

ENVIRONMENTAL STUDIES (MAY 2019)

Q.1) Attempt any five from the following:- (15 M)

a) Define soil depletion. Give the classification of ecosystems. (3 M)

Ans:

- Soil depletion occurs when the components which contribute to fertility are removed and not replaced, and the conditions which support soil's fertility are not maintained.
- Classification of Ecosystem are as follows:
- 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.).

b) Define pollution. State any four sources of soil pollution. (3 M)

Ans:

- Pollution is the introduction of contaminants into the natural environment that cause adverse change.
- Pollution can take the form of chemical substances or energy, such as noise, heat or light.

- Pollutants, the components of pollution, can be either foreign substances/energies or naturally occurring contaminants.
- The sources of soil pollution are as follows:
 1. **Industrial wastes:** There are two kinds of wastes that are generated from industrial activities: unused chemicals and unwanted industrial garbage.
 - Unused chemicals like fly ash, sludge, plastics and sawdust are some of the chemicals that are discharged from industries.
 - Unwanted garbage from industrial activities like glass, metals and wood are the other kinds of wastes which industries generate. When these wastes are left on the soil's surface, they change the chemical composition of the soil. The physical qualities of soil are also altered. Such sources of soil pollution make the soil harmful as well as barren.
 2. **Agricultural practices:** Sometimes, excessive chemical fertilizers are applied to the crops. Plants absorb what they need and the excess goes into the soil. Animal excreta, debris and crop residues are some other contaminants that result from agricultural practices. These contaminate the soil by changing its physical and chemical properties.
 3. **Biological agents:** Biological agents like bacteria, fungi, virus and protozoans are a major cause of soil pollution. Human and animal excreta, poor sanitary conditions, wastes from hospitals and food joints cause soil pollution because they perpetrate growth of biological agents in the soil.
 4. **Mining and smelting:** Mining and smelting activities are lethal causes of soil pollution. Extraction and processing of mineral ores causes harm to the top soil layer. Mining fires destroy lands around the area and mining wastes cause heaps of wastes to be produced if the activity is not checked. Similarly, on one hand, installation of cement factories in the mountainous region weakens the soil strata leading to landslides, and on the other hand, the cement dust that falls on natural vegetation and crops blocks their stomata to cause their eventual death.

c) Give the functions (any six) of state pollution and control board. (3 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.

d) Define and give any four objectives of green building. (3 M)

Ans:

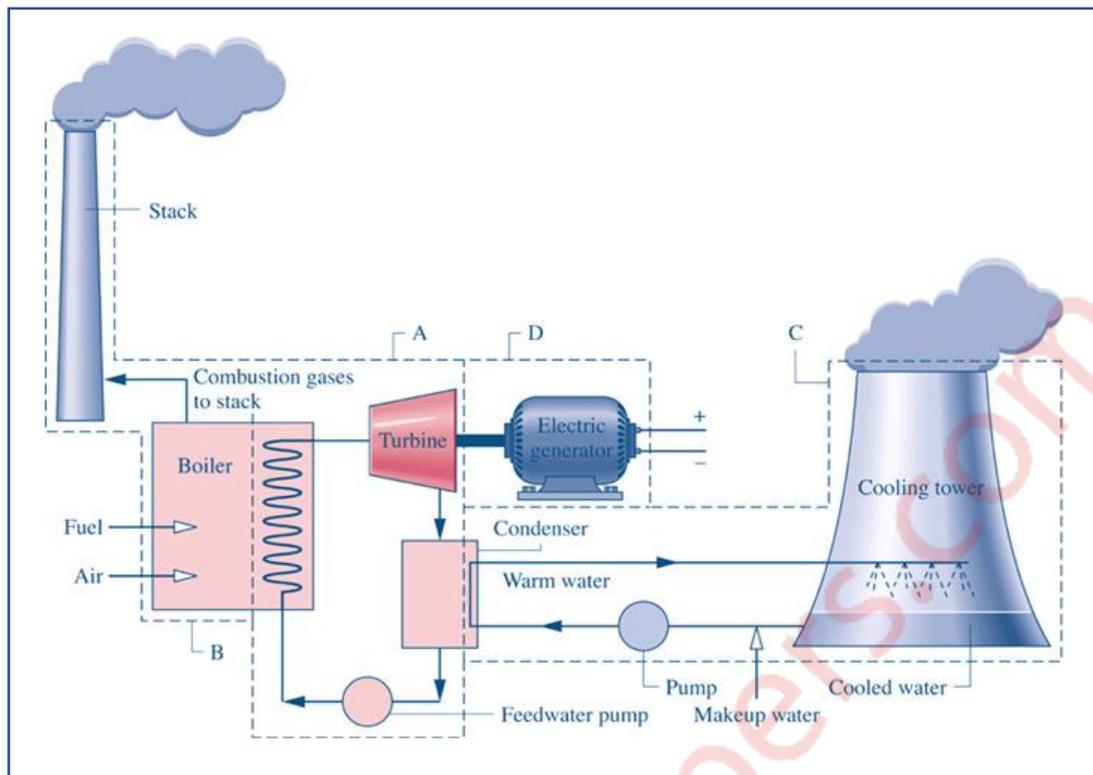
- Green Building over a conventional building help to retain nature to a maximum extent possible in three ways with reference to the location of the buildings.
 - Retain the external environment at the location of the building.
 - Improve internal environment for the occupants.
 - Preserve the environment at places far away from the building.
- **Green Buildings Retain the Environment at the location of the Building:**
- **Land:** The landscaping and the exterior design in a green building shall be in such a way that there is more shaded area, the light trespass is eliminated and local species of plants are grown.
- **Water:** The green building by its design and shape shall not disrupt the natural water flows, it should orient and stand just like a tree. Rain falling over the whole area of the complex shall be harvested in full either to replenish the ground water table in and around the building or to be utilized in the services of the building. The toilets shall be fitted with low flush fixtures. The plumbing system should have separate lines for drinking and flushing. Grey water from kitchenette, bath and laundry shall be treated and reused for gardening or in cooling towers of air conditioning.
- **Green buildings improve internal environment for the occupants:**

