

FIRST SEMESTER EXAMINATION, 2010-2011**ENVIRONMENT & ECOLOGY***Time : 2 Hours**Total Marks : 50*

Note : The question paper contains three sections-Section-A, Section-B, and Section-C with the weightage of 10, 15 and 25 marks respectively. Follow the instruction as given in each section.

SECTION-A

This question contains 10 questions of multiple choice/Fill in the blanks/True, False/Matching correct answer type questions. Attempt all parts of this section. (10×1=10)

1. Fill in the following blanks with suitable words :-

- The World Environment Day is observed on
- Chipko movement was started to conserve
- Acid rain is caused due to emission of to the atmosphere.
- Balika Samridhi Yojna is a measure ofwelfare.
- The ecological pyramid which is always straight to the is.....
- The maximum value of requirement (desirable limit) of Fluoride (as F) in drinking water as per IS 10500 is
- Gas leaked in Bhopal Tragedy was
- The study of interaction between living and non-living organism and environment is called as

Ans. (a) 5th June (b) Forest (c) SO₂/NO₂ (d) Girls/ Women (e) Pyramid of energy (f) 1 or 1.5 ppm (g) Methyl Iso Cyanate (MIC, CH₃NCO) (h) Ecology

Indicate True or False for the following statements :-

- Algae is an example of Protozoa - True/ False.
- Green marketing and eco-labeling are good strategies to protect environment from waste products - True/False.

Ans. (i) False (ii) True

SECTION-B

2. Attempt any three parts. All parts carry equal marks :- (5×3=15)

- Write an explanatory note on the multidisciplinary nature of environmental science.

Ans. **Multidisciplinary Nature of Environmental Studies :** Environmental Science is the methodological study of the environment and includes study of all bio-physical as well as anthropogenic conditions of circumstances under which an organism lives.

Today, Environmental Studies is a well recognized and well elaborated subject. It is highly interdisciplinary in nature and utilizes information from Biology, Ecology, Chemistry, Physics, Geology, Geography, Sociology, Economics, Management etc.

Besides these, there are a number of parallel disciplines which have evolved from Environmental Science viz. Environmental Studies, Environmental, Engineering, Environmental management, Environmental Economics etc.

The multidisciplinary nature of the subject is due to the fact that the concept of environment include all the factors that influence any organism. These factors can be physical, chemical, biological, geological, geographical, economic, social, political, cultural etc., hence in order to study their effects, reference of these disciplines is taken in environmental studies.

(b) Discuss the environmental effects of extracting and using mineral resources.

Ans. Environmental effects of extracting and using mineral resources : Minerals are used for most of the developmental activities in huge amount. They are extracted in mass scale from the land and seafloors by the process of mining. Mining has several environmental impacts. Mining involves deforestation and de-vegetation of a large area which results into ecological imbalance and loss of habitat to wildlife. Precious agricultural land is also consumed in this process.

Defacing or disfiguration of the landscape takes place due to mining. This results into destruction of soil fertility, hydrology and land topography. It induces soil erosion and siltation of water-bodies. Subsurface mining sometimes causes subsidence of land which results into cracking or tilting of nearby buildings, highway, railway tracks etc.

Pollution of surface and groundwater takes place due to release and leaching of harmful elements (c.g., Cadmium, Cobalt, Copper, Lead etc.) from mines. Acid mine drainage is one of the common problems of this kind.

Serious occupational health hazards are associated with mining. Miners generally suffer from respiratory and skin diseases, like Asthama, Bronchitis, Black lung disease, Asbestosis, Silicosis etc.

A number of air pollutants are also emitted from metallurgical operations associated with mines. These have potential health hazards.

Since mining disturbs the entire landscape, create pollution and destroys natural resources, it results into huge socio-economic disturbance to the people living in the area and particularly to those who depend on natural resources.

(c) Write down National Ambient Air Quality Standards for Industrial, Residential, Rural and other area as prescribed by Central Pollution Control Board.

