxide
- Carbon monoxide and carbon-di-oxide
- Ozone
- Lead

Indoor air pollutants :

Indoor air pollution, a major health problem in industries, has now been recognized as significant pollution at homes and offices in urban areas. Pollution from air conditioners, gas stove smoke, building materials,



furnishing, photocopies are increasingly found to cause allergy, asthma, diseases of the skin, lungs and respiratory tract. Prolonged exposure to oxides of nitrogen from gas stoves may damage the lungs and increase susceptibility to respiratory infections.

Volatile Organic Compounds (VOC) like formaldehyde from paper products, carpets, floor coverings, adhesives and resins may cause irritation in mucous membranes, headache, fatigue etc.

Air pollutants, their sources and effect on man

	Air pollutant	Sources of production	Effects on man
1.	Sulphur-dioxide	Coal & oil combustion	Causes chest constriction, headache, vomiting, death from respiratory ailments
2.	Nitrogen oxides	Soft coal & automobile exhausts, unvented gas stove, kerosene heaters, wood stoves	Headache, drowsiness, irritated lungs, childrens colds Inhibits cilia action so that soot and dust penetrate far into the lungs
3.	Carbon monoxide	Burning of coal, gasoline, motor exhausts, faulty furnaces, unvented gas stove, kerosene heaters, wood burning	Causes nausea, reduces oxygen carrying capacity of blood, Headache, drowsiness, irregular heartbeat

4.	SPM ash, soot smoke etc.	Incinerators & every manufacturing processes	Causes eye irritation, emphysema, cancer
5.	Hydrogen sulphide	Refineries, chemical industries, bituminous fuels	Causes nausea, irritation of eyes and throat
6.	Ammonia	Explosives, dye making, fertilizer plants	Inflames upper respiratory passages
7.	Phosgene or carbonyl chloride	Chemical and dye making	Induce coughing irritation and fatal pulmonary edema
8.	Aldehydes	Thermal decomposition of oils, fats or glycerol	Irritate nasal and respiratory tracts
9.	Suspended particles	Incinerators and almost every manufacturing process	Cause emphysema, eye irritation, cancer
10.	Asbestos	Pipe insulation, vinyl ceiling floor tiles	Lung diseases, lung cancer

Prevention and control of air pollution

Chemists always have to play a key role in protecting the environment from the adverse affects of the chemicals. The chemists have to think of the following points while involved in manufacturing different chemicals or design some new pathways for synthesis of chemicals.

- Synthetic methods should be designed to maximize the incorporation of all materials used in the process into the final products.
- Wherever practicable, synthetic methodologies should be designed to use and generate substances that possess little or no toxicity to human health and the environment.
- It is better to prevent waste than to treat or clean up waste after it is formed.
- The use of auxiliary substances (eg. solvents, separation agents etc) can be avoided wherever possible
- Energy requirements should be minimized.
- A raw material for feedstock should be renewable rather than depleting.
- They should encourage plantation programme in the industrial site in particular.
- Less polluting fuels should be used.
- Use of non conventional sources of energy should be encouraged.
- Proper Environmental Impact Assessment for any developmental work must be done.
- Strict rules and regulations can help in controlling air pollution.

Water Pollution :

Water pollution may be defined in a number of ways –

- Alteration in physical, chemical and biological characteristics of water that may cause harmful effects on man and other aquatic biota.

- Addition of excess of undesirable substances to water that make it harmful to man, animal and aquatic life or otherwise cause significant departure from the normal activities of various living organisms in or around water.

Sources of water pollution

The following sources have been identified as the sources of water pollution

- Domestic wastes
- Industrial effluents
- Agricultural wastes
- Run off from urban areas
- Soluble effluents
- Oil spills
- Seepage pits
- Refuse dumps
- Solid wastes
- Thermal pollutants
- Radioactive nuclides
- Particulates and atmospheric gases
- Infectious agents etc



Fig. Water pollution due to industrial effluents

Problems associated with drinking water

Man needs water for drinking, cooking, washing, bathing, gardening, irrigation, industry and for a lot of other purposes. The quality of water used by man for various purposes varies widely and what is satisfactory for one purpose may not be so for another. Water for human consumption must be free from pathogenic microorganisms and other substances which are hazardous to health. A water sample is normally rejected for drinking purposes if it is highly turbid, highly coloured or has an objectionable taste, but the absence of these adverse sensory effects does not guarantee the safety of water for drinking. The enormous pressure exerted by rapidly increasing population, massive industrial activities, modern agricultural practices have resulted in discharge of a very large amount of pollutants to the

water bodies. The problem is particularly manifested as the fresh water suitable for drinking purposes is in very short supply.

Contamination of drinking water, either directly or indirectly by sewage and other wastes or by human or animal excrement is the most common and widespread danger associated with water quality problem particularly in the underdeveloped world. Faecal pollution leads to introduction of a variety of intestinal pathogens – bacteria, virus and parasites – causing diseases starting from mild gastroenteritis to severe and fatal dysentery, cholera or typhoid. When drinking water is contaminated with sewage, gastroenteritis and infectious hepatitis may occur in epidemic proportion. Other diseases like rashes, fever, myocarditis, meningitis, respiratory diseases etc. are also likely. Protozoic diseases like amoebiasis, giardiasis may also occur through sewage contamination of water sources.

The chemical contamination do not cause immediate, acute health problems unless they are present in massive quantities through some accident. However, these are important in this respect that after prolonged period of exposure to them, they can do considerable harm by being cumulative poison and carcinogens.

It is generally thought that undesirable constituents in water will affect the appearance, smell or the taste of the water and a person can evaluate the acceptability of the water sample with his senses. This is no longer true. No water sample can be termed as safe if it is not subjected to rigorous test. Such tests particularly for drinking water are still in the infant stage in Assam.

Access to safe drinking water is vital for healthy life, also basic human right and accordingly considered as component of all holistic plans through out the globe for health protection. The importance of water, sanitation and hygiene for health and development has been reflected in the outcomes of a series of international policy forums and environment related protocols.

Water contamination

The most common and widespread health risk associated with drinking water is microbial contamination, the consequences of which mean that its control must always be of paramount importance,

because microbial contamination of major urban systems has the potential to cause large outbreaks of water borne diseases. Discharge of untreated sewage and agricultural waste waters, effluents from the industries, dumping of solid wastes, oil spills from giant oil tankers, mining operations etc are responsible for the contamination of the drinking water sources.

Water borne diseases

Diseases caused by ingestion of water contaminated by human activities or animal excreta, which contain pathogenic micro-organisms. Contaminated surface water sources and poorly maintained municipal water distribution systems contribute to transmission of water borne bacterial diseases. Brewery, dairy and distillery organic load, dyeing, leather tanning, textile colour, organic load, heavy metals etc can also affect water quality.

Common water borne diseases

- a. Typhoid – salmonella typhi
- b. Cholera - vibrio cholerae
- c. Dysentery – shigella
- d. Diarrhoea – cryptosporidium
- e. Giardiasis - giardia lamblia
- f. Diarrhoea – e coli
- g. Gastroenteritis – viruses
- h. Polio – polioviruses

Safe Water :

Any kind of water is not safe for drinking unless chemical test is carried out. Safe water is suitable for household activities along with personal cleanliness. Packaged water should be used for drinking. In some special activities like dialysis (medical sector), cleaning contact lens or food processing and manufacturing medicines, highly sophisticated water is essential.

Which water is unfit for drinking?

Untreated water is not safe for drinking. If water samples collected from hand pumps, ring wells and tapes are found highly coloured with objectionable taste, highly turbid, high iron content,

normally these are not fit for drinking. If the ranges of the water quality parameters are above the permissible level, then also it is not fit for drinking.

What we can do ?

The following suggestions can be made to improve the quality of drinking water at the community as well as at the individual level. Since cost is less so these are quite acceptable even to family with lower income.

- (a) Common filtration process using sand, stone and charcoal should be carried out as the first treatment.
- (b) High turbidity and iron can be removed by alum treatment and improved filtration technique at least in rainy season.
- (c) Hardness can be softened by boiling. This process also kills bacteria.
- (d) Disinfection with chlorine should be done to minimize bacteriological contamination.
- (e) Defluoridation technique using low cost bio absorbent can be encouraged.
- (f) Boiling of drinking water is highly essential.

Protective measures

To keep drinking water sources clean and safe the following measures should be adopted:

- (a) **Location:** Water sources should be on a higher location at least 10m to 15 m away from polluting sources like latrine, soak pit, garbage etc.
- (b) **Platform:** A cement concrete platform around the tube wells and ring wells extending 1m in all directions having gentle slope outwards towards a drain should be built. These platforms should be free from cracks and damages.
- (c) **Drain:** Water sources should have sound drainage systems to check stagnancy. Waste water should not be allowed to accumulate in these areas.

- (d) **Covering:** The mouth of a ring well should always be covered at all times to prevent foreign materials from entering it.
- (e) **Lining:** The lining of a ring well should be built of stones set in cement upto a depth of at least 6m so that water enters from the bottom and not from the sides.