- Light: In a designed green building the occupants shall feel as if they are in outdoor location. The interior and exterior designs shall go hand in hand by blending the natural and artificial lighting and presenting transparent views wherever possible.
 - Air: In the air conditioned environment, a green building shall be specially equipped to ensure the Indoor Air Quality for a healthy atmosphere. Even the nasal feelings shall be pleasant free from the odour of paints and furnishings.
 - **Green buildings preserve the environment at places far away from the buildings:** Green buildings shall use the products that are non-toxic, reusable, renewable, and/or recyclable wherever possible. Locally manufactured products are preferred so that the collective material environment of the locality remains a constant and moreover the fuel for the transport of materials is saved.
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e) Define geothermal energy. Draw a neat and labelled diagram of steam turbine power plant. (3 M)

Ans:

- Geothermal energy is thermal energy generated and stored in the Earth. The geothermal energy of the Earth's crust originates from the original formation of the planet (20%) and from radioactive decay of minerals (80%).
- This thermal energy is contained in the rocks and fluids beneath Earth's crust. It can be found from shallow ground to several miles below the surface, and even farther down to the extremely hot molten rock called magma.
- The steam turbine is one kind of heat engine machine in which steam's heat energy is converted to mechanical work.
- The construction of steam turbine is very simple. There is no piston rod, flywheel or slide valves attached to the turbine.
- So maintenance is quite easy. It consists of a rotor and a set of rotating blades which are attached to a shaft and the shaft is placed in the middle of the rotor.
- An electric generator known as steam turbine generator is connected to the rotor shaft. The turbine generator collects the mechanical energy from the shaft and converts it into electrical energy. Steam turbine generator also improves the turbine efficiency.



f) Define and give any four limitations of conventional sources of energy. (3 M)

Ans:

- Conventional energy directly mean the energy source which is fixed in nature like oil, gas and coal.
- In other words conventional energy is also termed as non-renewable energy sources. Their use leads to increased greenhouse gas emissions and other environmental damage.
- The limitations of conventional sources of energy is as follows:
 - 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.

g) Define land pollution. State any two sources of soil pollution. Give any two adverse effect of soil pollution. (3 M)

Ans:

- 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.
 - Sources of soil pollution are as follows:
 - Solid waste: Soil pollution is caused due to various household wastes and chemical fertilizers used in farming, besides chemicals and wastes generated in the industries. Most of these wastes contain residues of toxic inorganic and organic chemicals, which are extremely harmful. In these residues, radioactive elements such as strontium, cadmium, uranium, ladders are also found, which affect the vitality and fertility of the land.
 - Radioactive Pollutants: Radioactive pollutants are generated from explosive devices, atomic tests and atomic activities in laboratories of nuclear power plants. Radiation -106 and Rhodium -106, Iodine-131, Barium-40, Lanthan-40, Serium-144, etc, reach the radioactive waste and mud produced by nuclear testing laboratories. All of these radionuclides emit gamma radiations, which are also harmful to the soil.
 - The effects of soil pollution are as follows:
 - Effect on growth of plants.
 - Decreased fertility.
 - Toxic Dust.
 - Changes in structure of soil.
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Q.2) Attempt the following: (15 M)

- a) Give the reasons and consequences of cloudburst and landslides at kedarnath. (4 M)**

Ans:

- The early monsoons have brought misery in the life o people in Uttarakhand, especially in the districts of Rudraprayag, Uttarkashi, Chamoli, Paur and Theri. 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 Cloudburst 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 and damaging and washing away of property which has not been estimated yet.

