

ENVIORNMENTAL STUDIES (June 2017)

Q.1.a) Explain Food Chain.

(3 M)

Ans:

- In an ecosystem energy flows from one trophic level to another. A trophic level represents a group of organisms, which are either predators or preys. All organisms in an ecosystem are linked to one another based on their nutritional needs.
 - The relation between the individuals in a linear chain is a food chain. A food chain always begins with the producers. The various components of the food chain are a group of organisms. There is transfer of food energy through series of organisms by repeated eating and being eaten.
 - A food chain shows how each organism gets food and how nutrients and energy are passed from one creature to the other. Food chains begin with plant-life, and end with animal-life. Some animals eat plants, some animals eat other animals.
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Q.1.b) Explain Environmental aspects of sustainable development. (3 M)

Ans:

- An environmentally sustainable system must maintain a stable resource base, avoiding over-exploitation of renewable resource systems or environmental sink functions, and depleting non-renewable resources only to the extent that investment is made in adequate substitutes.
 - This includes maintenance of biodiversity, atmospheric stability, and other ecosystem functions not ordinarily classed as economic resources.
 - Environmental-Social Aspect: This blending of environmental and social aspects of sustainability deals with how we interact with our environment. This can include how we plan and design our homes and cities, how we take care of the resources we have available to us, and the ways we interact with the environment.
 - Environmental-Economic Aspect: When it comes to looking at how environmental and economic aspects interact, we need to look at both how economics affects the environment and how the environment affects economics. Environmentally friendly products are becoming more common, making it easier to purchase goods with less packaging, cleaners that are less hazardous to us and our environment and foods that are grown in ways that are better for the environment.
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Q.1.c) What is meant by E pollution?

(3 M)

Ans:

- E-waste is a term used to cover almost all types of electrical and electronic equipment (EEE) that has or could enter the waste stream. It includes televisions, computers, mobile phones, fridges, washing machines, dryers, home entertainment and stereo

systems, toys, toasters, kettles – almost any household or business item with circuitry or electrical components with power or battery supply.

- E-waste is now the fastest growing component of the municipal solid waste stream because people are upgrading their mobile phones, computers, televisions, audio equipment and printers more frequently than ever before. The problem is that much of these equipment's is ending up in landfills or overseas and is contaminating the environment.

Q.1.d) Differentiate between conventional and non-conventional energy. (3 M)

Ans:

Conventional Energy	Non-Conventional Energy
Conventional energy is finite and hidden.	It is reliable and plentiful.
These will become more expensive as supplies dwindle and demand increase.	These will potentially be very cheap once technology and infrastructure improve.
These sources on burning produce greenhouse gases and other pollutants that effects human health and environment.	These are clean sources of energy. They produce neither greenhouse gases, which cause climate change nor polluting emissions.
These has low maintenance cost and require less land area for installations.	These has high maintenance cost and require large land area for installations.
There are many safety concerns surrounding these resources, such as explosion on oil platforms and collapsing coal mines.	There are as such no safety concerns with these resources.
These resources have high energy density.	These resources have less energy density.
Coal, petroleum, natural gases are the examples of conventional energy resources.	Solar energy, wind energy, tidal energy etc. are the examples of non-conventional energy sources.

Q.1.e) Explain concept of carbon credit.

(3 M)

Ans:

- Carbon credit is a tradable permit scheme. It is a simple, non-compulsory way to counteract the greenhouse gases that contribute to climate change and global warming.
- Carbon credits create a market for reducing greenhouse emissions by giving a monetary value to the cost of polluting the air.
- A carbon credit represents one tonne of carbon dioxide either removed from the atmosphere or saved from being emitted.

1 credit = 1 tonne of CO₂

- Carbon credits are certificates awarded to countries that are successful in reducing emissions of greenhouse gases. Carbon credits are generated as the result of an additional carbon project.
- Carbon credits can be created in many ways but there are two broad types:
 1. Sequestration (capturing or retaining carbon dioxide from the atmosphere) such as Afforestation and reforestation activities.
 2. Carbon Dioxide Saving Projects such as use of renewable energies

The concept of carbon credits came into existence as a result of increasing awareness of the need for controlling emissions. Carbon credits were one of the outcomes of the Kyoto Protocol, an international agreement between 169 countries which created legally binding emission targets for developing nations.

Q.1.f) Explain Environmental Impact Assessment (EIA).

(3 M)

Ans:

- Environmental Impact Assessment (EIA) is a process of evaluating the likely environmental impacts of a proposed project or development, taking into account inter-related socio-economic, cultural and human-health impacts, both beneficial and adverse.
 - UNEP defines Environmental Impact Assessment (EIA) as a tool used to identify the environmental, social and economic impacts of a project prior to decision-making.
 - It aims to predict environmental impacts at an early stage in project planning and design, find ways and means to reduce adverse impacts, shape projects to suit the local environment and present the predictions and options to decision-makers.
 - By using EIA both environmental and economic benefits can be achieved, such as reduced cost and time of project implementation and design, avoided treatment/clean-up costs and impacts of laws and regulations.
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Q.1.g) Explain causes and effects of Ozone layer depletion.