Ans. National Ambient Air Quality Standards: Air quality standards are the legal limits of pollutants in the atmosphere. Ambient Air Quality Standards are related to air of general surrounding (ambience) and indicate permissible exposure for 24 hours per day and 7 days per week. Following table enlists CPCB prescribed NAAQS for SO₂, NO₂, SPM & RSPM

Pollutants	Time-weighted Average	Permissible concentration in ambient air		
		Industrial Areas	Residential Rural & other Areas	Sensitive
Sulphur Dioxide (SO ₂)	Annual Average*	80	60	15
	24 hours**	120	80	30
Oxides of Nitrogen as (NO ₂)	Annual Average*	80	60	15
	24 hours**	120	80	30
Suspended Particulate Matter (SPM)	Annual Average*	360	140	70
	24 hours**	500	200	100
Respirable Particulate Matter (RPM) (size less than 10 microns)	Annual Average*	120	60	50
	24 hours **	150	100	75

Note: (1) All values are in $\mu\text{g}/\text{m}^3$ of Ambient Air
(2) * Annual Arithmetic mean of minimum 104 measurements in a year taken twice a week 24 hourly at uniform interval.

(3) **24 hourly/8 hourly values should be met 98% of the time in a year. However, 2% of the time, it may exceed but not on two consecutive days.

(d) Discuss the Indian Scenario in solar energy utilization and development.

Ans. Indian scenario in solar energy utilization and development : India due to its geo-physical location receives solar energy equivalent to nearly 5,000 trillion kWh/year, which is far more than the total energy consumption of the country today. But India produces a very negligible amount of solar energy - a mere 0.2 percent. Up till now, India's energy base has been more on conventional energy like coal and oil.

However, India has now attained 7th place worldwide in Solar Photovoltaic (SPV) Cell production and 9th place in Solar Thermal Systems.

Grid-interactive renewable power installed capacity was 9,013 MW in 2006, corresponding to around 7 percent of the total power installed capacity which equates to over 2 percent of total electricity.

Most parts of India receive 4-7 kWh of solar radiation per square meter per day with 250-300 sunny days in a year. India has abundant solar resources, as it receives about 3000 hours of sunshine every year, equivalent to over 5,000 trillion kWh.

Realizing the potential of solar energy, the Indian Government has launched the ambitious Jawaharlal Nehru National Solar Mission (JNNSM) which promises to catapult India into becoming the largest market for solar energy in the world. In fact, India's solar energy sector has the potential to be the biggest energy opportunity of the 21st century.

At the India Solar Energy Summit senior officials, PV manufacturers and solutions providers will come together to provide a unique insight into evolving governmental policies, breakthrough technologies and investment strategies for this evolving sector.

(e) Explain Intensity, power and pressure levels of noise.

Ans. Intensity, power and pressure levels of noise

Sound is measured in Decibel (dB) unit that is a logarithmic function of sound intensity, sound power and sound pressure level.

Sound Power is the energy rate i.e., the energy of sound per unit of time (J/s, W in SI-units) from a sound source.

Sound Intensity is the Sound Power (W) per unit area. The SI-units for Sound Intensity are W/m^2 .

The Sound Pressure is the force (N) of sound on a surface area (m^2) perpendicular to the direction of the sound. The SI-units for the Sound Pressure are N/m^2 or Pa.

SECTION-C

Attempt any Five questions. (5×5=25)

3. (a) Define Ecology and ecosystem. Explain the role of producers, consumers and decomposers in an ecosystem.

Ans. Ecology: definition : The term ecology is derived of two words: *Oikos* (means house or living place) and *logos* (means study). It was coined by Ernst Haeckel in 1869.

To define; Ecology is the study of relationships between the organisms and their environment.

In simple words, ecology is the study of relationships between (i) Biotic and Abiotic components and (ii) Biotic and Biotic components of the ecosystem.

Ecosystem : definition

Ecosystem can be defined as a structural and functional unit of bio- sphere, consisting of biotic

ans abiotic components, both interacting an exchanging material between them.

The term ecosystem was given by Sir Arthur Tansely in 1935. Ecosystem is also called as *Holocoenosis*. Examples: Forest ecosystem, grassland ecosystem, pond ecosystem etc.