Soil Pollution :

Soil is the upper most part of the earth crust and is a mixture of organic as well as weathered rock and materials necessary for the plant growth. Soil system is indeed very complex and dynamic. It is formed as a result of long term process of complex interactions, disintegration and decomposition of rocks due to weathering leading to the production of mineral matrix in close association with interstitial organic matter. Dumping of various types of specially domestic and industrial wastes, application of pesticides in the agricultural fields etc make the soil polluted. Even the fertility of soil decreases due to addition of a number of different types of toxic materials.

Sources of soil pollution :

The following sources have been found to be responsible for soil pollution

- a. Industrial wastes
- b. Urban wastes
- c. Agricultural practices/wastes
- d. Municipal wastes
- e. Radioactive pollutants
- f. Biological agents

Effects of soil pollution

- a. Industrial wastes consist of a variety of chemicals which are extremely toxic. Chemicals like acids, alkalis, pesticides (weedicides, fungicides, insecticides, rodenticides), heavy metals etc affect soil fertility and ultimately affect human health.
- b. Some of the persistent toxic organic chemicals inhibit the non-target organisms, soil flora and fauna and reduce soil productivity. These chemicals accumulate in food chain and ultimately affect man and other animals.

- c. Sewage sludge has many types of pathogenic micro-organisms which may cause various diseases. Varieties of soil transmitting diseases like giardiasis, tetanus etc are caused by soil pollution.
- d. Nitrogen and phosphorus from the fertilizers in soil reach nearby waterbodies with agricultural run off and cause eutrophication.
- e. The problem of radioactive wastes dumped into the soil is more complicated. This is so because every radioactive element like radium, uranium, thorium, plutonium etc can remain active in soil for thousands of years. Since radioactive wastes are produced in huge quantities and have higher activation energy, they create an extremely difficult public health problem.

Control of soil pollution

- a. Industrial effluents should be properly treated before discharging them on the soil.
- b. Solid wastes should be properly segregated as biodegradable and non biodegradable wastes at source and then disposed off by adopting effective scientific methods.
- c. Use of bio-fertilizers should be encouraged instead of chemical fertilizers.
- d. Application of pesticides should be controlled.
- e. Bioremediation can be adopted for degradation of toxic chemicals present in soil.
- f. Necessary enactment of laws should be made for panel action against those who are involved in polluting soil.
- g. Awareness should be created among the people.

Noise Pollution :

We hear various types of sounds every day. Crowded cities, various means of transportation systems, new mechanisms of recreation and entertainment etc are dumping different types of sounds to the environment and people have to talk about the ill affects of these sounds. A particular sound may be musical to one but noise for another. A sound may be pleasant when soft, but noise when loud.

So noise pollution has become an important matter of concern specially in the urban environment.

Noise pollution may be defined in a number of ways -

Any unwanted electromagnetic signal that produces a displeasing effect and which interferes with human communication, comfort and health is termed as noise pollution.

Noise pollution is the unwanted sound dumped into the environment without regard to the adverse effect it may have.

Sources of noise pollution

The sources of noise pollution may be

- a) Natural
 - b) Man-made
- a) **Natural** : The natural source of noise pollution is thunder.
- b) **Man-made** : Noise pollution is mainly caused by the different activities of man. The automobiles such as trucks, buses, scooters, fire extinguisher vehicles, police vans, ambulances etc, the trains, the aeroplanes, industries, factories, loud speakers, musical instruments, sirens, blast of explosions etc produce unwanted sounds. During dewali, people of all ages enjoy with firecrackers. The noise produced by the crackers exceeds the permissible level. During the other festivals people use different forms of noise producers.

Effect of noise pollution

The effects of noise pollution may be auditory effects or non-auditory effects.

a) Auditory effects:

The most acute and immediate effect of noise pollution is the impairing of hearing which may cause auditory fatigue and finally lead to deafness.

b) Non-auditory effects:

The non-auditory effects are also equally serious. It includes interference with speech communication, annoyance leading to ill temper, mental anxieties, mental stress, bickering and violent behaviour. Noise pollution affects human health, disrupts comforts

and working efficiency. Excessive noise pollution causes psychological disorder.

Pollution from Solid Wastes

Solid wastes are all the wastes produced by household, commercial, institutional, agricultural, mining and industrial activities and are discarded as useless or unwanted. An apt definition of solid waste is “ materials in the wrong place”, implying that a material becomes waste only when a specific owner ceases to have a use for it. With rapid urbanization, industrialization, population growth and increasing economic standard, the solid waste has become a serious threat in recent years and the situation is going to be worse in coming years if appropriate measures are not taken immediately. Dumping the wastes as a waste has two-fold negative implications. On the one hand, it pollutes the air, water and land resulting in diseases and



Fig. Impact of Solid waste on environment

destruction of human habitat, while on the other hand, it deprives us of a powerful resource material for producing energy, electricity, manure etc. A commercially viable technology suited to deal with they content of the waste material can put this double-edged weapon in the service of human race and natural habitat.

The problem of solid waste management encompasses both the urban and rural spheres. This malaise needs to be looked into and considered urgently, lest it should become an uncontrolled proportion

in the near future, threatening the generations to come. The day-to-day management of municipal solid waste is a complex and a costly task. Direct activities that must be considered and coordinated on a daily basis include the generation rates, collection, storage, transfer and transport, processing and disposal of wastes. These activities are associated directly with the management programme which include – financing, operations, equipment and personnel, cost involved and budgeting, contact administration, ordinances and guidelines, public communications and public awareness. In short, the solid waste management imbibe in itself the (a) effective refuse of the solid wastes (b) determining a substitute technology toward recycling of solid wastes, with due consideration given to the economic constraints and environmental aspects.

Environmental effects of solid wastes :

Solid waste has the potential to degrade the air, water and the soil. There are potential risk to health and to the environment from improper handling of solid wastes. Direct risks concern mainly the workers in the field, who need to be protected , as far as possible, from the skin contact with the waste. There are also specific risk in handling wastes from hospitals and clinics.

For the general public, the main risk to health are indirect and arise from the breeding of disease vectors, primarily flies and rats. Improper storage and disposal provide the condition under which these risks arise. It also helps in inducing health hazards like plague, dengue, cholera etc. Garbage burning contributes significantly to urban air pollution. Using water polluted by solid waste for bathing, irrigation and drinking can also cause diseases like skin infections.

The other environmental damage caused by solid wastes is aesthetic – ugliness of street litter and the destruction of the beauty of countryside by uncontrolled dumping of city wastes. More serious and often unrecognized is the transfer of pollution to water bodies which occurs when the leachate from a refuse dump enters surface water or ground water. Air pollution may be caused from the inefficient burning of waste. Industrialization introduces the dangers of hazardous wastes. Improper disposal of such wastes results in the death of humans and other animals.

The present practice of solid waste disposal in different cities and towns is highly unscientific and poses a lot of environmental problems such as

- open dumps are malodorous places in which disease carrying vermins such as rats and flies proliferate
- methane gas is released into the surrounding air due to decomposition of solid wastes by the micro-organisms.
- liquid that oozes and seeps through solid waste heap ultimately find its way into the soil, surface water and ground water.
- hazardous materials dissolved in this liquid contaminate underground water and soil strata
- the solid waste is highly heterogeneous and is not being segregated at any stage. It includes wastes from industries, hospitals and nursing homes, domestic waste etc.
- the leachate consisting of a variety of chemical constituents seeps and pollute the ground water.
- absence of landfill liners aggravate the problem furthermore.
- health hazards faced by the residents living in the nearby areas of dumping sites can not be ignored.
- the present practice of collecting solid waste from the individual houses results in wastage of time and thereby increases the cost of collection.
- transportation of collected solid wastes openly by the tractors or trucks is unhygienic and the aesthetic look of the city is also affected.

Questions

1. What do you mean by environmental pollution? Name the different types of pollution.
2. What is air pollution ? Identify the sources of air pollution.
3. Mention few effects of air pollution on human health.
4. What is water pollution ? What are the effects of water pollution on human health ?
5. What is soil pollution ? How can it be controlled ?
6. What are solid wastes ? How are they classified ? Give examples.
7. Discuss the environmental effects of solid wastes.
8. Mention two methods of solid waste management.
9. What is noise pollution? Write two probable effects of it on human health.
10. What measures can be taken to keep drinking water sources clean and safe?

Concept of Sustainable Development :

The burgeoning population, rapid urbanization and accelerated rates of industrialization in recent times have brought about tremendous pressure on land, water and other natural resources leading to deterioration of environmental quality, loss of life forms and depletion of vast natural resources. Deterioration of the environmental quality and economic growth and development are inextricably linked. Towards the later part of 20th century, there emerged a new concept called sustainable development where the issue of environmental safety are taken care of in the development plan itself. Today, the need for maintaining balance in nature or environmental quality through the concept of sustainable development is emphasized by conservationists, environmentalists, planners and decision makers alike.