(3 M)

Ans:

Causes:

- The main things that lead to destruction of the ozone gas in the ozone layer. Low temperatures, increase in the level of chlorine and bromine gases in the upper stratosphere are some of the reasons that leads to ozone layer depletion. But the one and the most important reason for ozone layer depletion is the production and emission of chlorofluorocarbons (CFCs). This is what which leads to almost 80 percent of the total ozone layer depletion.
- There are many other substances that lead to ozone layer depletion such as hydro chlorofluorocarbons (HCFCs) and volatile organic compounds (VOCs). Such substances are found in vehicular emissions, by-products of industrial processes, aerosols and

refrigerants. All these ozone depleting substances remain stable in the lower atmospheric region, but as they reach the stratosphere, they get exposed to the ultra violet rays. This leads to their breakdown and releasing of free chlorine atoms which reacts with the ozone gas, thus leading to the depletion of the ozone layer.

Effects:

- In humans, exposure to UV rays can also lead to difficulty in breathing, chest pain, and throat irritation and can even lead to hampering of lung function.
- UV rays affect other life forms too. It adversely affects the different species of amphibians and is one of the prime reasons for the declining numbers of the amphibian species. It affects them in every stage of their life cycle; from hampering the growth and development in the larvae stage, deformities and decreases immunities in some species and to even retinal damage and blindness in some species.
- UV rays also have adverse effect on the marine ecosystem. It adversely affects the planktons which plays a vital role in the food chain and oceanic carbon cycle. Affecting phytoplankton will in turn affect the whole ocean ecosystem.
- UV rays will also affect the plants. UV radiations can alter the time of flowering in some plant species. It can also directly affect the plant growth by altering the physiological and developmental processes of the plants.

Q.2.a) Explain various modes needed for public awareness to protect earth from environmental degradation. (5 M)

Ans:

1. Public awareness of the environment comes from a result of general knowledge, specialist knowledge of a particular problem and a sense of responsibility for the environment.
2. As the Earth's resources are dwindling and our environment is being increasingly degraded by human activities, it is evident that something needs to be done. Human beings cannot isolate themselves from the environment.
3. Environmental protection and conservation is beyond the capacity of one individual, one institution or one government. Hence every citizen of the world needs to be aware and need to actively participate in protecting the global environment.
4. The various modes for public awareness to protect earth from environmental degradation are:
 - **Environmental education:** Environmental education must be introduced as a course in schools and colleges.
 - **Mass media:** Newspapers, magazines, television, radio programs can play an important role in educating masses.
 - **Seminars and conferences:** Organizing seminars and conferences that may help to spread the environmental information to generate public awareness.
 - **Entertainment:** Folk songs, street plays, documentaries can help propagate environmental awareness.
 - **Public supported movements:** Events, marches, campaigns can be organised for an environmental cause.

- **Science centres:** Science centres can be established in villages and remote areas to spread information about the environmental problems, causes and control measures.
 - **Government and Non-Governmental Organisations:** Government and NGOs can work together to carry out public awareness programs.
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Q.2.b) Explain need and importance of Environmental studies.

(5 M)

Ans:

Importance:

1. Environmental studies helps to understand the current environmental problems through the knowledge of physical, chemical, biological, and social processes. It provides the skills necessary to obtain solutions to environmental problems. It encourages the development and application of scientific principles to solve environmental problems.
2. Environmental studies helps to maintain ecological balance through basic operating knowledge of environmental systems and processes. It gives information regarding the changes in the environment due to anthropogenic factors. It helps gain skills to analyse the various environment systems and the effect of human activities on them.
3. Environmental studies helps to achieve sustainable development through the understanding of the relationships of development and environment. The concepts of environmental studies can be applied to study agriculture and design sustainable production systems.
4. Environmental studies applies economic methods, concepts of environmental policy analysis and environmental management. It helps to formulate the broad social, economic and regulatory frameworks in which environmental problems can be resolved. It includes property rights, cost-benefit analysis, economic instruments for pollution control etc.
5. Environmental studies aims to protect biodiversity. Growth in human population, increased material consumption, and technological development has increased rate and scale of environmental degradation leading to loss of biodiversity.
6. Environmental studies helps to educate people regarding their duties towards environmental protection. It provides basic information about the various environmental issues like energy needs, global climate change, toxic emissions, and waste disposal. It provides knowledge about development and utilisation of energy resources and importance of environmental stability in the contemporary culture.

Need:

- Public awareness of the environment comes from a result of general knowledge, specialist knowledge of a particular problem and a sense of responsibility for the environment.
- As the Earth's resources are dwindling and our environment is being increasingly degraded by human activities, it is evident that something needs to be done. Human beings cannot isolate themselves from the environment.
- The imbalance that they have created is slowly interfering with their survival and sustenance on Earth.

- Environmental pollution, growing human population, depletion of natural resources, climate changes, calamities and disasters are all environmental concerns. Environmental protection and conservation is beyond the capacity of one individual, one institution or one government.
 - Hence every citizen of the world needs to be aware and need to actively participate in protecting the global environment.
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Q.2.c) Explain the classification of Ecosystem.