Role of producers, consumers and decomposers

Producers or Autotrophs are the organisms that themselves make their food by the process of photosynthesis or chemosynthesis. All other organisms directly or indirectly depends upon them for food. e.g., green plants, algae, certain bacteria.

Consumers are the organisms that feed on other living beings and include majority of animals.

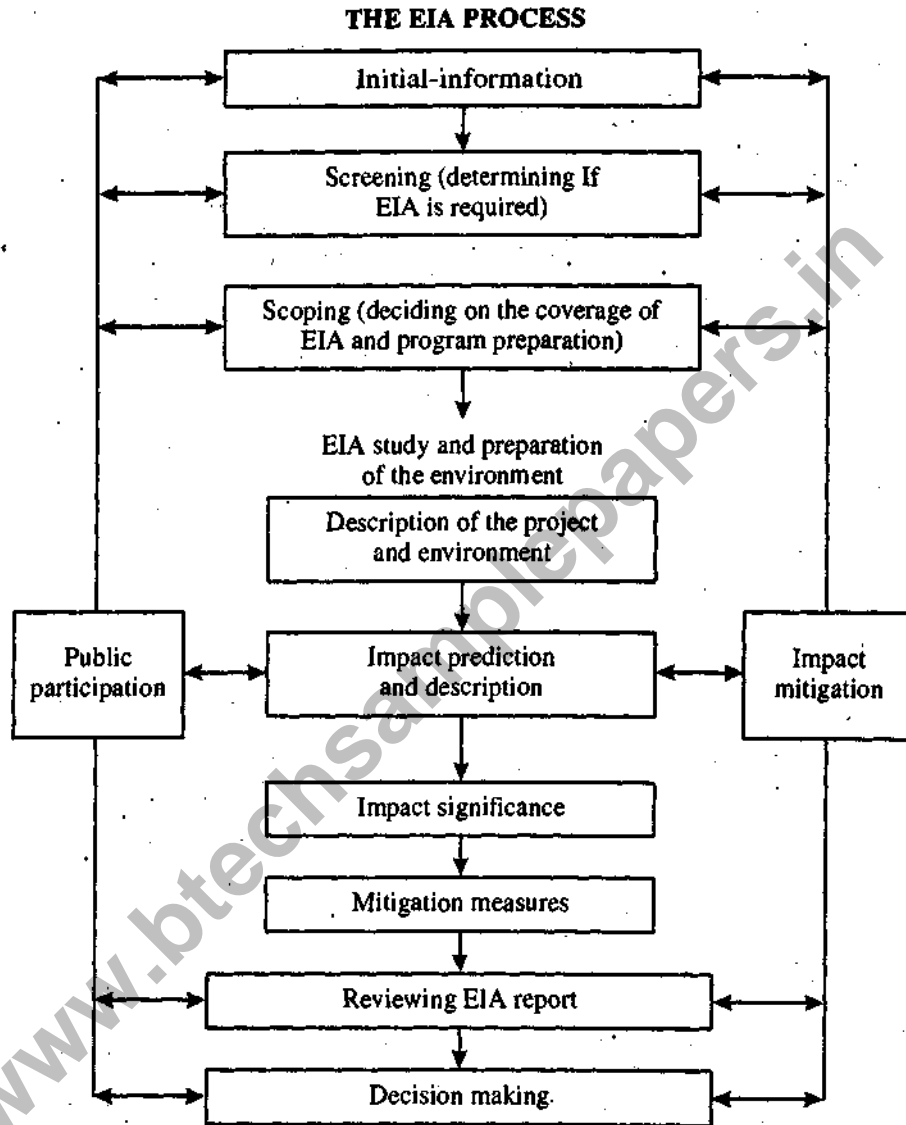
Consumers are further divided into three to four groups: herbivores, carnivores, top carnivores and omnivores.

Decomposers are the organisms that feed on dead plants and animals and convert them into simple compounds. They ensure recycling of nutrients in the ecosystem. e.g., bacteria, fungi and certain insects etc.

(b) With the help of flow chart, describe the Environment Impact Assessment process.