The concept of sustainable development has gained much importance since the publication of Brundtland Report, Our Common Future, in 1987 under the auspices of the World Commission on Environment and Development (WCED, 1987). According to Brundtland, sustainable development is “development that meets the need of the present without compromising the ability of the future generations to meet their own needs”. G.H.Brundtland was the Norwegian Prime Minister as well as the Director of World Health Organization (WHO). WECD maintains that sustainable development is a process of change in which exploration of resources, the direction of investment, the orientation of technological advancement and institutional changes are made consistent with future as well as present needs. It also includes social and economic development in one hand, and the maintenance of the environment on the other. It is based on improving the quality of life for all.

The concept got further boost and greater attention since the United Nations Conference on Environment and Development

(UNCED), popularly known as the ‘Earth Summit’ held in Rio de Janeiro in June, 1992. The UNCED came up with several documents including Rio Declaration on Environment and Development that listed 27 principles of sustainable development, the agenda 21 which is a detailed action plan for sustainable development in the 21st century and the convention on Biological Diversity.

Energy Utilization and Conservation :

The capacity to do work is called energy. Energy can not be destroyed, it can be transformed from one form to other. Energy consumption of a country is usually considered as an index of its development. Economic development depends on per capita use of energy in a country. This is because all developmental activities are directly related to energy. Our industries, transportation systems, lighting, cooling, heating need enormous amount of energy. With the increase in population and the fast changing of lifestyle, the demand for energy also increases manifold. So let us first look at the various sources of energy wherefrom these demands can be met.

Sources of energy:

A source of energy is one that can provide adequate amount of energy in a usable form over a long period of time. These sources can be divided into two types –

- a) Renewable or non-conventional energy resources and
- b) Non-renewable or conventional energy resources

a) Renewable energy resources

These energy resources are generated continuously in nature and are in-exhaustible. For example – solar energy, wind energy, hydropower energy, geothermal energy, ocean thermal energy, tidal energy, wood, biomass energy, bio-fuels, hydrogen etc. They can be used again and again. They are the non-conventional or alternative sources of energy.

b) Non-renewable energy resources

These energy sources, accumulated in nature, have been in use since a long time and are exhaustible. Once these sources are finished, they can not be replenished quickly. For example fossil fuels (coal,

petroleum, natural gas), nuclear fuels like uranium, thorium etc. These are used conventionally to meet the energy demands of human society.

Energy Conservation ;

As stated above development in every sector depends largely on energy. The rate of energy consumption today is considered as barometer of civilization. The energy potential of a nation has direct correlation with economic growth and prosperity. The stage of development is well reflected by the per capita energy consumption of a country. But the energy crisis has led to the formulation of energy policy framework within which the rate of growth and pattern of energy consumption could be regulated and energy conservation strategies should be adopted.

Energy conservation refers to efforts made to reduce energy consumption. Energy conservation can be achieved through increased efficient energy use, in conjunction with decreased energy consumption and/or reduced consumption from conventional energy sources. Energy conservation can result in increased financial capital, environmental quality, national security, personal security, and human comfort. Individuals and organizations that are direct consumers of energy choose to conserve energy to reduce energy costs and promote economic security. Industrial and commercial users can increase energy use efficiency to maximize profit. Energy conservation supports the ecofriendly lifestyle by providing energy, which saves money and at the same time saves the earth. When we decrease the amount of energy we automatically make efforts to reduce increasing global warming.

The following measures for energy conservation can be adopted as initial steps-

- a) Shifting from the use of fossil fuels and non renewable energy resources such as petroleum, coal, natural gas, uranium etc to renewable energy resources such as solar energy, wind energy, biogas etc.
- b) More technological innovation contributing efficient energy saving.

- c) Unnecessary use of electricity should be prohibited. Switch off the street lights early in the morning.
- d) Domestic consumers can curtail energy consumption on many household goods.
- e) Industries should develop a mechanism for judicious use of raw materials for their energy needs.

Rainwater Harvesting :

Rainwater harvesting is a technique of collection of rainwater from paved or G.I. corrugated roofs and paved courtyard of houses. It is also involved in increasing the recharge of groundwater by capturing and storing rainwater. This is done by constructing special water harvesting structures like dug wells, percolation pits, lagoons, check dams etc. Rainwater harvesting is now becoming increasingly used for meeting the domestic water needs in the rural as well as urban areas particularly during the dry period.

Rainwater harvesting has the following objectives–

To reduce run off loss

To meet increasing demands of water

To reduce pressure on ground water resource

To raise ground water table by the process of recharging

Rainwater harvesting is necessary in the areas experiencing significant rainfall but lacking any kind of conventional centralized government supply of water scheme and in areas where good quality of water is lacking. North eastern region is such an area of our country which gets more than sufficient rainfall during monsoon but little or sometimes no rainfall during winter. So rainwater harvesting can play a significant role to meet the growing demands of water in this region.

Rainwater harvesting has gained tremendous interest among the academicians, institutions, environmentalists, mediapersons and even laymen in the past few years in our country Rainwater harvesting is extensively carried out in cities like Bangalore, Chennai, Madhya Pradesh, Rajasthan, Gujarat, Mumbai, Delhi etc. In NE region this is carried out in Mizoram, in some parts of Meghalaya, Arunachal Pradesh and Manipur. In some hilly areas of Guwahti city rainwater harvesting has been done at present.

Advantages of rainwater harvesting :

- It provides a source of water at the point where it is needed.
- It involves little cost and every household can easily accommodate the simple mechanism required for recycling rainwater
- Rainwater is free from the contamination of fluoride, arsenic, iron etc
- Recycling of rainwater for domestic and other uses can significantly reduce the pressure on ground water as ground water depletion has become a serious problem in many cities of the world.
- It provides an essential reserve in times of emergency or breakdown of public water supply systems.
- The technologies are simple and common people can easily be trained to build one storage tank of rainwater with a minimum cost.

Environment and Health

According to World Health Organization (WHO) health is “ a state of complete physical, mental and social well being and not merely the absence of disease or infirmity”. Human health is effected by his environment. Many factors like nutritional, chemical, physical, biological, psychological, poor living conditions etc are correlated.

Access to safe drinking water is essential to health, a basic human right and a component of effective policy for health protection. The importance of water, sanitation and hygiene for health and development has been reflected in the outcomes of a series of international and national policy forums.

More than 80% diseases in India are water related which include typhoid, cholera, hepatitis, polio, gastro-enteritis, amoebiasis, giardiasis etc. Over 4 lakh children die annually in India due to water borne diseases. The most common and widespread health risk associated with drinking water is microbial contamination. Many toxic chemicals, pesticides, heavy metals (mercury, cadmium, lead etc) are released into the water bodies and soil. These may ultimately

enter into the human body through food chain causing adverse impacts on health.

Again the industries and transportation systems release a number of gases into the atmosphere. Some of these gases (e.g. sulphur dioxide, carbon monoxide, nitrous oxide, hydrocarbons and suspended particulate matter) can cause different health effects at different levels (see unit 5). Solid waste has the potential to degrade the air, water and the soil. There are potential risk to health and to the environment. Sometimes improper housing with poor hygienic condition may cause serious health effects. This is generally seen amongst the slum dwellers in urban areas. .. Illiteracy and lack of awareness about their health and environment, poverty and large family size, poor drainage and sanitation system and absence of proper medical facilities are the main reasons for the poor health conditions of the people.

Greenhouse Effect :

The earth is the only planet in our solar system that supports life . The evolution of life on earth was possible because of the presence of unique set of environmental conditions viz. water, oxygen rich atmosphere, land and a suitable surface temperature. The earth has an atmosphere of proper thickness and chemical composition. About 30 % of the incoming energy from the sun is reflected back to space while the rest (70 %) reaches the earth, warming the air, water, land and maintaining an average surface temperature at about 15°C. During the day, energy from the sun (largely in the visible part of the spectrum) is absorbed by the earth's surface. If all this energy were to be absorbed completely, the earth would gradually become hotter. But in reality, the earth both absorbs and simultaneously releases it in the form of infra red radiations (long wavelength, less energetic). All the rising heat is not lost to space, but is partly absorbed by some gases present in the atmosphere in very small quantities, called the Greenhouse Gases (GHGs). The major GHGs are carbondioxide, methane, nitrous oxide, chlorofluorocarbons (CFCs), water vapour and ozone. These gases re-emit some of the heat to the earth surface. This effect is called greenhouse effect as it

is similar to the warming effect observed in horticultural green house made of glass.

Global warming :

Due to greenhouse effect, the average surface temperature of the earth is at about 15°C and the earth becomes hospitable for a variety of life forms. If the GHGs do not perform this function, most of the energy would escape, leaving the earth cold (about -18°C) and the earth would become unfit to support life .Heat trapped by the greenhouse gases in the atmosphere keeps the planet warm enough to allow us and other species to exist.

But due to different natural as well as anthropogenic activities the concentration of the greenhouse gases in the atmosphere has increased during the past several decades. Scientists estimate that the earth's average temperature has increases by $0.3 - 0.6^{\circ}\text{C}$ since the beginning of the last century. Ever since the industrial revolution began 150 years ago, man-made activities have added significant quantities of greenhouse gases to the atmosphere. The atmospheric concentrations of carbon dioxide, methane and nitrous oxide have grown by about 31 %, 171 % and 17 % respectively between 1750 and 2000 (IPCC, 2001)

The rise in temperature due to the blanketing effect of increased level of greenhouse gases is termed as global warming.