(5 M)

Ans:

An ecosystem may be natural (like forest, lake, ocean etc.) or man-made (such as an aquarium, a crop field etc.), temporary (like a rain fed pond) or permanent (like a lake, forest, etc.), aquatic (such as pond, ocean etc.) or terrestrial (like grassland, forest, etc.).

- **Natural Ecosystem:** Natural Ecosystem may be terrestrial (like desert, forest, etc) or aquatic like pond, river, lake, etc. A natural ecosystem is a biological environment that is found in nature (e.g. a forest) rather than created or altered by man (e.g. a farm).
 - **Artificial Ecosystem:** Humans have modified some ecosystems for their own benefits and these are Artificial Ecosystem. They can be terrestrial (crop field, garden etc.) or aquatic (aquarium, dam, manmade pond etc.).
 - **Terrestrial ecosystems:** Terrestrial ecosystems are found everywhere apart from water bodies. They are broadly classified into:
 - **The Forest Ecosystem:** These are the ecosystems where abundance of flora (plants) is seen and they have a large number of organisms living in relatively small areas. Therefore, the density of life in forest ecosystems is very high.
 - **The Desert Ecosystem:** Desert ecosystems are found in regions receiving an annual rainfall of less than 25cm. They occupy around 17 percent of all land on the planet. Due to very high temperature, intense sunlight and low water availability, flora and fauna are very poorly developed and scarce. Vegetation is mainly bushes, shrubs, few grasses and rarely trees. Leaves and stems of these plants are modified to conserve water. The best known desert plants are the succulents like spiny leaved cacti. Animal life includes insects, reptiles, birds, camels all of whom are adapted to the xeric (desert) conditions.
 - **Aquatic ecosystem:** An aquatic ecosystem is an ecosystem located in a body of water. It comprises aquatic fauna, flora and the properties of water too. There are two types of aquatic ecosystems, marine and freshwater.
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Q.3.a) Explain principle, construction and working of venturi scrubber. (5 M)

Ans:

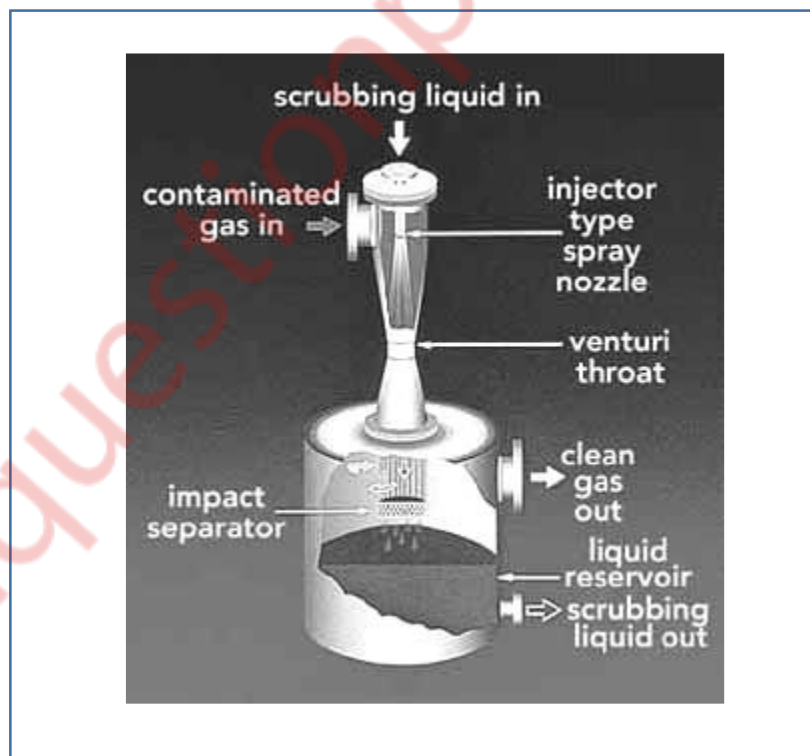
Principle:

- In the venture scrubber, gas laden with particulate matter passes through a constricted section of the scrubber where scrubbing liquid and gas reach high

velocities, resulting in high turbulence in the liquid and gas streams, which causes liquid droplet-particle contact. The scrubbing liquid hence removes the pollutants from the gas stream.

Description and Working:

- Venturi scrubber is a venturi shaped chamber with converging and diverging sections. It consist of a third section called the throat section.
- The scrubbing liquid (generally water) is introduced at the entrance to the converging section through a nozzle.
- The inlet gas stream enters the converging section and, as the area decreases, gas velocity increases.
- The inlet gas, which is forced to move at extremely high velocities in the small throat section, shears the liquid from its walls, producing a tremendous number of very tiny droplets.
- In the throat section, particle and gas pollutant removal occurs as the inlet gas stream mixes with the fog of tiny liquid droplets.
- The inlet stream then exits through the diverging section, where it is forced to slow down.
- Many scrubbers are available with pre-filters or final filters to further reduce emissions. Pre-filters are installed upstream of the scrubber intended to catch larger particles.
- A final filter is often installed downstream of the scrubber, and is intended to catch fine particles that were not removed during the scrubbing process.