- More incidents of cloudburst 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.
- There was a huge reservoir situated above the land area of 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 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: Chardham Yatra of Hindus and visit to the 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 27000 pilgrims stranded in Chamoli, 25,000 in Rudraprayag and nearly 9000 in Uttarkashi. This situation has led to problem of accommodation and foods 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.

b) Define noise pollution. State any four sources of noise pollution. State any four bad effects of noise pollution. Give the reactions taking place in environment during acid. (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.
- Effects taking place due to acid rains are:
- Effects of Acid Rain on Fish and Wildlife: The ecological effects of acid rain are most clearly seen in aquatic environments, such as streams, lakes, and marshes where it can be harmful to fish and other wildlife. As it flows through the soil, acidic rain water can leach aluminium from soil clay particles and then flow into streams and lakes. The more acid that is introduced to the ecosystem, the more aluminium is released.

- Effects of Acid Rain on Plants and Trees: Dead or dying trees are a common sight in areas effected by acid rain. Acid rain leaches aluminium from the soil. That aluminium may be harmful to plants as well as animals. Acid rain also removes minerals and nutrients from the soil that trees need to grow.
 - At high elevations, acidic fog and clouds might strip nutrients from trees' foliage, leaving them with brown or dead leaves and needles. The trees are then less able to absorb sunlight, which makes them weak and less able to withstand freezing temperatures.
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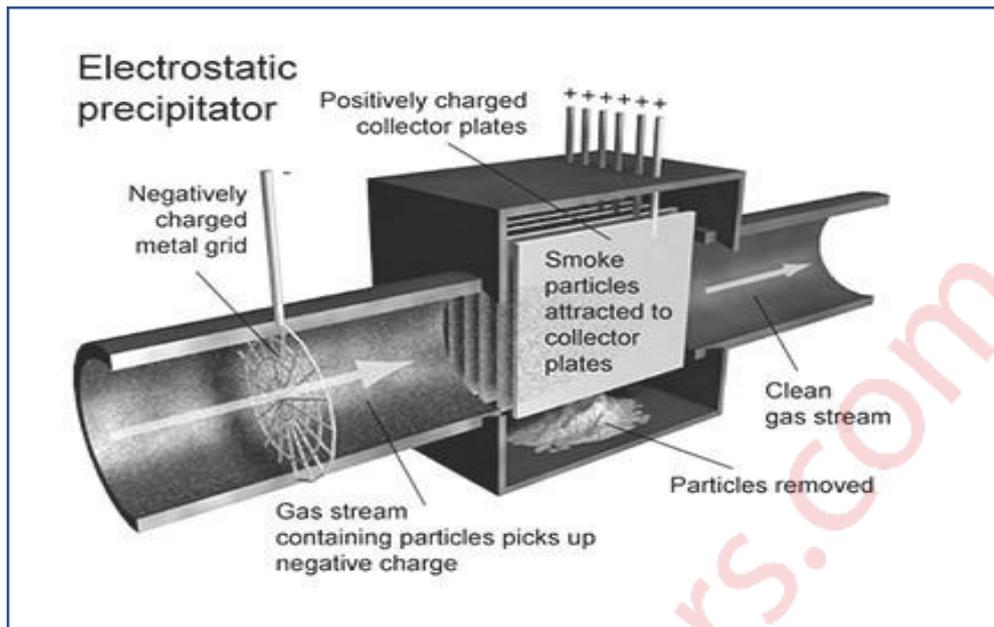
c) Draw a neat labelled diagram of electrostatic precipitator used for purification of air pollutants. Give the principle involved in electrostatic precipitator. Give any two advantages and Disadvantages of electrostatic precipitator. (6 M)

Ans:

- Electrostatic precipitator (ESP) is a particulate collection device that removes particles from a gas stream using the force of an induced electrostatic charge. Electrostatic precipitators are highly efficient filtration devices that operate at a very low pressure drop, and can easily remove fine particulate matter such as dust and smoke from the air stream by minimally interfering with the flow of gases through the device.
- **Principle:** The collection of particles by electrostatic precipitation involves the ionization of the stream passing though 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.