Ans. An environmental impact assessment (EIA) is an assessment of the possible impacts (positive or negative) that a proposed project may have on the natural environment. the major steps of the EIA process are briefly presented below through the following diagram:

1. **Screening** (to determine whether the proposed project requires an EIA; and if it requires EIA, then the level of assessment required)
2. **Scoping** (to identify the key issues and impact that should be further investigated; also to define the boundary and time limit of the study)
3. **Description of the project** (to clarify purpose, rationale and characteristics of the project)
4. **Consideration of alternatives** (to identify alternatives of project in terms of location, scale, layout, operation etc.; and also to include "No Action" as one option)
5. **Description of the environmental baseline** (to describe the current and future status (without project) of environmental parameters of the area)
6. **Identification of Key-Impacts** (to identify and enlist all the aspects / parameters that may be affected by the project)
7. **Impact Prediction and Evaluation** (to predict the magnitude of likely change in different parameters due to project implementation and to evaluate significance of these changes)
8. **Mitigation** (to recommend the actions for reducing or avoiding the major adverse environmental impact of the project)
9. **Public consultation** (to share the concerned information with the public and different stakeholders and to take their views of for necessary inputs)
10. **EIS Presentation** (to document all above steps in form of Environmental Impact Statement and presenting to decision making body and other stakeholders)
11. **Review** (to systematically review all steps of EIS and to give necessary feedback so as to ensure that all steps are properly done)
12. **Decision making** (to decide whether the project is rejected, approved or needs further change)
13. **Post-Monitoring** (after the project is commissioned, to check whether the impacts of the project do not exceed the legal standards and the mitigation measures are properly implemented)



4. (a) What is deforestation? Enumerate and discuss the various causes of deforestation.

Ans. Deforestation : Deforestation means cutting or felling of trees by human for various purposes. Economic gain is often the goal of most of these purposes.

Deforestation results into several environmental problems e.g., biodiversity loss, wildlife habitat loss, desertification, increased soil erosion, disturbance in climate, hydrology and soil fertility etc.

Deforestation is widespread across the globe as well as India. In India almost 1.3 million hectare forests are destroyed each year.

Following are the major reasons of deforestation:

- Removal of forests for getting fertile land for agriculture particularly slash & burn agriculture
- Removal of forests for expansion of cities and villages
- Removal of forests for the construction of big projects and infrastructure, e.g., dams, mines, factories, refinery, roads, highways, railways, airports, power-lines etc.
- Removal of forests for resettlement of displaced people and landless people
- Massive extraction of timber wood
- Over-grazing by animal and uncontrolled fuel-wood collection

(b) Explain the sulphur cycle with neat sketch.

Ans. Sulphur Cycle : Sulphur exists in nature in many forms (S, SO_2 , SO_3 , SO_4 , H_2S and organic sulphur). It is essential part of protoplasm of living beings. Sulphur circulate in nature through Sulphur-Cycle which is chiefly a sedimentary cycle.

Major steps of sulphur cycle are as:

- Plants get sulphate from soil and use it their protoplasm; animal eat plants and get sulphur; both die and form organic residue.
- Organic residue forms sulphate and sulphide through different channels; sulphide convert to sulphate and the vice-versa.
- Some sulphur moves to sediment or deposits; part of this sulphur return to earth surface and atmosphere by mining and volcano; SO_x are also released to atmospheric by combustion of fossil fuels.
- Atmospheric sulphur (SO_4) comes to earth by rain and direct absorption by water bodies and plants.