Climate change :

Climate is the average pattern of weather of an area and weather means the day to day atmospheric condition such as temperature, rainfall, humidity, wind, intensity of light, cloud etc. Such weather conditions which average over a long period of time, at least over 30 to 40 years is called climate.

Climate change is the statistically significant variations in the mean state of climate or in its variability over an extended period. In other words, climate change is a term used to express unexpected changes in climate such as rising temperature, changes in rainfall pattern, increased droughts, extreme colds etc. Climate change is a

complicated subject. Data measurement networks are sparse and there is a great deal of uncertainty associated with our scientific understanding of the climatic processes. Nevertheless, there is a near unanimity that the climate is indeed changing in significant ways.

Depletion of ozone layer ;

Ozone is a pale blue gas, mostly present in the stratosphere which is extended upto 50 km above the surface of the earth. Ozone strongly absorbs a large portion of sun's ultraviolet radiation and thus protects the living organisms on earth from the harmful effects of UV radiations of the sun. Only a small fraction of ultraviolet light reaches the lower atmosphere and the earth. The maximum ozone concentration is around 10 ppm in the stratosphere at an altitude of 25 – 30 km.

Now there has been much hue and cry about the destruction of ozone in the atmosphere and the issue has assumed global dimensions. The problem of ozone depletion and its adverse consequences have threatened the very existence of life on earth. The role of ozone is very crucial and significant because it acts as a protective shield in the biospheric ecosystem against their exposure to deadly and dangerous ultraviolet radiation. In the absence of this layer, all the UV rays of the sun will reach the earth's surface and consequently the temperature of the lower atmosphere will rise to such an extent that the survival of the living organisms on earth becomes impossible.

In the early 80's scientists reported a large hole in the ozone layer over Antarctica where ozone level dropped by 30 % . Subsequently a similar hole was discovered over the thickly populated northern hemisphere. This created a lot of concerns among the citizens of North Europe and USA. Again, a study by NASA scientists revealed that the amount of ozone over the northern hemisphere decreased by 3% between 1969 and 1986. Each one per cent reduction in ozone may cause as much as six per cent increase in skin cancer cases annually from exposure to UV radiation.

The main cause of the ozone layer depletion is the stratospheric concentration of man-made pollutants. The major group that stands

out are the chlorofluorocarbons (CFCs) invented in 1930s. These CFCs are widely used in a variety of goods because they are nontoxic, stable, inert, inexpensive, efficient and easy to handle. In 1950s, they were widely used as aerosol-propellants, refrigerants, cleaning solvents, plastic foams, in fast food packaging, in dry cleaning industries, for sterilizing surgical instruments, in medicinal and oral inhalation products, for cleaning and degreasing electronic equipments, in paint and varnishes industries etc. Being chemically inert they can remain in the atmosphere for more than 50 years. The CFCs are slowly released into the atmosphere and since there is no known sink for these CFCs they can exist quite for a long period. About 30 years of release, the CFCs percolate into the stratosphere and produce free chlorine atoms. These chlorine atoms are involved in destruction of ozone until these are removed from the system. Each CFC molecule acts in a catalytic fashion to destroy about 100,000 molecules of ozone.

Protective Measures to be taken :

Now time has come to ask if many traditional applications of CFCs are really necessary? Persistent efforts should be made to find better alternatives to CFCs. One promising line of substitutes seems to be Hydro-chloro-fluoro carbons (HCFCs) which have only 1/10th ozone depleting power as compared to CFCs. Helium can be used as coolant in refrigerators.

An international agreement made in 1987 at a conference in Montreal and signed by 34 countries (Montreal Protocol) called for a freeze on use of CFC and a reduction of upto 50% by the end of 2000. The world produces over 10⁹ kg of CFCs annually. Of this 67% is consumed by Western Europe and North America, while India and China use 5% at present

Today the foremost task before the world community is to reduce markedly the production and consumption of ozone destroyer CFCs. Scientists have to find out some suitable alternatives to these. To create awareness among the people regarding the dangerous effects

of depletion of ozone layer in the atmosphere, 16th September has been observed as the International day for the protection of Ozone layer since 1987. The Montreal Protocol was signed on September 16 of 1987 by more than 100 countries pledging to protect the ozone layer.

Acid rain :

Oxides of sulphur and nitrogen originating from industrial operations and fossil fuel burning are the major sources of acid forming gases in the atmosphere. When sulphur dioxide and nitrogen oxides are transported by prevailing winds, they come in contact with water vapour and form sulphuric acid and nitric acid respectively, droplets of sulphuric acid and small particulates of sulphates and nitrates. These chemical substances come down to the earth's surface in two forms – wet (as acid rain, snow, fog and cloud vapour etc) and dry (as acidic particles). The resulting mixture is called acidic deposition or commonly called acid rain..

Questions

1. What do you mean by sustainable development ?
2. What are renewable and non-renewable energy resources ? Give examples.
3. What is energy conservation ? Mention some measures for energy conservations.
4. What is rainwater harvesting ? What are the objectives of rainwater harvesting ?
5. What are the advantages of rainwater harvesting ?
6. How health may be affected by the environment ?
7. 'Population explosion is the root cause of environmental degradation' - Explain the statement.
8. What are the major greenhouse gases ? What is greenhouse effect ?
9. What do you mean by global warming ? Mention a few consequences of global warming.
10. What is acid rain ?

UNIT-2

DISASTER MANAGEMENT : RESPONSIBILITIES AND PRECAUTIONS

Introduction :

Man has a very close relation with Nature throughout the ages. But this relation of mankind with Nature does not remain cordial forever. The two factors that adversely affect the man-Nature relation are – firstly, wanton destruction of Nature by man for his selfish interest and secondly, the devastating geophysical disturbances and the sudden changes that occur in and around the earth, which are generally referred to as disasters.

Disasters may be divided into two categories – (i) Natural Disasters and (ii) Manmade Disasters.

(i) Natural Disasters : Natural disasters are the outcome of various natural calamities and geophysical changes that take place in and around the earth which take a huge toll on the lives and properties of the people. Instances of natural disasters are earthquakes, floods, cyclones, volcanic eruptions, drought, heavy rains, hailstorms, forest



Fig : Landslide at Tawang in Arunachal Pradesh

fire, heavy snowfalls, Tsunamis, etc. Natural disasters, over the ages, have played a very critical role in the life of the people and other living beings as well. The experts believe that the Harappa – Mohenjodaro civilization was ruined by natural disasters. The ancient city of Pompeii was also destroyed by the volcanic eruption of Mount

Vesuvius in 79 B.C. The unprecedented havoc caused by Tsunami in Japan, Indonesia, Thailand and India including coastal areas of 18 other countries a few years back still haunts the memory of the people.

(ii) Man-made Disasters : Industrial accidents, air crashes, train accidents, attack by terrorists, ethnic clashes, epidemics and fire-related accidents are some of the man-made disasters. The Union Carbide gas leakage tragedy in Bhopal, termed as the World's worst man-made disaster, the Chernobyl nuclear plant accident and violent attacks perpetrated by terrorist groups in places like New York, London, Paris, and in Indian cities of Mumbai, Delhi and Guwahati are some of the terrible instances of man-made disasters.



Fig : A major fire accident at Fancy bazar, Guwahati in November, 2015

Disasters both natural and man-made may have the following repercussions :-

- Complete disruption in the normal life of the people.
- Adverse impact on the emergency services.
- Interruption and shortage in the fundamental needs like foodstuff, shelter, health and communication.

A disaster, on the other hand, has the propensity to take the form of its monstrosity on account of the following reasons :-

- Unpredictability
- Unfamiliarity
- Speed
- Urgency
- Uncertainty
- Huge loss of life and property.



Fig : Cyclone at Gopalpur, Odisha

Some terrible disasters (both natural and man-made) in India since 1980 decades can be listed as follows–

SOME OF THE WORST DISASTERS IN INDIA

1	Bhopal Gas Disaster	Madhya Pradesh	December, 1984
2	Earthquake in Uttar Kashi	Uttaranchal	October, 1991
3	Earthquake in Latur	Maharashtra	September, 1993
4	Super Cyclone	Odisha	October, 1999
5	Earthquake in Bhuj	Gujarat	January, 2001
6	Floods in Koshi	Bihar	August, 2004
7	Tsunami	Kerala, Tamil Nadu, Puducherry, Andhra Pradesh, Andaman & Nicobar Islands	December, 2004
8	Earthquake	Jammu & Kashmir	October, 2005
9	Floods	Bihar	August, 2008
10	Serial bomb blasts in Guwahati	Assam	October, 2008
11	Serial bomb blasts in Mumbai	Maharashtra	November, 2008
12	Cyclone Aila	West Bengal	May, 2009
13	Floods	Andhra Pradesh, Karnataka	October, 2009
14	Floods and Landslides	Uttarakhand	June, 2013
15	Floods	Kashmir	September, 2014

DISASTER MANAGEMENT : Though disasters are unpredictable, yet it will be imprudent on the part of the human civilization to make themselves silent victims without any efforts to meet such challenges. Most countries of the world have taken steps to mitigate affects of disasters. Japan, for example, is one of the most earthquake-devastated countries in the world but despite such havocs by Nature, Japan has proved itself to be one of the most developed and rich countries of the world. For this, responsibilities and precautions on the part of the citizens are a must. Though we cannot prevent natural disasters, but precautionary measures can help us mitigate the adverse affects of natural disasters to a great extent and, on the other hand, our sense of responsibility can considerably prevent man-made disasters. Steps for Disaster Management can be taken in three stages: -

- (i) **Before the Disaster** (Precautions, Mass Awareness, Prediction, Preparation, etc.)
- (ii) **During the occurrence of Disasters** (Special steps to be taken as per type of the disaster, search and rescue operation, etc.)
- (iii) **After the Disaster** (Relief and Rehabilitation of the affected, health services, reconstruction of communication systems, etc.)

