

ENVIRONMENTAL STUDIES (DEC 2017)

Q.1.a) Explain depleting nature of forests: causes, effects and prevention. (3 M)

Ans:

- The problem of depletion and destruction of forests cause imbalances and enhance threatening the survival of the human species. In the past 100 years the world has lost almost half its forest area. And, as indicated by reports of the FAO (Food and Agriculture) the Earth is losing on net every year 11.2 million hectares of virgin forest.
- Over the years, the area under forest cover has decreased steadily, as forests have been cleared for agriculture, industry, housing, mining and other development activities like the construction of roads, railways, and hydroelectric plants.
- This decline of forests, particularly serious in the case of tropical forests not only increases the greenhouse effect by reducing the absorption of carbon dioxide but also aggravated the decline of water resources.
- As the dwindling forest cover, logically increases rainfall runoff, which favours floods, soil erosion and reduces the amount that seeps into the ground to recharge aquifers.
- Since the beginning of civilization, as seen from the Indus Valley Civilization, people have been clearing land for agriculture to meet the food needs of the ever- growing population.
- Most forest communities follow a method of slash and burn or shifting cultivation, known as Jhum in the Indian subcontinent. They clear a patch of forest, cultivate crops on it, and abandon it the following season. Then they move on to a new area and follow the same pattern. They often return to the same area after a few years. This method is more common in the hilly regions.
- It is now believed that Jhum was a good method of cultivation as the land was left uncultivated for a long period. This allowed the forest to regenerate and the soil to stabilize. Once the trees are felled, the soil becomes less fertile as it removes the nutrient-giving vegetation layer. This also leads to severe soil erosion. If the land is left to regenerate, the forest re-grows and the soil becomes stable.
- Today, though, this method of cultivation causes extensive damage to the area. Due to the increase in population, people are compelled to cultivate on the same plot of land more frequently as there is very little forest area available. Forests are also being converted to permanent settlements. Thus, forests cannot regenerate, and, in some cases, forest areas have become wasteland within a few years due to frequent cultivation.

Preventions:

- Adoption of massive plantation (commercial forestry) and forest extensions (social forestry, agro forestry, urban forestry).
 - Prohibition of mining and construction activities.
 - Enforcement of strict environmental laws and legal provisions (reserve forests, sacred forests, reforestation, block cutting).
 - Public awareness through afforestation and forest conservation programmes.
-

Q.1.b) Explain the concept of socio-economic aspects of sustainable development.

(3 M)

Ans:

- The overlap between social and economic aspects deals with fair and equitable treatment of people everywhere.
 - Purchasing fair trade goods, where the growers receive a liveable wage for selling their crops, is a way to give people in developing areas of the world a chance to earn a better life.
 - Boycotting companies who have an unfavourable environmental track record can send a strong message that can result in positive change.
 - Supporting local businesses helps your friends and neighbours and can keep money in your local economy.
 - Likewise, some large companies work to protect the environment and support communities around the world with donations and social betterment programs while providing employment for people all over the country or even around the globe.
-

Q.1.c) What is meant by greenhouse effect?

(3 M)

Ans:

- The greenhouse effect is a naturally occurring process that keeps the Earth's surface and atmosphere warm.
 - It is due to the fact that certain atmospheric gases like carbon dioxide, methane, water vapour, are capable of trapping the sun's heat.
 - This natural trapping of heat or the greenhouse effect has made Earth habitable. This effect helps to maintain the Earth's mean temperature at 15°C while in absence of the greenhouse effect it would have been about -18°C.
 - However, due to human activities the concentrations of the greenhouse gases has increased which will enhance the greenhouse effect thereby, increasing the Earth's surface temperature beyond 15°C. This is referred to as global warming.
 - Besides carbon dioxide, methane, nitrous oxide and water vapour other greenhouse gases are include CFCs and ozone. Methane is produced naturally when vegetation is burnt, digested or rotted in the absence of oxygen. It is also released in paddy fields, coal mines, from rotting garbage dumps and by fossil fuels. Chlorofluorocarbons (CFCs) are man-made industrial chemicals used in air conditioning etc. Nitrous oxide occurs naturally in the environment. In recent years, their quantities have increased significantly due to the use of chemical fertilizers and the burning of fossil fuels.
-

Q.1.d) Write a short note on: Environment Clearance Mechanism. (3 M)

Ans:

- 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.