Advantages:

- ESPs are very efficient collectors, even for small particles because the collection forces act only on the particles.
- ESPs can treat large volumes of gas with low pressure drops. These can collect dry materials, fumes, or mists.

Disadvantages:

- ESPs have high capital costs.
- They require large space because of the large size of the equipment.

Q.3) Attempt the following: (15 M)

a) Define indoor air pollution. State any four sources of indoor air pollution. State any four bad effects of indoor air pollution. (5 M)

Ans:

- Pollutants are any harmful contaminants in the air therefore, indoor air pollution is when pollutants from things such as gases and particles contaminate the air indoors.
- Indoor air pollution is a very real and dangerous thing because indoor air is far more concentrated with pollutants than outdoor air. It's estimated that 2.2 million deaths each year are due to indoor air pollution.
- Sources of indoor pollution are as follows:
- Radon: Radon is a highly radioactive gas that can be introduced into the home through the ground beneath it, well water, and the building materials that

constitute your house or apartment. Part of what makes radon so dangerous is the fact that it is colourless, tasteless, and odourless, and that it produces no immediate symptoms, which means that you will normally be completely unaware that you are inhaling it.

- Carbon Monoxide: Like radon, carbon monoxide (CO for short) is colourless, tasteless, and odourless, and therefore particularly insidious. Environmental tobacco smoke is one source of CO, but there are many others, including gas stoves and heaters, wood stoves, chimneys, and furnaces. Automobiles also produce CO, so attached garages increase the risk as well. CO attacks, among other things, your bloodstream and central nervous system. Exposure to low-level doses of carbon monoxide will leave you feeling sluggish, which means an inexplicable lethargy is a good early warning sign.
- Nitrogen Dioxide: Nitrogen dioxide (NO₂) comes from many of the same sources as carbon monoxide and carries with it similar health risks. In addition, it can also help produce another very dangerous chemical, ozone. Unlike CO, however, NO₂ possesses a sharp and easily detectable smell and a reddish-brown colour.
- Organic Gases: "Organic gases," or "volatile organic compounds" (VOCs), is something of a catch-all term for gases that are emitted from many different sources. Among the common sources for VOCs identified by the EPA are paint, cleaning supplies, pesticides, glue, printers and photocopiers, permanent markers, and certain building materials. As you can see, your home probably has many VOC sources, so being aware of them is important.
- Effects of indoor air pollution are as follows:
- If Asbestos is found in your home it can cause you very serious health problems such as lung cancer, asbestosis, mesothelioma, and various other types of cancers.
- If lead is found in the home it can also be severely life threatening. It can cause brain and nerve damage, kidney failure, anaemia, and a defective cardiovascular system.
- Tobacco smoke causes individuals to experience severe respiratory irritation, pneumonia, bronchitis, emphysema, heart disease, as well as lung cancer.
- If you use gas stoves in your home it can cause respiratory infections and damage and irritation to the lungs.

b) Draw neat and labelled diagram of solar heater. Give the principle involved in solar heater. Give the working of solar heater. (5 M)

Ans:

- A solar thermal device captures and transfers the heat energy available in solar radiation which can be used for meeting the requirements of heat in different temperature ranges.

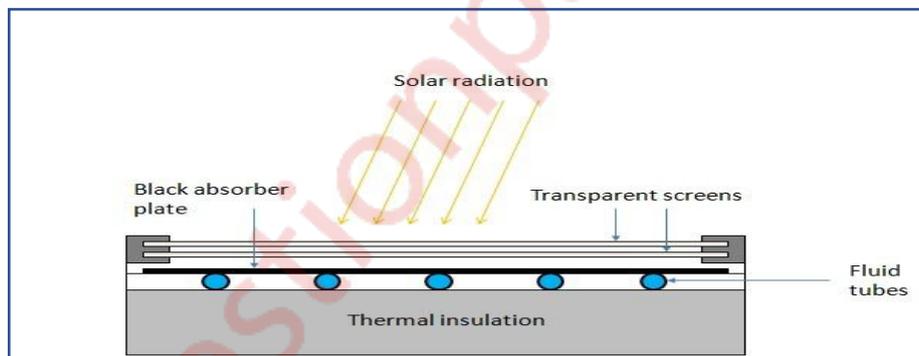
Principle:

- 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.
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c) What is the meaning of sustainable development? Give any four social and economical aspects of sustainable development. (5 M)

Ans:

- Sustainable development is a pattern of economic development in which resource use aims to meet human needs while preserving the environment so that these needs can be met not only in the present, but also for generations to come. Definition: The term 'sustainable development' (SD) was used by the Brundtland Commission which coined what has become the most often-quoted definition of sustainable development as:
- "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.
- Economic: An economically sustainable system must be able to produce goods and services on a continuing basis, to maintain manageable levels of government and external debt, and to avoid extreme sectoral imbalances which damage agricultural or industrial production.
- Social: A socially sustainable system must achieve fairness in distribution and opportunity, adequate provision of social services including health and education, gender equity, and political accountability and participation.
- Social-Economic Aspect: 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.4) Attempt the following:

(15 M)

a) Give the importance of environmental education. How does Biomass and energy flow related in ecological pyramid. (4 M)

Ans:

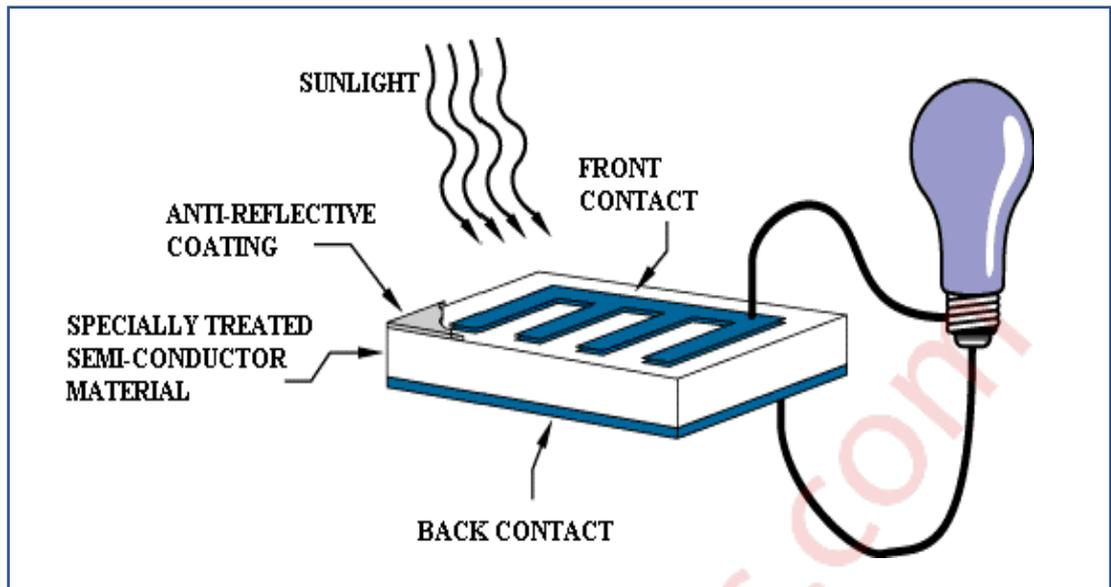
- Environmental study (EVS): It is a multidisciplinary subject that includes all disciplines such as science, humanities, engineering, commerce, geography, meteorology, management, sociology, health, computers, philosophy etc.. It promotes the study of the environment, the designs.
- Environmental studies 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.
- 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.
- 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.
- 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.
- 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.
- Pyramid of biomass is the graphic representation of biomass present per unit area of different trophic levels, with producers at the base and top carnivores at the tip. The total amount of living or organic matter in an ecosystem at any time is called 'Biomass'.

- Pyramid of biomass shows the total biomass at each trophic level in a food chain.
 - Pyramid of biomass can be inverted or upright.
 - The energy pyramids give the best picture of the overall nature of the ecosystem. Here there will be gradual decrease in the availability of energy from the autotrophs higher trophic levels. In other words, there is decrease in energy flow from autotrophs at successive trophic levels.
 - In the course of energy flow from one organism to the other, is considerable loss of energy in the form of heat. More energy is available in the autotrophs is the primary consumers. The least amount of available energy will be in the tertiary consumer. Therefore, shorter the food chain, greater is the amount of energy available at the top.
 - The energy pyramid is always upright and erect.
 - It shows the rate of energy flows at different trophic levels.
 - It shows that energy is maximum at producer level and minimum at the carnivores' level.
 - At every successive trophic level there is a loss of energy in the form of heat, respiration etc.
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b) Draw a neat labelled diagram of solar cells. Give principle involved in solar cells. Give the construction of solar cells. Give any two advantages and disadvantages of solar cells. (6 M)