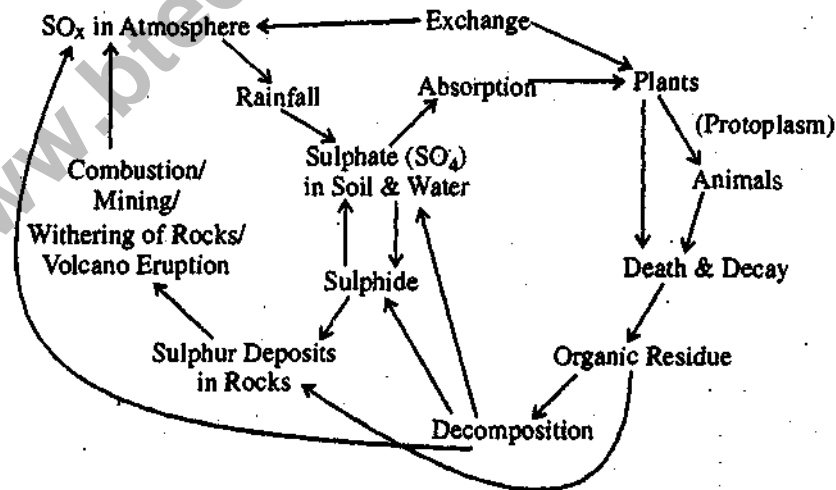


Fig. Sulphur Cycle

5. (a) Define air pollution. What are the sources of air pollutants? How will you classify air pollutants ?

Ans. Air pollution: Definition : Air pollution is presence of foreign substances in air in excessive concentration which adversely affect well being of the individual or causes damage to property.

Sources of air pollutants : Sources of air pollution can be Stationary (non-moving) or Mobile (moving). Similarly they can be Point source (from single location) or Area source (from diffused location). These sources can be natural as well as man-made:

Natural sources of air pollution include volcano eruption, forest fire, pollen grains, bio-pollutants etc.

Man-made sources are the main contributor to over all air pollution. They include burning fossil fuels, automobile emission, thermal power plants and different types of industries (steel, cement, textile, fertilizer, pesticides etc.).

Classification of air pollutants : The substances which cause air pollution are called air pollutants. They can be categorized based on different criteria.

Based on origin they can be of two types:

- Primary air pollutants are those which are emitted directly to the atmosphere and found there in the form in which they are emitted. CO, SO_x, NO_x, Hydrocarbons and particulate are the five main primary air pollutants and contribute over 90% of global air pollution.
- Secondary air pollutants are those which are produced in the air by the interaction among primary pollutants, e.g., tropospheric ozone, Per-oxy Acetyl Nitrate (PAN), formaldehyde, acid mist etc. These often make photochemical smog.

Based on chemical composition, they can be of two types:

- Organic air pollutants: They include hydrocarbon, polycyclic hydrocarbon, organic sulphur etc

- Inorganic air pollutants: They include CO₂, CO, SO_x, NO_x, O₃ etc.

Based on physical state, they can be of two types:

- Gaseous air pollutants: They include gases like CO₂, CO, SO_x, NO_x, O₃, NH₃, H₂S etc.
- Particulate air pollutant: They include solid (e.g., dust, smoke, fly ash, flumes etc.) and liquid particles (e.g., mist, spray, fog etc.) dispersed in air.

(b) What are the sources and effects of solid waste? Explain waste minimization techniques.

Ans. Sources of solid waste : Sources of solid wastes can be described in three categories:

- **Municipal wastes:** These wastes arise from residential areas (household activities, streets), commercial areas (hotels, markets, institutions.) and community areas (streets, parks, playground).
- **Industrial wastes:** These wastes arise from industrial activities and include rubbish, ashes, construction wastes, toxic wastes etc.
- **Hazardous wastes:** These are highly harmful wastes arising from hospitals, industries, nuclear plants, research institutions, laboratories and include biological wastes, toxic chemicals, radioactive substances, explosives and flammable wastes.

Effects of solid waste pollution

- Pathogens of different diseases arise from the wastes and spread diseases.
- Solid waste may choke drains and pits which result in water logging and breeding of mosquitoes
- Stray animal (dogs, cattle) feed on the garbage, spread it and also fall ill.
- Pollutants from garbage dump contaminate ground water and surface water

- Garbage dumps often destroy aesthetic value of the locality
- Fumes arising from burning of wastes pollute the air and foul smell due to decomposition of organic wastes create are unpleasant and create health problems.