MINE DISASTERS IN INDIA

India is enriched with mine. Sometimes during mining, unexpected accidents take many lives. Some of such accidents and its causes listed below :

Date	Place of occurrence	Persons died	Cause
March, 1973	Nunidih	48	Explosion
August, 1975	Kesurgardh	11	Roof collapse
December, 1975	Chachnala	375	Flooding
October, 1976	Sudamdih Shaft	43	Explosion
January, 1979	Boragulai	16	Explosion

June,1981	Jagannath	10	Fire
July, 1982	Dhaupa	16	Roof collapse
November, 1993	Tipong	09	Explosion
January, 1974	New Kenda	55	Fire
September, 1995	Gechlitend	64	Flooding

Role of Students in Disaster Management :

Students are the obligatory and highly sensitive part of the society. Today's students are tomorrow's citizen. So students can play a vital role in disaster management. Like—

1. The advice given by the experts in the Disaster Management awareness campaign held in the schools, colleges and other social functions should be shared with the senior members of the family and students should take initiative in-maintaining the precautions. Further we should always remain prepared to face any situation caused by disasters.
2. Earthquake is the most devastating of all the natural disasters as it is quite unpredictable and it occurs all of a sudden without any advance warning. One should not be nervous and panicky in such a situation and scrupulously follow the advices and precautions suggested by the experts.
3. During earthquake, one should take shelter under the hard frames of the doors, corner of the house, strong table/ beds or in open spaces.
4. One should never take shelter under electric wire/ posts, tall trees, water tanks, windows or furniture with glasses, kitchen, bathrooms.



Fig : First Aid Box

5. The Almirah, rack and furniture in the bedrooms or living rooms should be fixed properly.
6. A bag containing of emergency items like drinking water, foods, first aids, whistle, torch lights should be kept near the main entrance of the house for use in an emergency situation.
7. The updated telephone numbers of Fire Brigade, district administration, Civil Defence, etc, should be kept readily available for using in emergencies. Nowadays, Administration has provided helpline numbers like “Dial-100.”
8. Food items, first aids, torch, drinking water, etc. should be kept ready in the flood affected areas. Rafts made of banana tree or wooden planks should also be kept ready.
9. If you regularly listen to radio and T.V. news, you may get advance information against floods, hailstorms, Tsunami, heavy rains, etc. and take precautionary steps accordingly.



Fig : Uses of Rafts made of banana tree during flood

10. Precautionary and prohibitory measures imposed by the administration in such situations should strictly be followed.
11. There are frequent discussions in the electronic media and write-up published in the news papers regarding preliminary steps to be taken in case of burning, snake bite, attack of honey bees, heat stroke, electrocution, poisoning, dog-bite, excessive bleeding etc. Important points from those discussion and write-up may be noted down and necessary action may be taken accordingly.

There are many government departments including police, which maintain ‘Helpline’ numbers. Guwahati City Police has the Toll-free number of ‘100’. Like-wise govt introduces toll-free helpline number during disasters and natural calamities. Therefore, if any irregular and dangerous matters or developments are noticed, those may immediately be informed to the concerned department. The student’s community can play an important role in this regard. Such types of instances are:

1. Road accidents, unclaimed article/baggage/ packet (Police Deptt., 108 Ambulance Service)
2. Manhole on the footpaths (Municipality or Town Committee)
3. Dangerously hanging electric wires/ electric posts and sparking in transformers (Electricity Deptt.)
4. Dangerous looking hanging trees or parts of buildings, etc. (Municipality or Town Committee)
5. Defective railway track (Railways Deptt.)
6. Imminent danger while travelling by trains (GRP/ Local Police.)

Steps to be taken during Search and Rescue Operation :-

1. The Rescuers should be calm, composed but firm.
2. A thorough assessment should be made before executing search and rescue operations.
3. A safe distance be maintained from the damaged site.
4. Need to examine the damaged sites thoroughly.
5. First aids to be kept ready round the clock for primary treatment.
6. Help the injured first.
7. The victims of accident should be covered with blankets/ tarpaulins so that the injury is not further aggravated.
8. Sharp equipments for the rescue operations should be used very carefully.
9. Clothes of the victims should be loosened and such persons should be kept at a safe place.
10. If required, steps may be taken for artificial breathing of the victims. In case of haemorrhage, efforts should be made to stop it or brought it under control.

What ‘Not to DO’ during Disaster :

1. Don’t press the panic button unnecessarily.
2. Rescue operation should not be carried out without proper assessment and equipments.

3. Materials from the damage site should not be taken out in a haphazard manner to evade further damage.
4. No careless movement around the accident site be made, which may further endanger the lives of the victims.
5. If not emergent, no movement around/ over the accident site should be done.
6. Care should be taken not to come in contact with live electric wires.
7. The Rescuers should not violate the Safety Measures.

Disaster Management Initiatives in India :-

Considering the various factors like vast coastal area, geographical location, population size and unpredictable monsoon flows, India has been under the scourge of plethora of disasters at different times. At least twenty seven of Indian states are prone to natural disasters/ calamities like floods, drought, cyclone, excessive rainfalls, landslide/ erosion, earthquake, etc. About 85% of the total land area of India is affected by such natural calamities. Out of the total geographical area of India, 60% is affected by earthquake, 68% by drought, 12% by floods and 8% by cyclones.

In order to mitigate disasters, the Govt. of India constituted a High Power Committee in 1999 at district, state and national level on the issue of Disaster Management and Development. The Super Cyclone of 29/30th October, 1999 in Odisha and the earthquake of 26th January, 2001 in Gujarat exposed the weaknesses, lack of awareness and emergency services of the Government in dealing with natural disasters. Some important proposals on the basis of surveys conducted, were put forward by the High Power Committee constituted by the Govt. of India in its report. Following this, step was taken to transfer the primary responsibilities of disasters from the Ministry of Agriculture to the Ministry of Home Affairs.

After the Tsunami that occurred on 26th of December, 2004 causing large scale devastation and loss of lives in the coastal areas, the Govt. of India laid paramount importance on Disaster management. Soon the Disaster Management Bill was passed by both Houses of the Parliament unanimously. Steps were taken as per the Disaster Management Act, 2005 to monitor situations before, during and after disasters with due importance. As per the Disaster Management Act, 2005, National Disaster Management Authority (NDMA), State

NDRF BATTALIONS IN INDIA

	NDRF Battalion	State	Central Paramilitary Force
1	NDRF Battalion, Greater Noida	Uttar Pradesh	ITBP
2	NDRF Battalion, Bhatinda	Punjab	ITBP
3	NDRF Battalion, Kolkota	West Bengal	BSF
4	NDRF Battalion, Guwahati (Patgaon)	Assam	BSF
5	NDRF Battalion, Moondali	Odisha	CISF
6	NDRF Battalion, Arrakkanam	Tamil Nadu	CISF
7	NDRF Battalion, Pune	Maharashtra	CRPF
8	NDRF Battalion, Gandhi Nagar	Gujarat	CRPF

Disaster Management Authority (SDMA) and District Disaster Management Authority (DDMA) were constituted under the chairmanship of the Prime Minister of India, Chief Ministers of the States and the Deputy Commissioners of the districts concerned respectively.

A special unit called National Disaster Response Force (NDRF), which is a dedicated force to deal with such situation was constituted. Its members are recruited from the Central Armed Police Forces (CAPF). Eight battalions of NDRF have been created and they are placed in strategic locations of the country. Training in chemical, organic, nuclear and atomic hazards and emergency services

are imparted to the members of the NDRF to deal with any emergent situation during disasters. During natural disasters, they are engaged to help the local administration. The National Institute for Disaster Management (NIDM) - an elite institution of disaster management was also established at New Delhi in 2003.