Q.1.e) What are limitations of conventional energy sources? (3 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.1.f) Write a short note on 'Water crisis'. (3 M)

Ans:

- Water covers more than two-thirds of the Earth's surface. But fresh water represents less than 0.5% of the total water on Earth. The rest is either in the form of seawater or locked up in icecaps or the soil, which is why one often hears of water scarcity in many areas.
- Worldwide, the consumption of water is doubling every 20 years - more than twice the rate of increase in population.
- Though depletion of water resources is not a problem for everyone, the United Nations Food and Agriculture Organization (FAO) notes that 1.2 billion people, almost

20 percent of the Earth's population, are experiencing water scarcity. Another 500 million come perilously close to that threshold.

- A large amount of water is wasted in agriculture, industry, and urban areas.
- Excessive extraction for irrigation where groundwater is slowly renewed is the main cause of the depletion, and climate change has the potential to exacerbate the problem in some regions.
- It has been estimated that with available technologies and better operational practices, agricultural water demand could be cut by about 50% and that in urban areas by about 33% without affecting the quality or economics of life.
- But most governments do not have adequate laws or regulations to protect their water systems.
- Due to the increase in population there has been a rise in the demand for food, space for housing, consumer products, etc., which has in turn resulted in increased industrialization, urbanization, and demands in agriculture thereby leading to both river and groundwater contamination.
- Drought and changes in routine weather patterns are responsible for water depletion in some areas.

Q.1.g) Explain the 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.2.a) Write a detailed account of 'Chipko Movement'.

(5 M)

Ans:

- In the 1970s, an organized resistance to the destruction of forests spread throughout India and came to be known as the Chipko movement. The name of the movement comes from the word 'embrace', as the villagers hugged the trees, and prevented the contractors' from felling them.
 - Not many people know that over the last few centuries many communities in India have helped save nature. One such is the Bishnoi community of Rajasthan. The original 'Chipko movement' was started around 260 years back in the early part of the 18th century in Rajasthan by this community. A large group of them from 84 villages led by a lady called Amrita Devi laid down their lives in an effort to protect the trees from being felled on the orders of the *Maharaja* (King) of Jodhpur. After this incident, the *maharaja* gave a strong royal decree preventing the cutting of trees in all Bishnoi villages
 - In the 20th century, it began in the hills where the forests are the main source of livelihood, since agricultural activities cannot be carried out easily. The Chipko movement of 1973 was one of the most famous among these. The first Chipko action took place spontaneously in April 1973 in the village of Mandal in the upper Alakananda valley and over the next five years spread to many districts of the Himalayas in Uttar Pradesh. It was sparked off by the government's decision to allot a plot of forest area in the Alaknanda valley to a sports goods company. This angered the villagers because their similar demand to use wood for making agricultural tools had been earlier denied. With encouragement from a local NGO (non-governmental organization), DGSS (Dasoli Gram Swarajya Sangh), the women of the area, under the leadership of an activist, Chandi Prasad Bhatt, went into the forest and formed a circle around the trees preventing the men from cutting them down.
 - The Chipko protests in Uttar Pradesh achieved a major victory in 1980 with a 15-year ban on green felling in the Himalayan forests of that state by the order of Mrs Indira Gandhi, the then Prime Minister of India. Since then, the movement has spread to many states in the country. In addition to the 15-year ban in Uttar Pradesh, the movement has stopped felling in the Western Ghats and the Vindhyas and has generated pressure for a natural resource policy that is more sensitive to people's needs and ecological requirements.
-

Q.2.b) What are '3R control measures'?

(5 M)

Ans:

Reduce:

- The more we can reduce (consumption), the less we will need to reuse and recycle. If we first reduce, then we spend less time, money and energy trying to reuse, recycle, control etc.
- It takes resources to manufacture, transport, and dispose of products, so reduction minimizes the use of new resources. In terms of waste management, it is always the best option. Waste production is often due to the inefficient use of resources or bad planning.

