

ENVIRONMENTAL STUDIES (DEC 2016)

Q.1) Attempt any five from the following

(15 M)

Q.1.a) What is sustainable development? Why there is need for sustainable development.

Ans:

1. Sustainable development can be defined as development which meets the needs of the present without compromising the ability of future generations to meet their own needs.
 2. The concept of sustainable development can be interpreted in many different ways, but at its core is an approach to development that looks to balance different, and often competing, needs against an awareness of environmental, social and economic limitations we face as a society.
 3. It is based on improving the quality of life for all, especially the poor and deprived within the carrying capacity of the supporting ecosystems. It is a process which leads to a better quality of life while reducing the impact on the environment.
 4. Its strength is that it acknowledges the interdependence of human needs and environmental requirements.
 5. To ensure sustainable development, any activity that is expected to bring about economic growth must also consider its environmental impacts so that it is more consistent with long term growth and development.
 6. Many 'development projects', such as dams, mines, roads, industries and tourism development, have severe environmental consequences that must be studied before they are even begun. Thus for every project, in a strategy that looks at sustainable development, there must be a scientifically and honestly done EIA, without which the projects may not be cleared.
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Q.1.b) Differentiate between renewable and non-renewable sources of energy.

Ans:

Sr. NO.	Renewable sources	Non-renewable sources
1.	Renewable resources refers to the resources which replaces itself naturally, in a short period.	Non-renewable resources are the one that are not capable of replacing itself, in near future.
2.	It is sustainable	It is exhaustible
3.	It is present in unlimited quantity	It is present in limited quantity.
4.	It is environmental friendly.	It is not environmental friendly
5.	Its cost is low	Its cost is comparatively high
6.	Rate of renewal is greater than the rate of consumption	Rate of renewal is lower than the rate of consumption
7.	Eg: trees	Eg: crude oil, LPG

Q.1.c) What are the causes and effects of E-pollution?

Ans:

1. The main cause or rather reason for the increasing e waste is the increased number of products (because of development, technology, human mentality and population) because of which disposal problems are caused as excess of anything is not good. the following are major causes-

a. Growth of Technological Devices

One reason e-waste is occurring is because the growth of technological devices. In the modern era, technology is growing at a lightning fast speed which may result in new products coming out more frequently. This causes people to discard their old computers more frequently and let that waste build up. In developed countries, computers have an average life span of about two years. And that's only in developed countries where their lives are not very good. In developed countries like the United States, there are more than three hundred million obsolete computers. And since the use of computers is quickly rising because of globalization, more and more computers and other devices are being thrown out every year.

b. Growth of Population

Another reason e-waste is occurring is because of the growth of population. With everyone buying computers now a days, it is reasonable to believe that since the population is increasing it is reasonable to believe that more people are buying computers which means that more people are throwing them out. Not only is this creating it's own problem, but it is intensifying the other problems that are causing e-waste. And since the people in middle and higher class are always ready to buy the brand

"new cool product", the e-waste rate is going up and that is making the problem bigger and e-waste being more dangerous.

c. Human Mentality

And the last reason e-waste is occurring is because of human mentality. Since everybody is getting smarter are getting better jobs, more people are getting wealthier. This money is usually used to either pay taxes or to improve their lives with new technology. And computers and other electronics are usually mentioned when talking about this. And with new products always coming out and more people getting more money, it is reasonable to say that more people are buying new computers. And therefore throwing out their old ones at a faster rate. Hopefully human mentality will save us from this problem to.

Effects:

When we throw out our computers, they wind up in landfills, causing the possibility of toxic metal leaching into the groundwater. Toxic metals in e-waste leach into our supply of resources, threatening their integrity. When e-waste is warmed up, toxic chemicals are released in to the air, damaging the atmosphere. E-waste management is a critical consideration for future generations as proper electronic recycling is becoming harder to find.

Q.1.d) Write important functions of central pollution control Board (CPCB).

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

Ans:

1. Carbon credit is type of certificate showing that a government or company has paid to have a certain amount of carbon dioxide removed from the environment”.
 2. Carbon credits and carbon markets are a component of national and international attempts to mitigate the growth in concentrations of greenhouse gases (GHGs). One carbon credit is equal to one tonne of carbon dioxide, or in some markets, carbon dioxide equivalent gases. Carbon trading is an application of an emissions trading approach. Greenhouse gas emissions are capped and then markets are used to allocate the emissions among the group of regulated sources.
 3. The goal is to allow market mechanisms to drive industrial and commercial processes in the direction of low emissions or less carbon intensive approaches than those used when there is no cost to emitting carbon dioxide and other GHGs into the atmosphere. Since GHG mitigation projects generate credits, this approach can be used to finance carbon reduction schemes between trading partners and around the world.
 4. There are also many companies that sell carbon credits to commercial and individual customers who are interested in lowering their carbon footprint on a voluntary basis. These carbon off setters purchase the credits from an investment fund or a carbon development company that has aggregated the credits from individual projects. Buyers and sellers can also use an exchange platform to trade, such as the Carbon Trade Exchange, which is like a stock exchange for carbon credits. The quality of the credits is based in part on the validation process and sophistication of the fund or development company that acted as the sponsor to the carbon project. This is reflected in their price; voluntary units typically have less value than the units sold through the rigorously validated Clean Development Mechanism.
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Q.1.f) What is Nuclear Pollution? What are its sources and effects.