Assam State Disaster Management Authority (ASDMA) :-

The State of Assam has taken special steps to address disasters under the National Disaster Management Act, 2005. The Guidelines of the Assam State Disaster Management Authority was framed in the year 2010. The Assam State Disaster Management Authority is the nodal agency in the State. It has the primary duty of creating awareness among the people and streamlining precautionary measures to be taken during disasters. Its Headquarters is located at the Assam Civil Secretariat (Capital Complex), Dispur. An IAS officer is posted as the Chief Executive Officer and an officer of the rank of Joint Secretary to the Government of Assam works as the Project Officer to look after the functioning of the Authority. Apart from this central agency, there are also other disaster management agencies at the district, block and panchayat levels to carry out the guidelines of disaster management. The main function of these agencies are: -

1. Planning
2. Preparedness
3. Operation
4. Coordination.
5. Community participation.

Assam State Disaster Response Force (SDRF) :-

In order to frame an effective mechanism to deal with disasters, the Assam State Disaster Response Force was created in the year 2010 and recruitment to this organization has been done ever since. It was constituted on the line of the National Disaster Response Force and its headquarters is located at Sila, North Guwahati. The ASDRF functions under the supervision of the Director, State Fire and Emergency Services, Assam. The ASDRF works in collaboration with the Fire Services in search and rescue operations during disasters.



Fig : SDRF in rescue operation during flood

Natural disasters apart, this Force is pressed into service in the instances of drowning of individual or fire accidents and such other catastrophies.

“If you plan for a year, grow crops; if you plan for ten years, then grow trees; if you plan for hundred years, then educate the people,” – thus goes a Chinese proverb. In order to reduce the hazards of natural disasters, both long term and short term plans should be devised apart from making the general public conscious about it. A concerted effort both on the part of the Administration and general public would yield fruitful results in the regard.

Questions

1. Write the names of two natural and two man-made disasters.
 2. What are the reasons of various disasters in Assam.
 3. Write three reasons of artificial (man-made) disasters in India.
 4. How can the man-made disasters be mitigated? Suggest three measures of your own.
 5. Mention about the measures which should be taken before and after a disaster.
 6. What are the major and genuine causes of increasing numbers of disasters during the last two decades?
 7. What were the biggest earthquake on earth and when and where they occurred ?
 8. What are the reasons of frequent floods in Assam ?
 9. Write about five probable problems related to earthquake.
 10. What are the purposes and functions of Assam State Disaster Management department?
 11. What type of disaster is the “Guwahati Serial Blast” which occurred in the year 2008?
 12. Write a note on the disasters in Mines in India.
 13. What are the stages of disaster Management? What steps can be taken in each stage ?
 14. Suggest five steps which you can take as a student in disaster management.
 15. What should not be done during disaster ?
 16. Write briefly about National Disaster Response Force (NDRF).
 17. What do you know about Assam State Disaster Management Agency?
 18. There are frequent instances of landslide in Guwahati city. What are the reasons of it? Suggest some measures from your views to prevent such landslides.
-

ROAD SAFETY

The 21st century has been accompanied by many new forms of challenges and threats such as climate change, piracy, cyber crimes, terrorism to name a few. Among these one of the major problems that the society in large today faces are road accidents. Road accidents are a major problem faced throughout the world. In order to curb the menace of road accidents every country today has come up with home-grown solutions and a working plan to mitigate such challenges. In such a context it becomes essential for every youth to be aware of certain basic rules and regulations and methods to avoid road accidents.

What does road safety mean?

Road safety can be referred to the precautionary measures taken by any vehicle driver, cyclist, pedestrian and passenger on road in order to prevent injuries, accidents and thereby assuring safety. There are traffic rules and regulations which have been laid out and should compulsorily be followed.

Causes of road accidents

Studies suggest that there are numerous and varied reasons which can cause road accidents. Drunk driving, high speed, sleepless night, rough road, inclement weather, car break down, violating traffic rules etc. They can be summarized as given below:

1. **Human factors** : 85% accidents are caused by human factors such as drunk driving, drowsiness, fatigue, lack of awareness of road signs, violation of rules, distracted driving, pedestrian errors etc
2. **Infrastructure** : Poor infrastructure such as incorrect road engineering, dilapidated condition of roads etc also contributes significantly to road accidents
3. **Mechanical factors** : Mechanical errors such as driving an ill-maintained vehicle, abrupt mechanical failure etc can lead to accidents on road.

4. **Environmental factors** : Unfavourable terrain, unforeseen natural calamities, bad weather conditions etc cause accidents frequently.

In order to combat these factors some remedies have been devised and can be summarized as the 4 'E's

1. **Engineering** : Indian Roads are commuted by pedestrians, bicycles, carts, rickshaws, public heavy vehicles, light motor vehicles etc. Therefore roads should be constructed systematically and scientifically for the benefits of all commuters. Like wise vehicles should also be manufactured with latest and advanced technologies. Proper and correct engineering of roads can ensure lower rate of accidents.
2. **Enforcement** : Regular and strict enforcement of road safety rules and regulations have managed to bring down accident rates and can continue to do so in future. It also gives States the scope to incorporate safety related positive legislative changes and strict enforcement thereof.
3. **Education** : Imparting education on golden rules of the road to each and every driver and road user will help ensure safer roads for travelers and vehicles.
4. **Emergency Services** : Well regulated and effective emergency medical services can bring down the number of deaths due to accidents substantially.

Issues of road safety :

One of the main objectives to educate the youth on road safety is with the hope that the future generation, who plays an active role in the society, will in turn spread awareness among the masses on the challenges of road safety, simultaneously being well equipped themselves on the same. The United Nations General Assembly in March 2010, has declared a worldwide movement and therefore, on 11th May 2011 “The Decade of Action on Road Safety 2011-2020” was launched across the globe. The movement has been initiated not only to start awareness on road safety but also to curb the loss of lives due to road mishaps. There are several strategies put forward under this initiative, some of them are to enhance emergency services,

building road safety management, improved legislation and enforcement on helmets, seatbelts, child restraints and avoiding drinking and driving and speeding etc. In India too, there have been many initiatives taken by the government. Since 1989, the Government has been organizing 'Road Safety Week' every January devising several different strategies to promote awareness on road safety. In the year 2005 the Union Cabinet based on the recommendations of the Sundar Committee approved the National Road Safety Policy to improve road safety activities in the country. Among the eleven policies adopted for the National Road Safety Policy, awareness among the public has been given prime importance.

Some Statistical data related to Road Accidents :

The impact of road accidents can be understood from the statistics given below:

According to World Health Organisation, 1.25 million people die and around 5 million persons injured in road accident across the world annually. World's 10% accidents occur in India whereas total number of vehicle is only 1% compared to the world's total vehicle. Rate of accidents is three times higher in our country than developed countries.

Road accident statistics of National Crime Record Bureau of India :

1. In the year 2014 in India 141526 persons died and 477731 persons seriously injured in 450898 Nos. of road accidents.
2. On an average, 16 persons killed in 51 road crashes per hour. One person dies in every 4 minutes
3. Out of total fatalities 26.4 % bikers die in road crash
4. 27.5% accidents occur on National Highways whereas 25.3% on State Highways
5. 36.8 % accidents occur due to over speed
6. 3.2% accidents occur due to bad weather
7. 54.7% and 45.3% accidents occur in rural area and urban area respectively

In Assam

In 2014, total 2522 and 6500 persons died and seriously injured respectively, out of 7144 total number of accidents. It is presumed that the number of road accident related figures may be more since some accidents go unreported.

Rules of the Road

There are certain Rules of the Road which are expected to be followed by the road users for the purpose of safety. These are enlisted in the Motor Vehicle Laws. Some of those are mentioned below-

1. Keep the vehicle as far as possible to the left hand side of the road and allow other vehicles to move by your right hand side.
2. A vehicle intending to take a right turn should move along the centre of the road and allow other motor vehicles behind it to overtake from the left side or vice versa.
3. Overtake vehicles from same direction by right hand side.
4. Do not overtake if–
 - (a) If creates difficulties for vehicles from opposite side.
 - (b) Road intersection, hill side where visibility is not clear.
 - (c) Another vehicle of trying to overtake you.
 - (d) You have not got proper signal from the vehicle moving ahead of you.
5.
 - (a) If a vehicle has begun to overtake a vehicle ahead, it shall not accelerate or do anything that will cause inconvenience to the intending vehicle from overtaking smoothly.
 - (b) While entering onto the main road from a bye-lane, where traffic is not being regulated, give priority to the vehicles travelling along the main road slowly.
 - (c) Give way to the fire brigade vehicle or ambulance by drawing yourself to the left side.
6.
 - (a) While slowing down, give signal visibly to the vehicles behind by extending right arm with downward palm several times.