Reuse:

- Reuse is the use of materials more than once in their original form instead of throwing them away after each use.
- Reuse keeps new resources from being used for a while longer, and old resources from entering the waste stream. Initiatives include waste exchange, garage sales, quilting, travel mugs, composting (nutrients), laundry, repair, re-gift, and up-cycle.
- Even, repairing of the non-working mechanical, electrical & electronic items/goods is to be done and reuse the same by enhancing/increasing its life/longevity. This also reduces the waste and proved to be economic too.

Recycle:

- Recycling involves converting waste materials into new products, changing them from their original form by physical and chemical processes.
 - Although recycling uses energy, it helps to prevent new resources from being used and old materials from entering the waste stream.
-

Q.2.c) Define 'noise pollution'. Which are its sources? What are its health effect?

(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.

Q.3.a) Explain principle, construction and working of electrostatic precipitator.

(5 M)

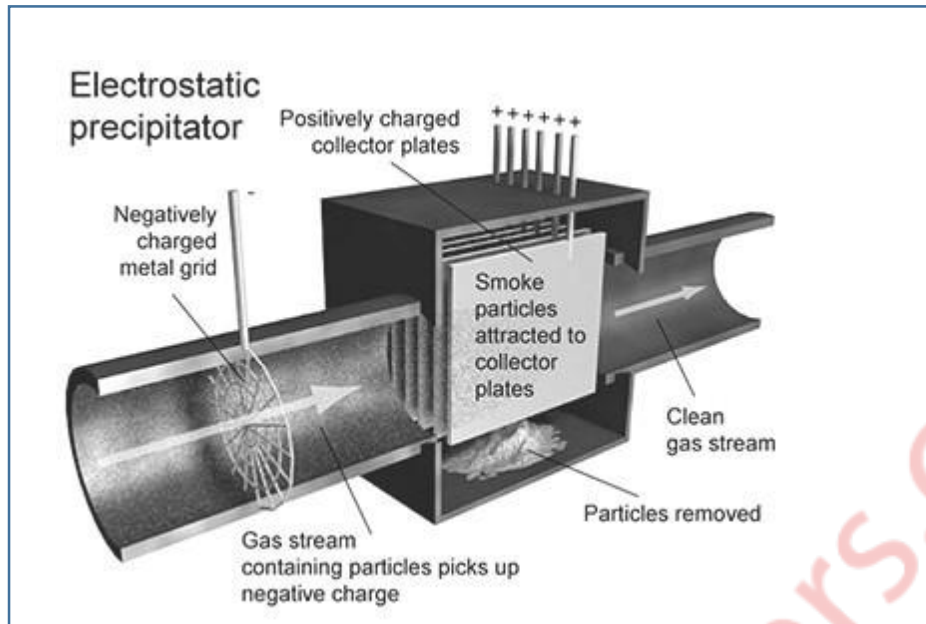
Ans:

Principle:

The collection of particles by electrostatic precipitation involves the ionization of the stream passing through the ESP, the charging, migration, and collection of particles on oppositely charged surfaces, and the removal of particles from the collection surfaces.

Description and Working:

- ESP is made of a rectangular or cylindrical casing. All casings provide an inlet and outlet connection for the gases, hoppers to collect the precipitated particulate and the necessary discharge electrodes and collecting surfaces.
- There is a weatherproof, gas tight enclosure over the precipitator that houses the high voltage insulators.
- ESP use electrostatic charges to separate particles from a polluted gas stream.
- High voltage, direct current electrodes are used to establish a strong electric field.
- This field (known as a corona) delivers a (usually) negative charge to particles as they pass through the device. This charge forces the particles onto the walls of collection surfaces.
- The collection surfaces (or collection electrodes) are then rapped, vibrated, or washed with water to dislodge the particles, which fall into a hopper to be disposed.



Q.3.b) Discuss the case study of cloudburst and landslide at 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 Paittani 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 Govindgarh 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 straddled in Rudraprayag, Chamoli and Uttarkasi areas.