**Q.3.b) What is meant by water pollution? Explain sources and effects of water pollution.
(5 M)**

Ans:

Water pollution refers to the addition of any substance to water that may cause changes in its physical and chemical properties and interfere with its use for legitimate purposes. The following are indications that water is polluted:

1. Bad taste or offensive odour
2. Reduction in number of aquatic lives in rivers, fresh water, seas.
3. Oil or grease floating on the surface of water.
4. Unchecked growth of aquatic weeds.
5. Outbreak of an endemic.

Sources of water pollution:

1. Effluents released from industrial units such as inorganic and organic pollutants, oil, grease, plastic, metals, acids, toxic chemicals, colour dyes etc.
2. Discharge of untreated or partly treated sewage of domestic and municipal waste, leachates from solid disposal.
3. Fertilizers, pesticides, soil additives from agricultural activities.
4. Human activities such bathing, washing, other customs and traditions.

Effects:

- **Effect on humans:** The consumption of polluted water can lead to various water borne diseases like cholera, typhoid, infectious hepatitis, amoebic dysentery etc. Toxic substances polluting the water have several effects on human health. It may damage liver, kidneys, brain and lead various diseases of the central nervous system. Some examples of diseases due to water pollution Minamata disease, Itai-Itai disease, blue baby syndrome, etc.
 - **Effect on plants:** Polluted water may also contain high concentrations of heavy metals which are toxic for plants and hamper their growth. The excess amount of nitrates and phosphates (fertilizers) that are run off into the nearby water bodies lead to an increase in growth of certain plants on the surface of the water bodies. As a result the water becomes deficient of dissolved oxygen which causes the aquatic life to perish. This phenomenon is known as eutrophication. Polluted water becomes turbid and lowers the amount of light that reaches the submerged plants that leads to reduction of photosynthesis.
 - **Effect on animals:** Drinking polluted water causes the toxins in the water to enter the body of the organism, which may lead to serious health disorders and even death in many animals. The presence of harmful chemicals and pollutants in water makes the survival of aquatic organisms extremely difficult. Bio magnification is the cumulative increase of a persistent chemical substance in the successive trophic levels in a food chain. An example is the decrease in the population of ospreys that consumed fishes, due to bio magnification effects of DDT (insecticide) washed off into the nearby water bodies.
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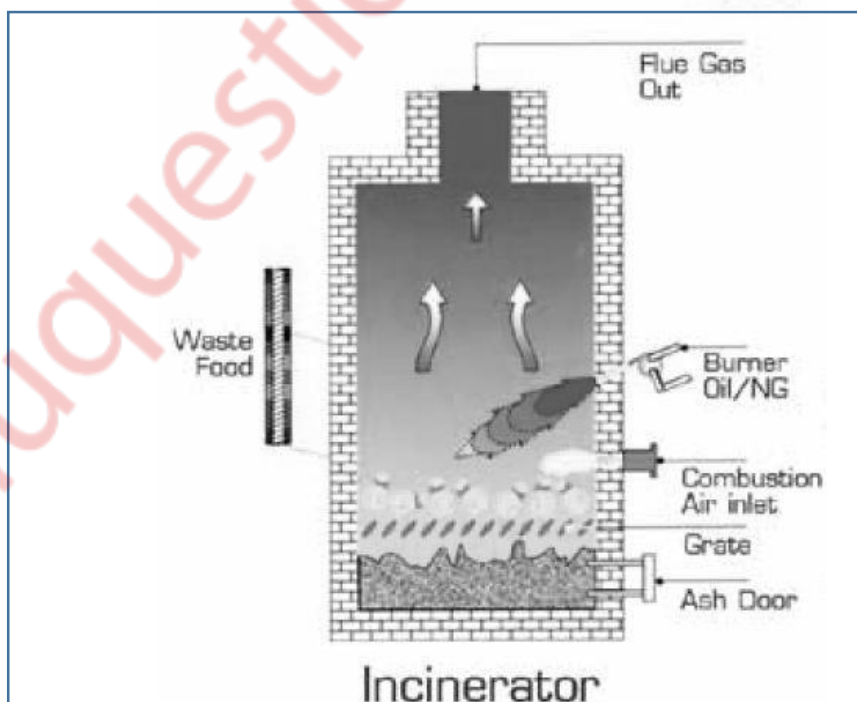
Q.3.c) List the widely used methods for solid waste treatment. Explain any one in details. (5 M)

Ans:

The management of solid waste is very essential for the sustainable growth of human civilization. The major considerations in solid waste management are public health and environmental conservation. Solid waste management is basically a three step process which includes collection, transportation, and disposal of solid waste. It involves several practices like source reduction, recycling, composting, landfilling, and incineration.