- (b) While stopping, raise right fore arm vertically outside and to the right of the vehicle, with palm to the right.
 - (c) While turning right or overtaking a vehicle ahead, extend right arm in horizontal position outside with the palm of the hand to the front.
 - (d) While turning or drawing to the left hand side of the road, extend right arm and rotate in an anti clockwise direction.
7. **Don't park**
- At or near road intersection, a bend, top of a hill or a bridge,
 - On a footpath,
 - Near a traffic light or pedestrian crossing,
 - On a main road or fast traffic lane,
 - Opposite to parked vehicle or as obstruction to others,
 - Along side another parked vehicle,
 - On roads or places where there is a continuous white line,
 - Near a bus stop, school or hospital entrance or entrance to a premise or blocking a traffic sign-board or on the wrong side of the road and at place other than parking place.
8. Don't drive on a declared 'one-way' except in the specified direction.
9. **Don't blow horn**
- No driver shall blow horn continuously, needlessly or more than necessary or in 'silent zone'. Use of multi-toned horn giving harsh, shrill and loud noise is prohibited.
10. Maintain adequate distance from other vehicle ahead to avoid collision if the vehicle in front suddenly slows down or stops.
11. On hill roads and steep roads give precedence to the vehicle moving uphill.
12. Don't carry any explosive, inflammable articles except the fuel or lubricants required for own vehicle.
13. Obey the people in uniform.
14. (a) A road marked by lanes for movement of traffic, drive within the lane and don't change the lane without giving proper signal.
- (b) Where a road is divided with a yellow line, don't overtake touching the yellow line.

- (c) When any line is drawn and painted with either in white, black or yellow on the surface of the road at junction, don't touch the line when you stop.
15. Slow down when approaching a road intersection and not to enter such intersection, junction or crossing until it is certain that there is no danger to pedestrian or other traffic.
16. (a) Registration number and other marks be maintained in a clear and legible condition.
- (b) Registration number plate, head light should not be blocked or interrupted by placing any goods or load.
- (c) Always carry driving licence, registration certificate, insurance certificate, pollution under control certificate and in case of transport vehicle the permit, fitness certificate. On demand by authorised officer in uniform produce them for inspection.
17. Donot mix drink and drive. If may cause inconvenience to you and others.
18. Move you vehicle to extreme roadside while attending a telephone call.
19. While driving at night crossing the headlight must be lowest.
20. Don't drive at a speed exceeding 25 kilometre while passing a procession or workmen engaged in road repair.
21. Respect the pedestrian, blind, elders and differently abled persons.
22. Where 'U' turn is prohibited one should not take 'U' turn. Take 'U' turn only after giving proper signal and looking at the rear view mirror.
23. Don't permit any person to sit or stand or anything to be placed, which may interrupt driving.

Must obey

- Every direction or signal given by any authorised police personnel,
- Any direction given by means of traffic sign, signal and indication applicable,
- Any direction given by automatic signaling devices.

While walking

- # Use zebra crossing while crossing a road .
- # While crossing road - look left then right then again left.
- # Use footpath where it exists. Where footpath doesn't exist walk on the extreme side of the road.
- # Walk along the extreme left side of the road. While moving along side of a stationary vehicle look to the front and rear.
- # Use torch light at night .
- # Don't allow tiny-tots to move on the roads without guide.
- # Avoid walking with friends collectively, it creates problem to others and self.

While traveling by bus

- # Get in a bus one after another.
- # Get hold on secure place while entering to avoid bodily injury.
- # Abrupt use of brake of the bus you are traveling may cause injury; therefore, to avoid this hold tightly at secure place.
- # On getting out of a bus look at front and rear then walk.
- # Tender exact amount of money and ask for the ticket from the conductor.
- # Carefully keep your articles on the bunker (meant for luggage) inside a bus so that it does not fall on others causing head injury.
- # Resist the driver if he drives in excessive speed which may endanger your safety.
- # Report your complaints if any to the nearest police station or transport authority or record in the complaint book kept in the vehicle.
- # Don't hurry while embarking; slow and steady is the best policy for your safety.
- # Journey on foot-board of a bus is not permitted
- # Inflammable and hazardous articles are not allowed while traveling in any kind of passenger vehicle.
- # Don't cause inconvenience by standing yourself at the footboard of buses etc.

Rules applicable for School Bus

- # Driver must have 5 years experience of driving heavy vehicle.
- # The driver becomes unfit to drive school bus if he commits the following offences twice during a year-
 - Jumping of Red Light
 - Parking at No Parking area
 - Overtaking unlawfully
 - Violation of Stop line at Road intersection
 - Allowing unauthorized persons to drive
- # Over speeding or under the influence of drugs disqualify a person to be a school bus driver
- # Driver should wear uniform
- # School buses must be painted with yellow colour with school name and contact details.
- # 'On school duty' shall be inscribed in the front of the school bus
- # The bus should be fitted with speed governor restricting speed @ 40 kmph
- # Facility to automatically close the doors should be available
- # As per Hon'ble Supreme Court of India school buses can accommodate 1.5 times the students as against total seating capacity for adults.

Helmet

As per section 129 of Motor Vehicles Act, 1988 wearing of helmet by both the Biker and the rider is mandatory. The helmet certified by Bureau of Indian Standards is only permissible for use. Two wheelers make up a large proportion of those injured or killed on the roads. A helmet protects from head injuries and fatalities and its use is effective at reducing fatalities up to 40% and up to 70% severe head injuries. Non compliance of this legal requirement is punishable under MV Law.

Drunken Driving

Driving under the influence of alcohol can reduce the response time of the driver of a vehicle. This in turn results in a large number of accidents on roads. To reduce the number of drunken driving cases on Indian roads the enforcement agencies conduct regular checks. If breath analysis or blood tests indicate a blood alcohol level of 30 mg or more for every 100 ml of blood, the driver is liable for a fine of minimum rupees 2000 or imprisonment or both u/s 185 of Motor Vehicles Act, 1988.

Use of mobile phone during driving

No driver is permitted to use mobile phone or head phone during driving. Whoever is detected doing so is liable for punishment including suspension or cancellation of Driving Licence.

Vehicular emission pollution

As per Motor Vehicles Act, 1988, a vehicle completing one year from the day of initial registration must carry 'Pollution under control certificate' from an authorized emission testing station. The vehicle must undergo compulsory emission pollution test every 6 months. Violation of this provision is punishable u/s 190 of Motor Vehicles Act, 1988.

Seat belt

A speeding vehicle causes the occupant's body to reach a state of uniform motion along with the motion of the vehicle which is termed as inertia. In the event of a collision or sudden use of brake of a vehicle, the occupant's body still remains in motion due to the force of inertia. A seatbelt serves as a Primary Restraint System by applying opposite force on the occupant's body and hence preventing ejection from the vehicle. Additionally it also keeps the passenger and driver's body in correct position so that air bags can function with maximum effectiveness during a collision. As a result injuries can be minimized during collisions. Studies reveal that a significant percentage of deaths during accidents can be attributed to negligence in fastening of seat belts. U/S 177 of Motor Vehicles Act, 1988, non fastening of seat belt is a punishable offence.

Driving licence

Driving licence is a licence issued by a competent authority authorizing the person to drive a specified class of vehicle. In Assam, driving licence is issued by the District Transport Officer of Transport Department.

Following are the classes of vehicle for which a Driving Licence is issued :

- Motor cycle without gear,
- Motor cycle with gear,
- Invalid carriage,
- Light motor vehicle,
- Transport vehicle,
- Road-roller,
- Motor vehicle of a specified description.

There are two steps for eligibility to have a Driving Licence.

Step 1 : Learner's Licence

Step 2 : Main Driving Licence

A person below the age of 18 years is not eligible to apply for a Learner's Licence. However, a person completing the age of 16 years is eligible to apply for a two wheeler without gear vehicle with the consent of parents or guardian .The applicant is granted Learner's Licence if qualified in a preliminary test on traffic signals, road signs and road regulations. During the course of learning the learner has to display the letter 'L' in red on a white background in the front and rear of the vehicle. No person other than the instructor giving guidance should be sitting in to control the vehicle during learning.

Upon gaining confidence in driving one becomes eligible to apply for the driving licence after 30 days from the date of issue of learner's licence. On successful completion of necessary test for driving one is granted the Driving Licence.

International Driving Permit

There is a provision in the Motor Vehicles Act, 1988 for granting International Driving Permit for Indian Citizens to drive in foreign countries. It is valid for 1 year only. One can apply in the prescribed form with the following details to the local District Transport Officer.

1. Copy of Indian Driving Licence

2. Copy of Passport and Visa
3. 3 copies of recent passport photo
4. Medical certificate in prescribed form
5. Necessary fees

IF ACCIDENT OCCURS

The driver shall stop the vehicle forthwith. If any person is injured due to an accident, the driver of the vehicle involved in the accident shall take immediate measures to get medical treatment of the injured unless the injured person or his guardian desires otherwise. Inform the occurrence of the accident to the nearest police station as soon as possible, in any case within 24 hours and also to inform the insurer in writing.