- District Authority had mentioned over 27 000 pilgrims straddled 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.3.c) How electricity is generated from 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:

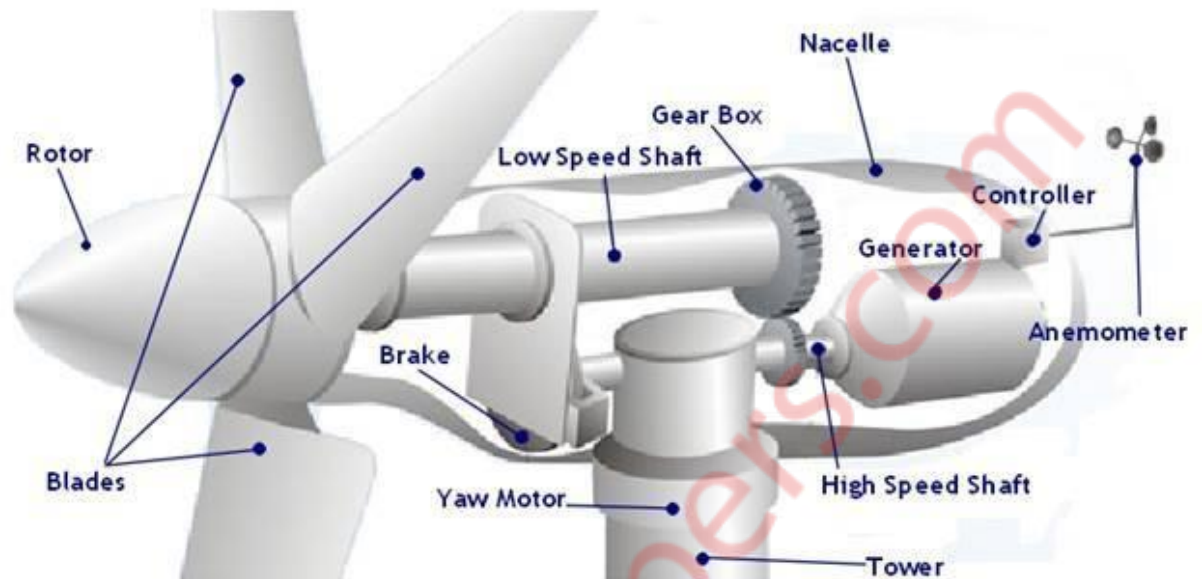
Wind turbines convert the kinetic energy in the wind into mechanical power. A generator can convert mechanical power into electricity. The mechanical power can also be utilized directly for specific tasks such as pumping water.

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.4.a) Discuss the case study of 'London smog'.

(5 M)

Ans:

- London was cold and foggy on December 5, 1952. Damp, chilly air from the English Channel blanketed the city, trapping a dense stagnant layer just above ground level. As the 8.3 million Londoners stoked coal furnaces that heated most buildings and

fuelled most industry in the city, smoke mingled with the fog to form a dark, acrid smog.

- By midday, visibility dropped to a few meters. Traffic slowed to a standstill, and pedestrians, unable to see landmarks, got lost only blocks from home. Hospitals overflowed with people suffering from respiratory distress and cardiovascular problems. With all beds occupied, patients on stretchers filled hallways. As the smog lingered for three more days, visibility dropped until people couldn't see their own feet as they walked down the street. Abandoned cars littered the roads.
- People huddled in their homes, stuffing wet rags around windows and doors trying to keep out the choking smog. Prize cows at the Earl's Court Cattle Show suddenly dropped dead, their lungs black with coal smoke. Humans, also, began to die in alarming numbers. Undertakers ran out of coffins. Several temporary morgues were set up to deal with the sudden influx of corpses. Many of those killed were elderly, or already weak or ill, but young, apparently healthy people also collapsed and died after only a few hours exposure to the toxic cloud.
- By the time winds finally swept away the smog on December 9, more than 4,700 people had died—three times the number for the same period the previous year. The first government reports correctly attributed the deaths to air pollution. Worried, however, that the public might demand costly pollution controls or cleaner-burning fuel, the government later blamed the deaths on an influenza epidemic, even though medical records show no increase in flu diagnoses. In a recent study of historic documents, epidemiologists Devra Davis and Michelle Bell conclude that death rates in London continued to be abnormally high for at least three months after the 1952 episode.
- Altogether, they calculate, at least 12,000 early deaths occurred because of this killer smog, and hundreds of thousands of people suffered from asthma, heart attacks, and other conditions aggravated by polluted air. This would make London's killer smog the greatest air pollution disaster in recorded history. Dirty air wasn't new to London.
- Until the twelfth century, most Londoners burned wood for fuel. As the city grew and the forests shrank, wood became scarce and expensive. Most people switched to abundant supplies of low-quality, bituminous coal for fuel. In 1272, Edward I forbade burning coal in the city and threatened to execute anyone caught breaking his ban.
- Lacking affordable firewood, however, most people ignored this royal proclamation and continued to use coal. In 1578, Queen Elizabeth I complained about the foul air of London, and in 1661, John Evelyn published *Fumifugium or the Inconvenience of the Air and Smoke of London Dissipated*, in which he deplored the "clouds of smoke and sulphur so full of stink and darkness." Still, as the population grew, air pollution worsened.
- A fog in 1879 lasted from November to March, four long months of sunless gloom. Residents described the air as "thick as pea soup." They complained about the bitter smoke and darkness, but most people assumed that smoky urban air was just an inconvenience or the cost of progress. The high number of deaths in 1952, however,