Incineration:

1. Incineration is a waste treatment technology, which includes the combustion of waste for recovering energy. Incineration coupled with high temperature waste treatments are recognized as thermal treatment.
2. During the process of incineration, the waste material that is treated is converted in to gases, particles and heat. These products are later used for generation of electricity. The gases, flue gases are first treated for removal of pollutants before going in to atmosphere.
3. Incineration reduces the mass of the waste from 95 to 96 percent. This reduction depends upon the recovery degree and composition of materials. This means that incineration however, does not replace the need for landfilling but it reduced the amount to be thrown in it.
4. Incineration comes with a number of benefits in specific areas like medical wastes and other life risking waste. In this process, toxins are destroyed when waste is treated with high temperature.
5. Incinerator can be understood more precisely as a furnace where waste is burnt. Modern incinerators are equipped with pollution improvement systems, which play their part in cleaning up the flue gas and such toxicants.



Q.4.a) Outline the important features of environmental clearance and authorisation mechanism? (5 M)

Ans:

Clearance:

- Normally the MPCB's No Objection Certificate (NOC) in the form of combined Consent to establishment under Water Act, Air Act & Hazardous wastes Rules would be required for setting up of an industrial unit.
- In regard to 39 specified industrial and infrastructure projects, environmental clearance from the Ministry of Environment and Forests(MoEF), Government of India (GoI) and State Environment Department are also required as per Environmental Impact Assessment Notification dtd.14/09/2006.
- For the industrial units, Municipal Solid Waste (MSW) sites and other developmental activities located on the coastal stretches of bays, estuaries, creeks, rivers and back waters, Coastal Regulation Zone (CRZ) clearance also is required.

Authorisation:

- The standards are prescribed by the Ministry of Environment & Forest and Government of India, which are minimum uniform national standards, which cannot be relaxed by any authority including CPCB and MPCB. But MPCB can prescribe more stringent standards than whatever laid down by the Ministry of Environment & Forest and Government of India, taking into consideration the local conditions.
- The authorization for collection/reception/treatment /transport/storage/disposal of Hazardous wastes and biomedical wastes as defined under the rules needs to be obtained by Board.
- Monitoring of the industrial unit means sending out the monitoring teams comprised of skilled technical & scientific officers to verify the compliance of conditions imposed in NOC, Consent, authorization etc. Monitoring includes performance evaluation of Environment Management System (EMS) in respect of Board's notices/directives and checking the compliance of Environmental Clearance conditions and that no violation of law takes place. MPCB has set up mechanisms to analyse the reports received from the monitoring teams and the laboratory verifies the samples and also verifies the compliance of other techno-legal requirements that the unit has to comply with. Based upon the findings so arrived at enforcement measures are taken. In certain cases surprise checking through vigilance squad are also carried out.

Q.4.b) What are important powers and functions of Central Pollution Control Board.

(5 M)

Ans:

1. Advise the Central Government on any matter concerning prevention and control of water and air pollution and improvement of the quality of air.
2. Plan and cause to be executed a nation-wide programme for the prevention, control or abatement of water and air pollution;
3. Co-ordinate the activities of the State Board and resolve disputes among them;

4. Provide technical assistance and guidance to the State Boards, carry out and sponsor investigation and research relating to problems of water and air pollution, and for their prevention, control or abatement;
5. Plan and organise training of persons engaged in programme on the prevention, control or abatement of water and air pollution;
6. Organise through mass media, a comprehensive mass awareness programme on the prevention, control or abatement of water and air pollution;
7. Collect, compile and publish technical and statistical data relating to water and air pollution and the measures devised for their effective prevention, control or abatement;
8. Prepare manuals, codes and guidelines relating to treatment and disposal of sewage and trade effluents as well as for stack gas cleaning devices, stacks and ducts;
9. Disseminate information in respect of matters relating to water and air pollution and their prevention and control;
10. Lay down, modify or annul, in consultation with the State Governments concerned, the standards for stream or well, and lay down standards for the quality of air;
11. Perform such other function as may be prescribed by the Government of India.

Q.4.c) What do you mean by noise pollution? Explain sources and effects of Noise pollution.

(5 M)

Ans:

- Noise is defined as unpleasant or disagreeable loud sound or sound that causes discomfort to the listener. With the rapid growth in population, traffic and urban crowd, noise has emerged as a widely prevalent irritant. The efficiency of humans is higher when they perform their duties under satisfying and comfortable conditions than when they are constantly irritated or annoyed by their surroundings.
- Noise pollution is unwanted or offensive sounds that unreasonably intrude into our daily activities.
- Noise measurements are expressed as Sound Pressure Level (SPL) which is logarithmic ratio of the sound pressure to reference pressure. It is expressed as a dimensionless unit called decibel (dB).

Sources of noise pollution:

- The main identified sources of noise pollution are categorized as:
- **Natural sources:** Some natural phenomena like volcanic eruption, thunder, firestorm etc. are sources of noise pollution which is not humanly possible to control.
- **Man-made sources:** Some sources of noise pollution owing to human activities are occupational noise due to heavy industrial machines, domestic appliances, transport noise due to road traffic, aircraft, rail traffic and neighbourhood noise due to loud speakers, fireworks, entertainment etc.