Major Motor Vehicle Laws

1. Motor Vehicles Act, 1988
2. Central Motor Vehicles Rules, 1989
3. Assam Motor Vehicles Rules, 2003
4. Assam Motor Vehicles Taxation Act, 1936
5. Assam Motor Vehicles Taxation Rules, 1936

Documents of the vehicle to be carried

In case of non transport (personal) vehicle, one may require to produce the following valid documents of his vehicle on demand by authorised officials—

In case of Non-Transport (Personal) Vehicle :

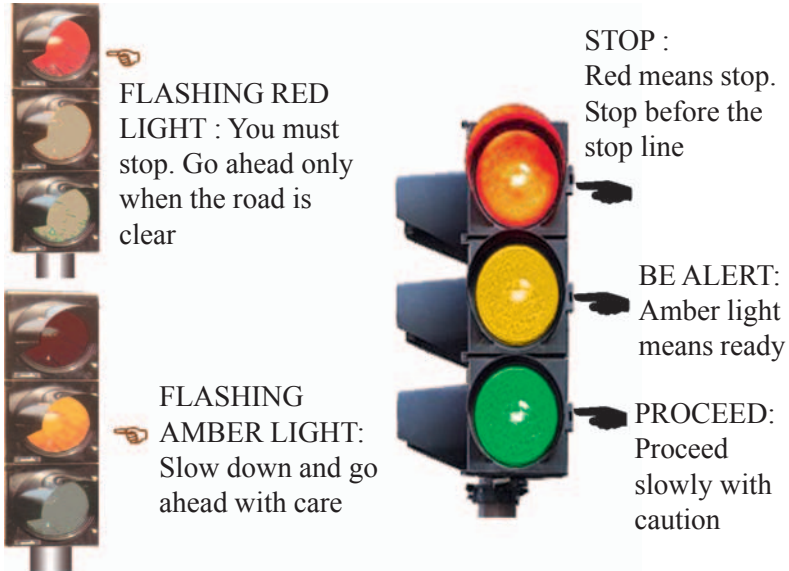
1. Registration Certificate. 2 Insurance Certificate.
3. Pollution under control certificate (if the vehicle is 1 year old from the date of initial registration).
4. Driving licence of the class of vehicle you are driving.

In case of Transport (Commercial) vehicles :

1. Fitness Certificate
2. Up-to-date Road tax receipt or proof thereof
3. Permit
4. Conductor's licence in case of Bus
5. Any other documents as required by permit conditions

Traffic Light

At traffic points three kinds of lights are displayed : red, amber (yellow-brown) and green.



Road signs

Road signs can be referred to those signs which are displayed on the roadside to guide the pedestrians, cyclists and the vehicle drivers on the rules of the road or on the forthcoming road circumstances. The United Nations Economic Commission of Europe (UNECE) in 1947 made road safety as one of its prime concerns and formulated a Working Party on Road Traffic Safety known as W.P.1. On 19th September, 1949, a treaty under the Convention on Protocol on Road Signs and Signals in Geneva was signed under the aegis of UNECE which came into force on 20th December, 1953. Subsequently, on 8th November, 1968 in Vienna during a Convention on Road Signs and Signals some amendments were incorporated and comprehensive deliberations were made on Road Safety as this was important so as to have uniformity among the contracting parties on the usage of the signs.

Accordingly in India, uniform road signs are incorporated in Motor Vehicles Act ,1988

These Road signs are classified into three and these are:

1. Mandatory Road signs
2. Cautionary Road signs
3. Informatory Road Signs

MANDATORY ROAD SIGNS

These are generally in circular shape with red border except some are in blue colour. Violation of Mandatory Sign is an offence



Stop



Give way



No entry



One way



All vehicles prohibited



Truck prohibited



Bullock & Handcart prohibited



Bullock cart prohibited



Tonga cart prohibited



Hand cart prohibited



Cycle prohibited



Pedestrians prohibited



Right turn prohibited



Left turn prohibited



U-turn prohibited



Overtaking prohibited



Horns prohibited



Width limit



Height limit



Length limit



Load limit



Axle load limit



Speed limit



No parking



No stopping or Standing



Compulsory turn left



Compulsory ahead only



Compulsory turn right



Compulsory ahead or turn right



Compulsory ahead or turn left



Compulsory keep left



Cycle track



Compulsory sound horn



Compulsory minimum speed



Restriction end

CAUTIONARY ROAD SIGNS

These signs are indicated in triangular shape with red border



Right hand curve



Left hand curve



Right hairpin bend



Left hairpin bend



Right reserve bend



Left reserve bend



Steep ascend



Steep descend



Narrow road



Wide road



Narrow
bridge



Slippery
road



Loose
gravel



Cycle
crossing



Pedestrian
crossing



School
ahead



Traffic
signal



Cattle
ahead



Ferry
ghat ahead



Falling
rocks



Dangerous
dip



Hump or
rough road



Barrier
ahead



Men
at work



Gap in
median



Cross
road



Left
side road



Right
side road



Y-Intersection



Main
road ahead



Staggered
intersections



Round
about



Guarded
rly crossing



Un-guarded
rly crossing



Quayside or
river bank



Traffic
signal

INFORMATORY ROAD SIGNS

These signs give information about facilities on road and these are normally blue in colour



First Aid post



Light Refreshment



Eating place



Resting place



No thorough side road



Park this side



Parking both side



Parking lot - Cycle



Parking lot - Taxis



Public Telephone



Petrol Pump



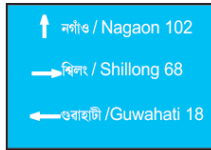
Hospital



No Thorough Road



Advance Direction Sign



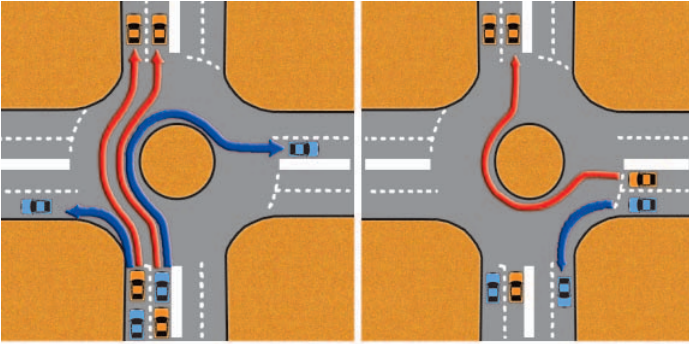
Destination Sign



Direction Sign

Road Markings

Roundabout or Rotary



A roundabout means an intersection having a central traffic island. Always slowdown your vehicle and use your indicator showing where you are proceeding. Where there is lane markings, use appropriate lane and maintain it. Remember, you must give way to other traffic on your right.

Zebra Crossing



This is called Zebra crossing drawn across the road. This is for pedestrians to cross the road from either side.

White Broken Line

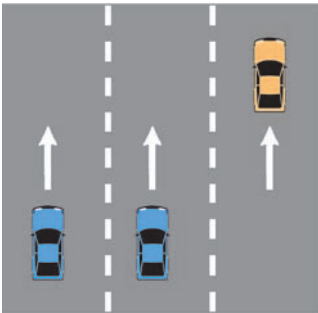


These white broken lines across the road means that any motorist approaching it is to give preference to oncoming traffic.

White or Stop Line



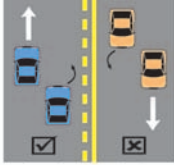
This white line is called stop line. This means, when you are signalled to stop, you are to stop just before the stopline and must not cross it. Generally such single or double stop line across the road is seen near junction or traffic light.



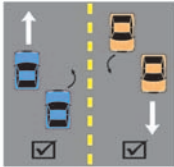
Lane Separator

These lines are lane separators on a road on same direction. To change lane give proper signal.

Road Markings



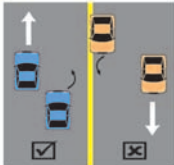
If there is a broken line with a solid line running alongside of the broken line then you are allowed to overtake on the broken side only and no overtaking is allowed on the side of the solid line.



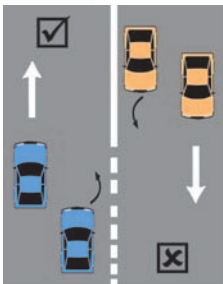
If there is a broken line on a two way road, you are allowed to overtake giving proper signal with utmost care.



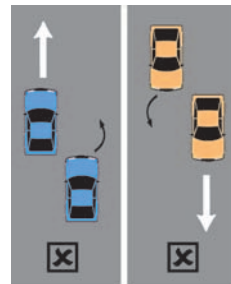
The yellow line along the edge of the road means you are not permitted to park your vehicle at all times.



Yellow Dividing Line : A road having a yellow line dividing the road means the vehicle overtaking another vehicle of same direction shall not cross the yellow line.



If there is a broken white line and changing into a solid white line then you must not overtake here till it change into the broken white line.



If you find a solid continuous white line, on a two way road, you must not overtake.



Questions

1. What does Road Safety mean?
2. What are 4 'E's in respect of road safety? Specify in brief.
3. What is a Helmet and why should it be used?
4. Write a short note on the requirement of seat belt.
5. What is a Driving Licence? Specify the classes of Motor Vehicles for which Driving Licence is granted?
6. What does Motor Vehicles Act, 1988 state with respect to drunken driving?
7. Mention 5 road rules applicable for a school bus?
8. How many classes of road signs exist? Mention them
9. What should a driver do in case of an accident?
10. What valid documents should be carried by a non-transport (personal) vehicle?
11. What are the major causes of Road accidents?
12. What is the name of Road Safety plan adopted Worldwide in the year 2011? Write in brief.
13. Since when did the National Road Safety policy was adopted in India?
14. Mention 5 Traffic Rules to ensure Road Safety.
15. What kind of licence is to be procured from our country by an Indian to drive in foreign country? What are the application procedures?

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