Techniques for waste minimization

Waste minimization or disposal means processing of waste so as to get rid of it. It also means to reduce volume, harmful effect and unpleasant appearance of solid waste. The collected solid waste is minimized/disposed of through the following techniques:

- (i) Sanitary land filling (ii) Composting
(iii) Incineration (iv) Pyrolysis (v) Pulverization

6. (a) **What are greenhouse gases? Name and discuss their contribution to global warming. What can be the effects of global warming?**

Ans. Green house gases : Global warming is caused due to trapping of out going long wave solar radiation by atmospheric gases, which in turn increases its temperature. This phenomenon is often known as green house effect. Green house effect is shown by a number of gases known as green house gases (GHGs). They include water vapor, carbon dioxide, methane, ozone, nitrous oxide, CFCs and other halocarbons.

Green house gases and their contribution

Water vapour (H₂O) : It shows potential green house effect. It exists in form of moisture and clouds. The amount of water vapour present in atmosphere greatly varies across time and space. Hence its effect has not been counted in estimation of % contribution of GHGs.

Carbon-dioxide (CO₂) : It is the most important GHG. It has more than 64% contribution (among man made sources) in global warming.

Methane (CH₄) : It has about 19% contribution (among man made sources) in global warming. Its green house potential is 25 times than that of CO₂.

Nitrous Oxide (N₂O) : It has about 6% contribution (among man made sources) in global warming.

Chlorofluorocarbons (CFCs) : It has about 11% contribution (among man made sources) in global warming.

Ozone (O₃) : Its contribution is relatively small.

Effects of global warming : Faster melting of glaciers and polar ice is contributing in sea level rise. As per IPCC report (2007), mean sea level may rise up to 59 cm in a period of one century.

Due to sea level rise, a number of coastal regions and islands are facing risk of sinking in sea. This will result in loss of agricultural and shelter land.

Faster melting of glaciers will result into faster depletion of glaciers. This may result into drying of glacier fed rivers like Ganga, Yamuna etc. Drying of rivers will greatly destroy the civilizations in areas far from the seas.

Global warming will also result into loss of agricultural productivity, chiefly because, the grain size will remain small due to its early ripening.

Due to high temperature moisture level will increase and that moisture will again increase the global warming. Such positive feed back loop is particularly dangerous.

High moisture level will sustain more pathogens and bacteria. They will pose more health threats or diseases. Moreover, floods will be frequent and hence the frequency of water borne diseases will increase.

Rainfall pattern will be highly disturbed across the globe. This will result into major ecological disturbance, forest fires, loss of productivity, loss of biodiversity, etc.

(b) **'The Earth System is not and never has been free from climate change'.**
Comment.

Ans. The Earth System has never been free from climate change : Climate refers to average

pattern of weather phenomena, including temperature, precipitation (rainfall, snowfall), winds, glaciations, storms etc. Long term variation in this pattern is called as climate change.

During the last century the overall climate of the earth underwent significant changes. The most remarkable change is its increasing temperature, which is often referred as global warming. Global warming is resulting into several consequences like sea level rise, faster glacial melting, altered rain fall pattern etc.

Many scientists hold the view that this is not the first time that global climate is changing. In fact the climate of the earth has changed drastically many times in geological past. During these climatic changes, temperature of our atmosphere increased as well as decreased both. These views also propose that the earth, as a system somehow maintains a balance in its climate through these fluctuations.

There are geological evidences that in past there were several alternate incidences of global warming and glaciations. Global warming was partly caused due to increased concentration of CO_2 triggered by volcanic eruption and many other earth processes.

Glaciations, also termed as ice ages, refer to the stages of the earth when significant portion of the earth was covered with ice. This cooling was partly caused by periodical fluctuation in the intensity of solar radiation as well as changing concentration of CO_2 in the earth's atmosphere. There have been as many as eighteen incidences of glaciations.

7. (a) What is ozone hole? What are the causes of ozone hole formation? What are the effects of depletion of ozone layer?

Ans. Ozone hole : Stratospheric ozone absorbs UV-rays and protects the living beings of the earth from their harmful effects. Unfortunately,

the ozone layer is being depleted due to many chemicals like CFCs. As a result of this, harmful UV-rays are entering our biosphere and harming us. The term "ozone hole" refers to regions where stratospheric ozone is highly depleted.