changed attitudes toward air pollution. In 1956, Parliament enacted a Clean Air Act restricting coal use and requiring filters and scrubbers on industrial smokestacks.

- Subsequently, most other industrial countries have passed similar legislation, and air quality in the developed world has increased dramatically. Still, air pollution is probably responsible for many health problems. In megacities of the developing world, poor air quality remains a major health threat.

Q.4.b) Write in details: Food chain and Food Web.

(5 M)

Ans:

Food Chain:

- 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.

Food Web:

- A food web is a graphical description of feeding relationships among species in an ecological community, that is, of who eats whom. It is also a means of showing how energy and materials flow through a community of species as a result of these feeding relationships.
 - Typically, species are connected by lines or arrows called "links", and the species are sometimes referred to as "nodes" in food web diagrams.
 - A food web differs from a food chain in that the latter shows only a portion of the food web involving a simple, linear series of species (e.g., carnivores, herbivores, plants) connected by feeding links.
 - A food web aims to depict a more complete picture of the feeding relationships, and can be considered as a network of food chains occurring within the community.
 - All species occupying the same position within a food chain comprise a trophic level within the food web. For instance, all of the plants in the food web comprise the first or "primary producer" trophic level, all herbivores comprise the second or "primary consumer" trophic level, and carnivores that eat herbivores comprise the third or "secondary consumer" trophic level. Additional levels, in which carnivores eat other carnivores, comprise a tertiary trophic level.
-

Q.4.c) Write a note on: Green Buildings – Concept and objectives.

(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.5.a) What is land pollution? Discuss solid waste management.

(5 M)

Ans:

- Land is one of the most important components of our natural environment. Land provides substratum for the growth of vegetation and crop plants.
- Land pollution is the degradation of Earth's land surfaces often caused by human activities and their misuse of land resources. It occurs when urban and industrial wastes are not disposed properly, due to exploitation of minerals, and improper use of soil by inadequate agricultural practice. Urbanization and industrialization are major causes of land pollution.
- Mechanisms that initiate land degradation include physical, chemical, and biological processes.
- Important physical processes are decline in soil structure leading to crusting, compaction, erosion, desertification, anaerobism, environmental pollution, and unsustainable use of natural resources. Significant chemical processes include

acidification, leaching, salinization, decrease in cation retention capacity, and fertility depletion. Biological processes include reduction in total and biomass carbon, and decline in land biodiversity.

Solid waste Management:

- 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.
-

Q.5.b) Which are renewable energy resources? Write about their importance. (5 M)

Ans:

Renewable resources of energy:

- Sunlight, wind, tidal, geothermal heat are renewable energy resources. These energy resources can be replenished in a short period of time.
- Renewable energy sources are replenished constantly by sunlight, aside from geothermal and tidal energies. Uneven solar heating of the Earth's surface causes wind.
- Sunlight also fuels the water cycle, which is harnessed through hydropower. Biofuels are grown using sunlight.
- Geothermal energy is considered renewable because radioactive decay in the Earth's core, which isn't expected to cool down any time soon, produces it. The gravitational pull of the sun and moon causes the tides.

Importance:

The indispensable partner in the fight against climate change. Renewables do not emit greenhouse gases in energy generation processes, making them the cleanest, most viable solution to prevent environmental degradation.