Ans:

- Photovoltaic cell is composed of semiconductor material, which combines some properties of metals and some properties of insulators. That makes it uniquely capable of converting light into electricity.
- **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:**
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)



- Advantages:
 - Generate clean and green energy
 - Size based on energy requirements
 - Low operation and maintenance costs
 - Easy to set up in remote locations
- Disadvantages
 - Limited access to sunlight at certain times
 - Expensive energy storage systems
 - High initial cost
 - Large installation area requirement

c) Explain the concept of control measure through the concept of Recover. Give the advantages and disadvantages of such programs. (5 M)

Ans:

- Concept of control measure through the concept of recovery consist of five important steps which are as follows:
 - **Prepare To Be Prepared:** Disaster prevention is first and foremost about preparation. Pre-plan every job before employees commence any work on it. Schedule a meeting or huddle with all participating employees to fully understand and outline the details of the job. This includes scope of the work, key issues, potential problems, equipment access, personnel access and any important information.
 - **Be Informed:** After preparation, the next most important disaster prevention measure is knowledge. Make sure the physical and chemical characteristics of hazardous substances are visibly listed.

These include items such as boiling and freezing points, density, vapor pressure, specific gravity, solubility, volatility and the product's general appearance and odour.

- **Get Supplies Ready:** It's not pleasant or fun to think about a potential spill, but if it does happen, you'll be glad you prepared the necessary supplies to clean it up. These supplies include containers, temporary diking and clean up materials.
- **Communication:** This is key for most challenges in life, but especially for disaster prevention. Before work commences on a project, analyse how the work will impact other personnel and operations. Then, make sure proper communication channels and procedures are in place between participating parties.
- **PPE:** Review the Personal Protective Equipment and tools that are necessary for the project, and make sure your supplies of these materials -- clothing, helmets, masks, goggles, etc -- are adequate.

Advantages:

- Response readiness, or the capacity of an organization to respond effectively to large earthquakes as reflected in planning and exercises
- Rapid recovery, encompassing the mitigation of hazards, restoration of the built environment, and return to normal community life.
- Management of earthquake emergencies, or the ability of an organization to mount a timely and effective response that minimizes the loss of life and property damage, and maintains operational capabilities

Disadvantages:

- Loss of lives Insufficient and inadequate availability of resources.
- Drastic change in the life of human from general cases to violence case.

Q 5) Attempt the following:

(15 M)

- a) Define wind energy. Give the principle involved in wind turbines. Give any two advantages and disadvantages of wind energy. Give the construction of wind turbines.**

(6 M)

Ans:

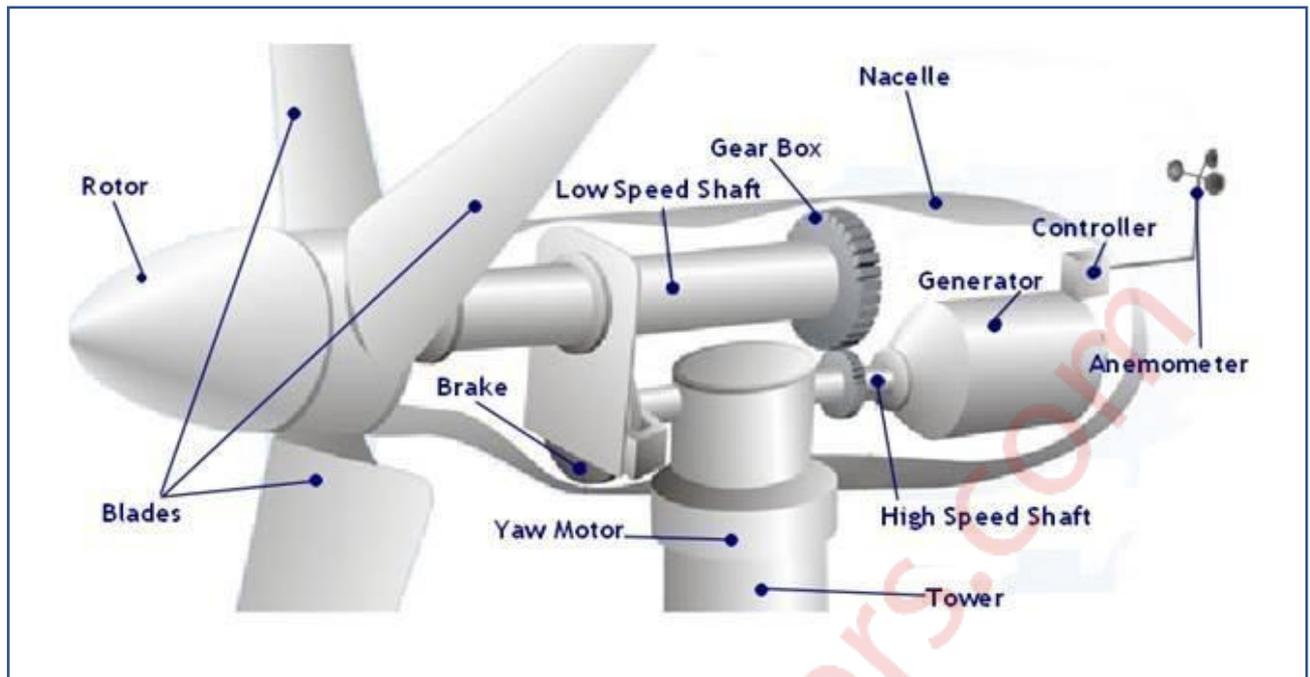
- Wind is caused by the uneven heating of the atmosphere by the sun, variations in the earth's surface, and rotation of the earth. Mountains, bodies of water, and vegetation all influence wind flow patterns.
- Wind energy technologies use the energy in wind for practical purposes, such as generating 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.