Effects of noise pollution:

- Noise pollution does not only affect hearing capabilities on humans but also can cause various other health disorders and so effects of noise pollution can be classified into:

- **Auditory effects:** Exposure to high intensity sound for short duration can cause temporary deafness and continuous exposure to high intensity noise will lead to irreversible hearing loss or permanent deafness.
 - **Non-auditory effects:** The other effects of noise pollution in humans include physiological disorders like anxiety, insomnia, high blood pressure, fatigue, etc., loss of working efficiency due to poor concentration and reduced ability to think, annoyance due to noisy surroundings. Some effects on wildlife due to loud noise include an increase in rate of mortality as a result of interference in the predator – prey detection and avoidance, disturbances in sound communication and navigation of species like whales and dolphins, migratory birds, health deterioration of many animals due to continued exposure to high intensity noise. Sometimes buildings and materials may get damaged by exposure to infrasonic / ultrasonic waves and may even get collapsed.
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Q.5.a) How electricity is generated by wind energy?

(5 M)

Ans:

- Wind is caused by the uneven heating of the atmosphere by the sun, variations in the earth's surface, and rotation of the earth. Mountains, bodies of water, and vegetation all influence wind flow patterns.
- Wind energy technologies use the energy in wind for practical purposes, such as generating electricity, charging batteries, pumping water, and grinding grain. Mechanical or electrical power is created through the kinetic energy of the wind. Wind power available is proportional to the cube of its speed, which means that the power available to a wind generator increases by a factor of eight if the wind speed doubles.
- Wind power is now the world's fastest growing energy source and the generation capacity has reached 435 GW at the end of 2015, around 7% of total global power generation capacity.
- Offshore wind has the potential to deliver substantial quantities of energy at a price that is cheaper than most of the other renewable energies, as wind speeds are generally higher offshore than on land.

Principle:

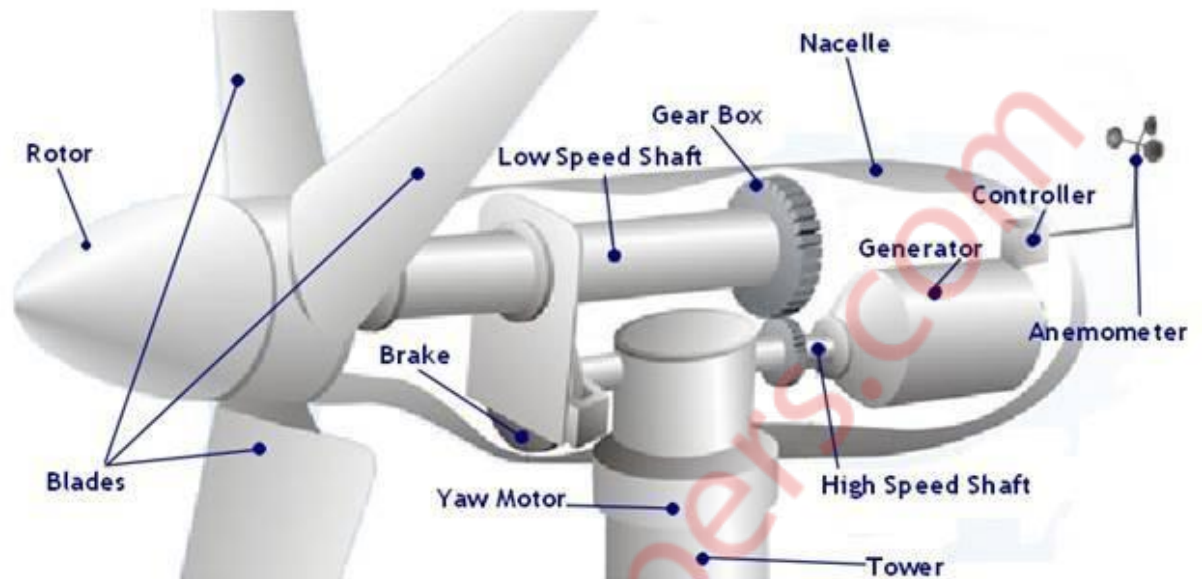
Wind turbines convert the kinetic energy in the wind into mechanical power. A generator can convert mechanical power into electricity. The mechanical power can also be utilized directly for specific tasks such as pumping water.

Construction and Working:

The basic components of the wind turbine include:

- a rotor, consists of the blades and the hub which convert the wind's energy into rotational shaft energy
- a nacelle containing a drive train, includes shafts, gearbox and generator
- pitch drive, turns the blades out of the wind to control rotor speed
- brake, slows the rotor down
- yaw drive, keeps the rotor and therefore the turbines facing the wind

- controller-anemometer, starts and stops the turbine from working depending on conditions
- a tower, to support the rotor and drive train; electronic equipment such as controls, electrical cables, ground support equipment, and interconnection equipment.



The schematic of the wind turbine components are shown here.