Causes of ozone hole formation : Ozone holes occur during spring season above Antarctica (larger hole) and the Arctic region. In these regions, special meteorological conditions and very low air temper enhance the destruction of ozone loss by man-made ozone depleting chemicals (ODCs).

Ozone depletion chemicals (ODCs) include a number of industrial organic compounds, especially chlorofluorocarbons (CFCs), Methyl chloroform ($\text{C}_2\text{H}_5\text{Cl}_3$), Carbon tetrachloride (CCl_4), Carbon tetra fluoride (CF_4), and Halons which contain bromine instead of chlorine.

These compounds reach stratosphere and destroy ozone molecules through a variety of catalytic reactions.

Effects of ozone layer depletion : Due to depletion of ozone layer, UV rays (particularly UV-B) reach the earth - surface and causes harmful effects like skin cancer, eye sight defect (eye cataract) and genetic disorder (DNA-damage) in man, animals and plants.

There are three categories of UV radiation: UV-A (320-400 nm), UV-B (280-320 nm) and UV-C (200-280 nm). Out of these UV-A is the least damaging (longest wavelength) and reaches the Earth in greatest quantity. UV-B and UV-C radiations are most harmful to living beings. Most of these are absorbed by oxygen and ozone in the stratosphere, so they do not reach the Earth's surface.

7. (b) What should be the 'guidelines for excellence' for environmental education?

Ans. Guidelines for excellence for environmental education : The North American Association for Environmental Education has

established the following "Guidelines for Excellence" in Environmental Educations:

1. **Fairness and accuracy** : The content should be accurate in describing environmental problems.
2. **Depth** : The content should be deep enough to address concept, values, attitudes, perceptions related to environmental problems.
3. **Emphasis in skill building** : Such education should build lifelong skills in the learners.
4. **Action orientation** : Such education should have applicability in personal life, civic life, civic life as well as in solving environment problems.
5. **Instructional soundness** : Such education should be imparted through clear instructions in order to ensure effective learning.
6. **Usability** : Such education should be clear, logical, adaptable, long lasting and easy to use. They should fit with national, state or local requirements.
8. (a) **Discuss the strategy and policy adopted by Government of India for the development of women education.**

Ans. Strategy/policy of Govt. of India for Women Education in India

Following are the some strategies/policies of Govt. of India for promoting women education:

- The 86th Constitutional Amendment has made elementary education a fundamental right for the children between the age 6 to 14.
- Balika Samridhi Yojana: to encourage enrollment and retention of girls in schools
- The Programme of Development of Women and Children: to improve socio-economic condition of rural women and children
- Indira Mahila Yojana: for women empowerment by forming groups Mahila

Samridhi Yojana: to encourage habit of saving in women

- Reservation of seats in institution of higher education efforts are being made
- Scheme of Employment and Income Generating Training-cum-Production Centres: funded by Norwegian Agency for employment
- Rashtriya Mahila Kosh: for credit needs of women.
- Scheme of Short Stay Home for Women and Girls: for providing stay to helpless women and girls
- The Integrated Child Development Services (ICDS): for providing health support to children, mothers and pregnant women

(b) **Discuss the role of Government and legal aspects in environmental protection.**

Ans. Role of government in environmental protection : Major roles of government for environmental protection includes (for example in India) :

- Making environmental laws/policies and implementing them
- Conserving forests, wildlife and different natural resources through institutional framework
- Monitoring pollution levels across the country through Pollution Control Boards
- Conducting large scale pollution control programs (e.g., Ganga Action Plan, Yamuna Action Plan)
- Running municipality, sewage system, solid waste dumping etc. for disposal of urban waste
- Promoting environmental education at all levels (at schools, colleges and universities) and promoting research and development in environmental field
- Creating awareness among public for their participation in environmental protection