Advantages:

- Clean and inexhaustible energy resource
- Low operational costs
- Ability to place turbines wherever necessary
- Bring power to remote locations

Disadvantages:

- Wind fluctuations
- Generate noise pollution

- Contribute to mortality rates among bird and bat populations
- High installation cost

b) Explain the case study of boiler blast tragedy in Dombivali MIDC. (4 M)

Ans:

- A powerful explosion at the boiler unit of Probace Enterprises at Shivaji Udyog Nagar of MIDC phase-II area in Dombivli (East) resulting in the death of five workers and injuring 150, out of which 35 are considered to be critical and been treated in various hospitals.
- The blast occurred around 11 am causing grave damage to two adjacent plants - Acharya Chemicals and Herbert Brown Pharmaceutical & Research Laboratories. Such was the impact of the explosion that it shattered the glass panes in the nearby residences and other industrial units creating a scene of panic and pandemonium in the vicinity.
- Around five-six industrial units have been affected by the mishap which fall within 1.5 kilometers of the blast.
- **BOILER EXPLOSION**
- The explosion happened around 11.20 am when the 10,000 liter boiler exploded leaving Acharya Chemicals unit in debris. Locals, who witnessed the fire, said that over 50 workers were working in the factory at the time of the blast, among whom, 16 were grievously injured. They were taken to the municipal hospital in Dombivali.
- To prevent any further eventuality, the fire brigade officials immediately cordoned off the area as the workers reported that there were three-four more boilers inside Acharya chemicals which could have triggered further blasts. The officials sprayed fire retardant in order to lessen the damage in case the boilers gave way.
- Eye-witness accounts suggest, the impact of the blast was so immense that it felt like a minor tremor with regions close to Ulhasnagar could feel its impact.
- **RESCUE & RECOVERY**
- Five fire engines were immediately dispatched at the spot of explosion to douse the flames. District Disaster controller, Dinesh Kurhade said more than a dozen fire tenders had reached the spot for rescue and recovery efforts.
- Around 45 National Disaster Response Force [NDRF] personnel reached at the spot at 2 pm. Approximately, 11 ambulances were put to use, and 47 workers working in that area are admitted.

- PP Sengupta, a senior official of NDRF team said, “We received a call at 12.30 pm from Thane police, that there is a massive fire at Probace Enterprises, and a boiler exploded at 11.30 am at Dombivli, KDMC.”

c) Define water pollution. State any four sources of water pollution. State any four bad 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:
 - Bad taste or offensive odour
 - Reduction in number of aquatic lives in rivers, fresh water, seas.
 - Oil or grease floating on the surface of water.
 - Unchecked growth of aquatic weeds.
 - Outbreak of an endemic.
- Sources of water pollution:
 - Effluents released from industrial units such as inorganic and organic pollutants, oil,
 - grease, plastic, metals, acids, toxic chemicals, colour dyes etc.
 - Discharge of untreated or partly treated sewage of domestic and municipal waste, leachates from solid disposal.
 - Fertilizers, pesticides, soil additives from agricultural activities.
 - Human activities such as bathing, washing, other customs and traditions.
- Effects of water pollution:
 - 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.
 - 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. Biomagnification 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 biomagnification effects of DDT (insecticide) washed off into the nearby water bodies.