- When the wind blows a pocket of low-pressure air forms on the downwind side of the blade. The low-pressure air pocket then pulls the blade toward it, causing the rotor to turn. This is called lift.
- The force of the lift is actually much stronger than the wind's force against the front side of the blade, which is called drag. The combination of lift and drag is what causes the rotor to spin.
- As the rotor spins, the low-speed shaft, which is connected to the gearbox, spins at the same rate.
- The gearbox takes this slow rotational speed and through correct gearing turns it into a faster rotational speed.
- The high-speed shaft, which is on the outgoing end of the gearbox and connected to a generator, spins at a higher rate of speed.
- The generator spins at this high rate of speed which spins magnets around a coil of metal wire and generates electricity.
- This electricity then travels down the tower to a transformer, where it is converted again to AC or DC voltage depending on the grid.

Q.5.b) State and explain, construction and working of flat plate collector used for solar energy. (5 M)

Ans:

The Earth receives an incredible supply of solar energy. The sun, an average star, is a fusion reactor that has been burning over 4 billion years. It provides enough energy in one minute to supply the world's energy needs for one year. The amount of solar radiation striking the earth over a three-day period is equivalent to the energy stored in all fossil energy sources. Global installed capacity for solar-powered electricity has seen an exponential growth, reaching around 227 GW at the end of 2015. It produced 1% of all electricity used globally. Solar energy is used in thermal and photovoltaic systems:

- **Thermal systems** concentrates sunlight, converts it into heat, and applies it to a steam generator or engine to be converted into electricity in order to warm buildings, heat water, generate electricity, or destroy dangerous waste. For example, solar thermal collectors.
- **Photovoltaic systems** are composed of cells made of semiconductor material, (silicon). It can produce power when sunlight strikes the semiconductor material and creates an electric current. For example, solar cells.

Flat Plate collectors (Solar thermal collectors):

- The flat-plate solar collectors are probably the most fundamental and most studied technology for solar-powered domestic hot water systems.

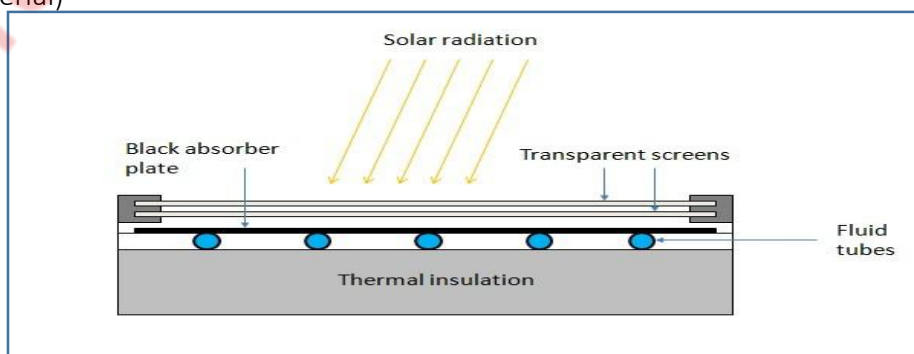
Principle:

- The basic principle for this device is that the sun heats a dark flat surface, which collects as much energy as possible, and then the energy is transferred to water, air, or other fluid for further use.

Construction and Working:

These are the main components of a typical flat-plate solar collector:

- **Black surface** : absorber plate that absorbs the incident solar energy (copper or aluminium sheet coated with selective coating)
- **Glazing cover:** transparent layer that transmits radiation to the absorber, but prevents radiative and convective heat loss from the surface (plastic or glass)
- **Tubes:** contain heating fluid to transfer the heat from the collector
- **Support structure:** protect the components and hold them in place
- **Insulation:** cover sides and bottom of the collector to reduce heat losses (polymeric material)



The schematic of a flat plate solar collector with liquid transport medium is given here.

- The black absorber plate absorbs radiant heat from sunlight.
- The black absorber plate is covered by transparent screens to reduce the heat loss due to convection and radiation to the atmosphere.
- There are tubes carrying water, which gets heated due to the heat absorbed.
- The thermal insulation prevents heat loss during heat transfer.
- The flat-plate systems normally operate and reach the maximum efficiency within the temperature range from 30 to 80 °C, however some new types of collectors that employ vacuum insulation can achieve higher temperatures (up to 100°C).
- Due to introduction of selective coatings, stagnant fluid temperature in flat-plate collectors has been shown to reach 200 °C.
- Flat-plate collectors need to face the sun to obtain maximum sunlight exposure. The installation angle should be equal to or up to 15° higher than the latitude of the location.
- This angle ensures optimal heat output throughout the year. The flat plate solar collectors are highly useful for low temperature heating. The main use of this technology is in residential buildings where the demand for hot water has a large impact on energy bills. Commercial applications include car washes, military laundry facilities and eating establishments.

Q.5.c) What are the limitations of conventional sources of energy?

(5 M)

Ans:

- Very Costly Production Cost.
- Heavy Transmission & Distribution Loss.
- Limited Reach.
- Big Threat for Environment & Public Health.
- Cause of Global Warming, Greenhouse Effect, Acid Rain Etc.
- Uncertainty in availability, not replenish able, available in limited amount in environment and availability depends on the rate of consumption by humans.
- Electricity Tariff is increasing at about 8 to 10% p.a. on an Average.