Legal Aspects in environment protection

- Legal aspects include different environment laws and their implementation. Worldwide, a number of countries have well defined environmental laws to protect their environment.
- India is the first country in the world which has provision for environment protection in its constitution (Article 48-A and Article 51-A of the Constitution of India). These acts identify environmental conservation as one of the fundamental duties.
- In India, there are more than 200 central/state laws for environmental protection. These are related to different aspects of environment. Some laws are applicable while others are limited to certain areas /zones / regions.
- **Environmental laws help environmental protection in the following ways :**
 - Guidelines for resource use and checking their overexploitation
 - Regulating pollution and defining limits
 - Resolving conflicts related to environment
 - Punishing or imposing penalty on the violators of laws
- Most of the laws are highly relevant for environment conservation. But unfortunately, due to poor enforcement they remain ineffective
- Major reason for failure of these laws have been very effective to bring big changes in India also. For example, closure of polluting factories and adoption of CNG based transportation in Delhi were largely due to intervention of law or court as a response to PIL (Public Interest Litigation) by common man.

9. Write short notes on following :-

- (a) **Effect of transportation activities on environment.**

Ans. Effect of transportation activities on environment : Globally, transport consumes 30% of energy resources (particularly of fossil fuels). 82% of this is consumed in road transport. Transport is in fact one of the biggest cause of energy crisis.

Emission from vehicles is the major source of air pollution. Transport accounts for 60% of total CO emission, 42% of total NO_x emission, 40% of total hydrocarbon emission and a large part of SPM emission (Suspended Particulate Matter).

Used tyres, oils and air conditioning system if vehicles emit CFCs (which deplete Ozone) and other harmful chemicals. Vehicular emission containing NO_x and hydrocarbon undergo complex reactions and form Photochemical Smog, which create harm to human health, crops and social assets.

Transport infrastructure consumes 25-30% of land of modern cities. Roads, Highway, Railway tracks, Airports etc. are made by destroying agricultural land, forest land and other natural resources. This results in ecological imbalance and loss of habitat for wildlife. It also provide corridor for the spread of harmful pests and weeds.

Noise pollution and vibration created by road traffic, trains and aeroplane causes serious health problems to the people living nearby.

Increasing degree of motorization, increasing traffic congestion and increasing commuting time is causing negative impact on human health, lifestyle and family economy. It has also restricted the mobility of children, old aged and disabled people, and has made everybody automobile dependent.

Transportation of hazardous substance is associated with risk of spillage due to accidents. This results into ecological devastation, e.g., of marine or coastal environment.

(b) Hydrogen as an alternate future source of energy.

Ans. Hydrogen as an alteroative future source of energy

- Hydrogen is an efficient, renewable and non-polluting fuel. When it is mixed with oxygen it provides 29 kcal/per gram energy which is higher than petrol (11.2 kcal/gram) and coal (7.8 kcal/gram).
- Hydrogen energy is believed to greatly reduce our reliance on fossil fuel and hence it is considered as major alternative source of energy in future.
- Hydrogen fuel cells are devised for the purpose of energy production. The fuel cell simply combines hydrogen and oxygen chemically to produce electricity, water and waste heat. There are several types of fuel cells, but the one most suited for cars is called the proton-exchange membrane (PEM) fuel cell.
- Hydrogen (H) is the most abundant element in the universe, constituting about 93% of all matter. It is found in water (H_2O), fossil fuels (basically, compounds of hydrogen and carbon), and all plants and animals. Its major reserve on the earth is water and that is inexhaustible. In atmosphere it is found in very low concentration (0.1 ppm) due to its high reactive nature and lowest density.
- There are three major ways to manufacture hydrogen: Breaking down of hydrocarbon mainly methane; Electrolysis of water; Reacting water with metals; Bio-photolysis of water
- Commercial level production of hydrogen is however very challenging. This is due to the fact that the process of splitting water molecule into hydrogen and oxygen is often energy consuming and energy input often exceeds energy output.
- Apart from manufacturing challenges, hydrogen is associated with limitation in its storage, transport and use in motor vehicles due to its low density. There are risk of leakage and catching fire also.
- Worldwide intensive R&D is being done for improving efficiency of processes of hydrogen manufacture and its applications in automobiles. Remarkable achievements have also been made.