- **Inexhaustible.** Compared to conventional energy sources such as coal, gas, oil and nuclear - reserves of which are finite - clean energies are just as available as the sun from which they originate and adapt to natural cycles, hence their name "renewables". This makes them an essential element in a sustainable energy system that allows development today without risking that of future generations.
- **Reducing energy dependence:** the indigenous nature of clean sources gives local economies an advantage and brings meaning to the term "energy independence". Dependence on fossil fuel imports results in subordination to the economic and political short-term goals of the supplier country, which can compromise the security of energy supply. Everywhere in the world there is a renewable resource – whether that be the wind, sun, water or organic material – available for producing energy sustainably.

- **Increasingly competitive.** The main renewable technologies – such as wind and solar photovoltaic – are drastically reducing their costs, such that they are fully competitive with conventional sources in a growing number of locations. Economies of scale and innovation are already resulting in renewable energies becoming the most sustainable solution, not only environmentally but also economically, for powering the world.
 - **Benefiting from a favourable political horizon.** Decisions adopted at COP21 have shone the spotlight firmly on renewable energies. The international community has understood its obligation to firm up the transition towards a low-carbon economy in order to guarantee a sustainable future for the planet. International consensus in favour of the “de-carbonization” of the economy constitutes a very favourable framework for the promotion of clean energy technologies
-

Q.5.c) Write a note on: Functions and power 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.6.a) What is nuclear pollution? Discuss fukushima disaster.

(5 M)

Ans:

- Radiation is energy travelling through space. Energy can be transported either in form of electromagnetic waves (radiations) or a stream of energetic particles, which can be electrically charged or neutral.
- These radiations are of two types:

Non-ionizing radiations:

- These are the electromagnetic waves of longer wavelength from near ultraviolet rays to radio waves. These waves have energies enough to excite the atoms and molecules of the medium through which they are moving, causing them to vibrate faster. These do not have enough energy to ionize atoms and molecules.

Ionizing radiations:

- These are the electromagnetic radiations having high energy, such as short wavelength ultra violet radiations, x-rays and gamma rays. The energetic rays like
- α , β , γ radiations are produced by the process called radioactive decay. The unstable nuclei decay spontaneously and emit these radiations. These rays (radiations) can affect some other non-radioactive atoms to become radioactive (unstable) and give out radioactive radiations.
- Living organisms are continuously exposed to a variety of radiations called background radiations. If the level of the radioactive radiations increases above a certain limit it causes harmful effects to living beings. This harmful level of radiations emitted by radioactive elements is called radioactive pollution.

Fukushima Disaster:

- Following a major earthquake, a 15-metre tsunami disabled the power supply and cooling of three Fukushima Daiichi reactors, causing a nuclear accident on 11 March 2011. All three cores largely melted in the first three days.
 - The accident was rated 7 on the INES scale, due to high radioactive releases over days 4 to 6, eventually a total of some 940 PBq (I-131 eq).
 - Four reactors were written off due to damage in the accident – 2719 MWe net.
 - After two weeks, the three reactors (units 1-3) were stable with water addition and by July they were being cooled with recycled water from the new treatment plant. Official 'cold shutdown condition' was announced in mid-December.
 - Apart from cooling, the basic ongoing task was to prevent release of radioactive materials, particularly in contaminated water leaked from the three units. This task became newsworthy in August 2013.
 - There have been no deaths or cases of radiation sickness from the nuclear accident, but over 100,000 people were evacuated from their homes to ensure this. Government nervousness delays the return of many.
 - Official figures show that there have been well over 1000 deaths from maintaining the evacuation, in contrast to little risk from radiation if early return had been allowed.
-

Q.6.b) What is an ecosystem? Discuss the classification of ecosystems with examples.
(5 M)

Ans:

- An ecosystem is a natural unit consisting of all plants, animals and micro-organisms in an area functioning together with all of the non-living factors of the environment.
 - According to British ecologist Arthur Tansley (1935), an ecosystem is a system that arises from the integration of all living and non-living factors of the environment.
 - There are many examples of ecosystems – a pond, a forest, an estuary, a grassland.
 - Early conceptions of an ecosystem were as a structured functional unit in equilibrium of energy and matter flows among constituent elements. Politically, the concept has become important, since the Convention on Biological Diversity in 1992, (CBD), signed by almost 200 nations.
 - The CBD formulates the concept in the following definition: "Ecosystem" means a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit".
 - 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.).
-