Q.6.a) Explain case study of kedarnath.

(5 M)

Ans:

- The early monsoons have brought misery in the life of the people in Uttarakhand, especially in The districts of Rudraprayag, Uttarkashi, Chamoli, Pauri and Tehri. The State of Uttarakhand has been severely affected by floods and landslides following the torrential rainfall in the region since Friday, 14 June 2013. Incidents of

Cloudbursts and landslides across the state have led to the current death toll being raised more than 1000 in the region. Increasing levels of water in two main rivers of the State, namely Alakhnanda and Bhagirathi, have also resulted in the collapse of bridges, and damaging and washing away of property which has not been estimated yet.

- More incidents of cloud burst are reported in the districts of Pauri Garhwal on June 24. According to initial information received from our sources, some 30 shops, 40 to 50 livestock and, 10 houses have been lost in Paittäni village of Pauri District. Rescue operations by Army personnel continue with at least 4000 people still stranded.

The problems:

- There was a huge reservoir situated above the land area of the Kedarnath temple which was burst on 17th, June releasing huge volume of water. There was also cloudburst in the same area. Both together caused huge flow of water and release of silt, which filled the temple and complex of Kedarnath and the surrounding places burying thousands of pilgrims and local people.
- Many roads connecting the pilgrim centres like Kedarnath, Badrinath, Gangotri, Yamotri and Govindgath have been damaged. In various parts of Uttarakhand around 400 roads have been damaged making communication and transportation difficult. Since this being the time of pilgrimage: Chardam yatra of Hindus and visit to the holy place of Sikh community to Govindgath near Joshimath, there was huge flow of pilgrims to these places. It is reported that initially, over 70,000 pilgrims visiting these holy places were stranded in Rudraprayag, Chamoli and Uttarkashi areas.
- District Authority had mentioned over 27 000 pilgrims stranded in Chamoli, 25,000 in Rudraprayag and nearly 9000 in Uttarkashi. This situation has led to problem of accommodation and food as they were being rescued by the Indian army
- From 19th, onwards the state government deployed helicopters to rescue the people who were held up in different places particularly in Kedarnath temple area.

Q.6.b) Explain the concept of green building.

(5 M)

Ans:

Green building (also known as green construction or sustainable building) refers to a structure and using process that is environmentally responsible and resource-efficient throughout a building's life-cycle: from site to design, construction, operation, maintenance, renovation, and demolition.

It is a building which can function using an optimum amount of energy, consume less water, conserve natural resources, generate less waste and create spaces for healthy and comfortable living, as compared to conventional buildings.

This requires close cooperation of the design team, the architects, the engineers, and the client at all project stages. The Green Building practice expands and complements the classical building design concerns of economy, utility, durability, and comfort.

Although new technologies are constantly being developed to complement current practices in creating greener structures, the common objective is that green buildings are designed to reduce the overall impact of environment on human health by considering:

- Efficient use of energy, water, and other resources,
- Protecting occupant health and improving employee productivity,
- Reducing waste, pollution and environmental degradation.

Green building design is a practical and climate conscious approach to building design.

Various factors, like geographical location, prevailing climatic conditions, use of locally available and low embodied energy materials and design parameters relevant to the type of usage of the building are normally taken into consideration.

Green Building over a conventional building help to retain nature to a maximum extent possible in three ways with reference to the location of the buildings.

- Retain the external environment at the location of the building.
- Improve internal environment for the occupants.
- Preserve the environment at places far away from the building.

Q.6.c) What are various techniques of disaster management.

(5 M)

Ans:

- Natural calamities of different types & intensities (Earthquakes, Hailstorms, Cyclones, Hurricanes, Flood, Avalanches, Landslides, Tsunami, etc.) affect Nations all over the World. Not all natural calamities can be predicted and prevented, but a state of preparedness and ability to respond quickly to the natural calamity can considerably mitigate loss of life & property and restore normalcy at the earliest is referred as Disaster Management.
 - There are no standardized rules defining the different phases of the disaster management cycle. Different agencies use different cycles depending upon their objectives. However, while approaches vary, it is agreed that disaster management activities should be carried out in a cycle.
1. **Mitigation:** any activity that reduces either the chance of a hazard taking place or a hazard turning into disaster.
 2. **Risk reduction:** anticipatory measures and actions that seek to avoid future risks as a result of a disaster.
 3. **Prevention:** avoiding a disaster even at the eleventh hour.
 4. **Preparedness:** plans or preparations made to save lives or property, and help the response and rescue service operations. This phase covers implementation/operation, early warning systems and capacity building so the population will react appropriately when an early warning is issued.
 5. **Response:** includes actions taken to save lives and prevent property damage, and to preserve the environment during emergencies or disasters. The response phase is the implementation of action plans.

6. **Recovery:** includes actions that assist a community to return to a sense of normalcy after a disaster.
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