Q 6) Attempt the following:

(15 M)

a) Give the importance of environmental education from the environmental degradation. Give the causes of depletion of natural water resources.

(5 M)

Ans:

- 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.
- 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.
- 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.
- 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.
- 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.
- 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.
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b) Define photochemical smog. State any four sources of photochemical smog. State any four bad effects of photochemical smog. (6 M)

Ans:

- The word smog is derived from smoke and fog. Smog is the most common example of air pollution that occurs in many cities of the world. There are two types of smog:
- Classical smog occurs in cool humid climate. It is a mixture of smoke, fog and sulphur dioxide. As it is a reducing mixture, it is also called reducing smog. eg: London smog
- Photochemical smog occurs in warm, dry and sunny climate. Photochemical smog formed by photochemical reactions is a mixture of particulates, nitrogen oxides, ozone, peroxyacetyl nitrates, unreacted hydrocarbons etc.
- Photochemical smog has high concentration of oxidizing agents and is, therefore, called as oxidizing smog. eg: Los Angeles smog. Photochemical smog consists of brown hazy fumes due to the presence of nitrogen dioxide.
- Sources of photochemical Smog are as follow:

- **Natural Causes:** An erupting volcano can emit high levels of sulphur dioxide along with a large quantity of particulate matter; two key components to the creation of smog.
 - However, the smog created as a result of a volcanic eruption is often known as vog to distinguish it as a natural occurrence. The chemical reactions that form smog following a volcanic eruption are different than the reactions that form photochemical smog.
 - The term smog encompasses the effect when a large amount of gas phase molecules and particulate matter are emitted to the atmosphere, creating a visible haze. The event causing a large amount of emissions can vary but still result in the formation of smog.
 - Plants are another natural source of hydrocarbons that could undergo reactions in the atmosphere and produce smog
 - Effects of Photochemical smog are as follows:
 - Photochemical smog causes eye, nose, and throat irritations. It may cause impaired lung function, coughing and wheezing.
 - It can cause material damage like deterioration of rubber and fabric.
 - It can damage plants, leading to crop loss.
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c) Explain the case study of earthquake in Latur.

(4 M)

Ans:

- The Latur, India earthquake was the most destructive earthquake in 1993. It occurred on September 30, 1993. The main reason for its lethality was the fact that it occurred at 3:45 AM, while the entire area was indoors and asleep. The earthquake struck in South-eastern India, in the state of Maharashtra.
- The two districts which were decimated by the earthquake were the districts of Osmanabad and Latur. The coordinates of the earthquake's epicentre were N18.07 and E76.62. This was very close to Latur, and consequently, it suffered the most damage. The earthquake measured 6.45 on the Richter scale, with its focal point 12 meters beneath the surface. Unlike the Latur earthquake, most earthquakes occur along fault lines, where two plates meet.
- The Latur earthquake was one of a very rare type of earthquakes. It was what is referred to as a SCR, or a stable continental region earthquake. Most earthquakes are a result of interaction between two plates, whether they be sliding, colliding, or forming a subduction zone. However, in this instance, the cause is very complicated.

- The Latur earthquake was an intraplate earthquake, or it occurred in the middle of a plate, as opposed to a plate boundary. The earthquake's epicentre was very far from any fault line. The cause of this earthquake is still in speculation. Some scientists claim that it was a result of the force released from the continuous crumpling of the Indian plate against the Eurasian plate.
 - The Latur earthquake was tremendously destructive. More than 30,000 lives were lost. The earthquake itself didn't cause as much damage. Most of the people were living in houses made of stones on soft soil. The tiles of the roofs were generally constructed out of stone plates, which were used as a result of availability and cost effectiveness.
 - The tremors caused these plates to literally bury the local populace without food, water, and sometimes even air. The liquefaction, which resulted from the earthquake, destroyed the foundations of the houses and caused them to crumble. More than 60% of the deaths were a result of this. Liquefaction is the phenomenon that causes soft soil or sand to shake loose as a result of seismic activity.
 - According to scientists, it wasn't even possible for an earthquake to strike this region, which is why there weren't any monitoring stations in this region. However, to answer the general question, most people live in hazard prone regions for many reasons.
 - Generally, it is a matter of livelihood. At other times, it is the case of ancestral heritage, or houses in hazard prone areas that are handed down, generation to generation. More often in LEDCs, it is the simple fact that the people who live in hazard prone regions cannot afford to move out to a less threatened region.
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