Q.6.c) Draw a schematic diagram of photovoltaic cell. Explain its principle and working.
(5 M)

Ans:

Principle:

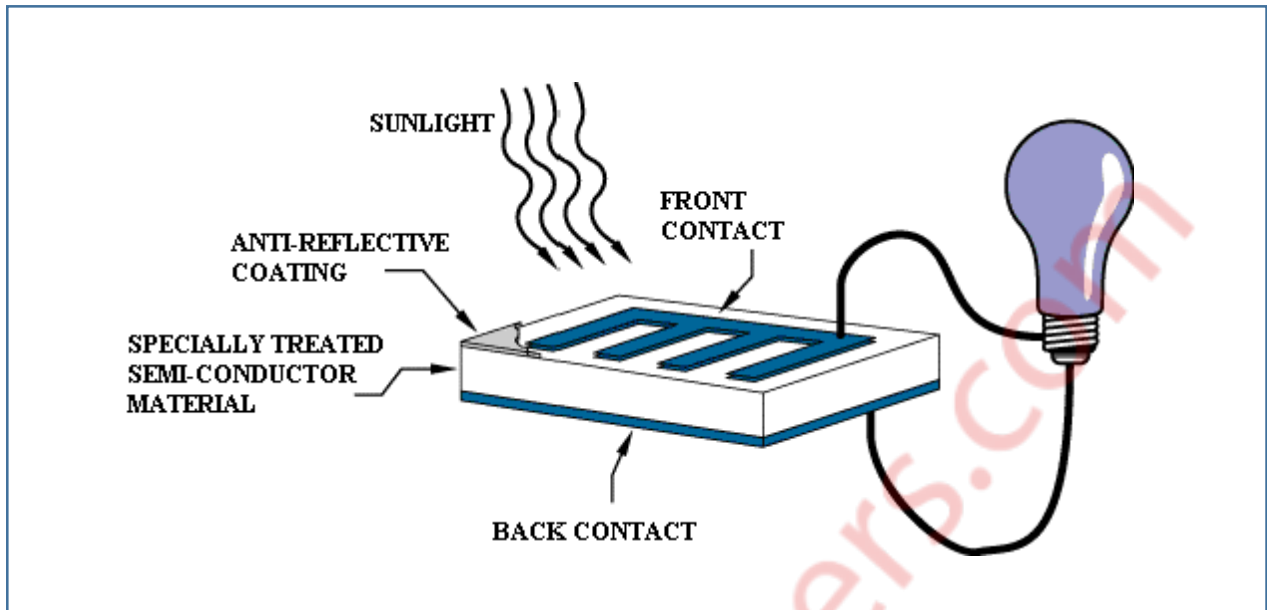
When light is absorbed by a photovoltaic cell, photons of light can transfer their energy to electrons, allowing the electrons to flow through the cell as electrical current. This current flows out of the cell to metal contacts as electricity.

Construction and Working:

A photovoltaic cell is made up of:

- a thin highly pure silicon semiconductor wafer made of two layers
- The layers have been doped with boron on one side and phosphorous on the other side, producing surplus of electrons on one side and a deficit of electrons on the other side.
- metallic contacts on either side of the semiconductor

- anti-reflective coating to reduce reflection and increase light absorption (silicon nitride or titanium oxide)



The schematic of photovoltaic cell is given here.

- When light falls on the cell, photons in the sunlight knock off some of excess electrons, this makes a voltage difference between the two sides as the excess electrons try to move to the deficit side.
- With an external circuit attached to the metallic contacts, the electrons can get back to where they came from and a current flows through the circuit.
- The amount of current is determined by the number of electrons that the light photons knock off. Bigger cells, more efficient cells, or cells exposed to more intense sunlight will deliver more electrons.
- In practice, the typical photovoltaic cell has an overall thickness of between 0.25 and 0.35 mm and is made of mono or multi-crystalline silicon. Generally, it has a surface measuring somewhere between 100 and 225 m² and, with an irradiation of 1 KW/m² at a temperature of 25°C, produces a voltage of approximately 0.5V.
- The photovoltaic cell has no storage capacity, it simply acts as an electron pump.