Ans:

1. Contamination of the atmosphere by radiation and radioactive particles is called nuclear pollution.

2. Nuclear energy can be both beneficial and harmful depending on the way in which it is used. We routinely use X-rays to examine bones for fractures, treat cancer with radiation and diagnose diseases with the help of radioactive isotopes.
3. Approximately 17 % of the electrical energy generated in the world comes from nuclear power plants. However on the other hand it is impossible to forget the destruction that nuclear bombs caused the cities of Hiroshima and Nagasaki.
4. The radioactive wastes from nuclear energy have caused serious environmental damage.

Sources:

1. Nuclear explosions and detonations of nuclear weapons.
2. Defence weapon production.
3. Nuclear waste handling and disposal.
4. Mining of radioactive ores (such as uranium ores).
5. Nuclear accidents.

Effects:

1. A nuclear explosion releases large amounts of radioactive substance. This can cause damage to the eyes. The retina of the eye can either become blinded due to the intensity of the infra-red rays or it can melt because of the high temperature release.
 2. Direct effect of a nuclear blast is damage to life and property. This explosion is most serious in places of higher altitude. The blast range increases with height gain.
 3. The explosion will have negative impact on the environment and the atmosphere.
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Q.1.g) What is ecological succession?

Ans:

1. Ecological succession is a process through which ecosystems tend to change over a period of time.
 2. Succession can be related to seasonal environmental changes, which create changes in the community of plants and animals living in the ecosystem.
 3. Other successional events may take much longer periods of time extending to several decades. If a forest is cleared, it is initially colonized by a certain group of species of plants and animals, which gradually change through an orderly process of community development.
 4. One can predict that an opened up area will gradually be converted into a grassland, a shrub land and finally a woodland and a forest if permitted to do so without human interference.
 5. There is a tendency for succession to produce a more or less stable state at the end of the successional stages. Developmental stages in the ecosystem thus consist of a pioneer stage, a series of changes known as seral stages, and finally a climax stage.
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Q.2.a) Explain social and economic aspects of sustainable development. (5 M)

Ans:

1. Economic aspects

The modern concept underlying economic sustainability seeks to maximize the flow of income that could be generated while at least maintaining the stock of assets (or capital Economic efficiency plays a key role in ensuring optimal consumption and production.) which yield this income. Fisher had defined capital as “a stock of instruments existing at an instant of time”, and income as “a stream of services flowing from this stock of wealth”. Hicks argued that people’s maximum sustainable consumption is “the amount that they can consume without impoverishing themselves”.

2. Social aspects

Social development usually refers to improvements in both individual well-being and the overall social welfare, that result from increases in social capital – typically, the accumulation of capacity for individuals and groups of people to work together to achieve shared objectives. Social capital is the resource which people draw upon in pursuit of their aspirations and is developed through networks and connectedness, membership of more formalized groups and relationships of trust, reciprocity, and exchanges. The institutional component of social capital refers mainly to the formal laws as well as traditional or informal understandings that govern behaviour, while the organizational component is embodied in the entities (both individuals and social groups) which operate within these institutional arrangements. For our purposes we assume that human capital (e.g., education, skills, etc.), and cultural capital (e.g., social relationships and customs) are also included within social capital although fine distinctions do exist.

Recent research has emphasized the role of institutions in explaining differences among nations in terms of economic growth or stagnation – i.e., how behavioural norms govern social conduct, which ultimately determines economic behaviour.

Q.2.b) Draw a neat labelled diagram of Electrostatic precipitator and explain how it is useful to control gaseous particulate emissions? (5 M)

Ans:

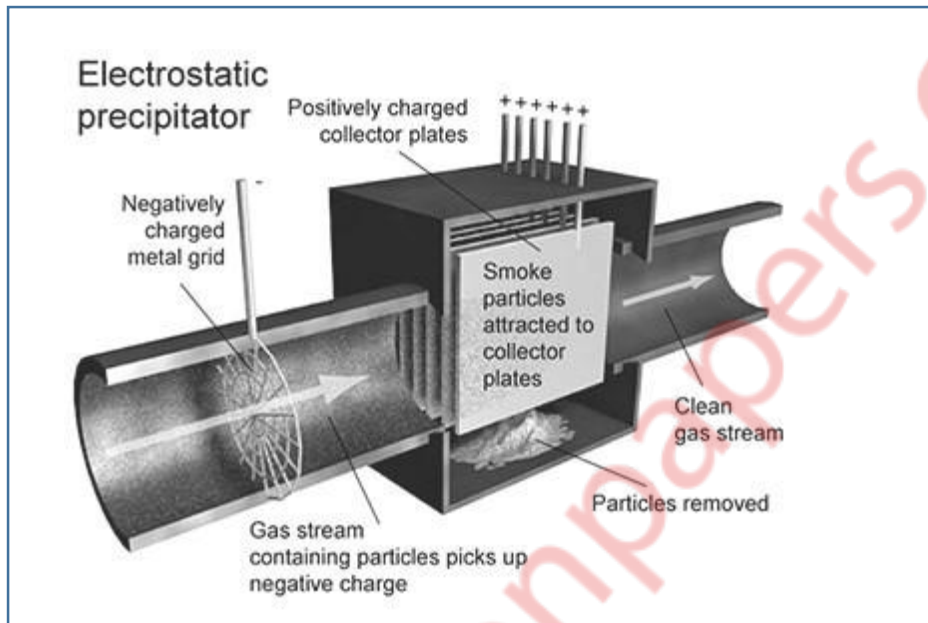
Principle:

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.



Applications:

ESPs are applicable in cement factories, pulp and paper mills, steel plants, chemical industries, petroleum industries, electric power industries etc. ESPs are used mainly to remove particulate matter from gas streams but can also be used to collect and recover valuable materials from the gas stream.

Q.2.c) What is hydropower? Draw a suitable diagram and explain how hydropower is generated. (5 M)

Ans:

Hydropower:

Hydropower uses the Earth's water cycle to generate electricity because movement of water as it flows downstream creates kinetic energy which can be then converted into electricity. Hydropower is the leading renewable source for electricity generation globally, supplying 71% of all renewable electricity. Reaching 1,064 GW of installed capacity in 2016, it generated 16.4% of the world's electricity from all sources.

Hydropower Plants:

Principle:

Hydropower uses the natural gradient force of water flowing down from a considerably height under gravity which is capable to turn turbines to generate electricity.

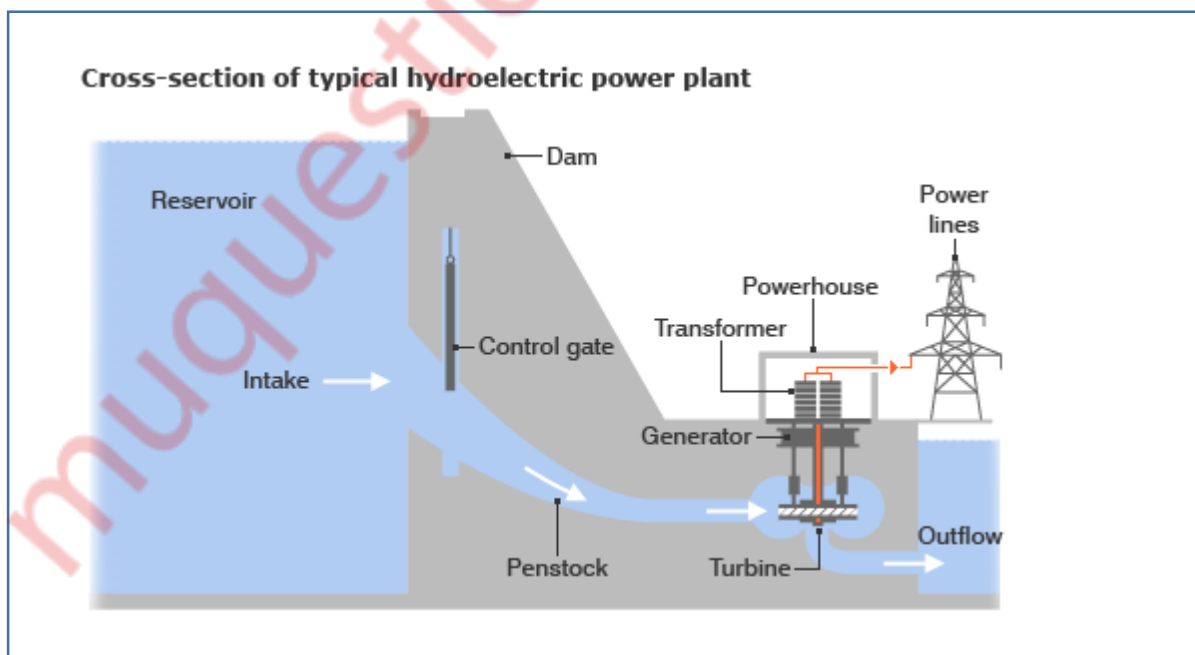
There are three types of hydropower plants:

- 'run of river': where the electricity is generated through the flow of a river
- 'reservoir': where power is generated through the release of stored water
- 'pumped storage': where stored water is recycled by pumping it back up to a higher reservoir in order to be released again

Construction and Working:

The basic components of a conventional hydropower plant are:

- Dam: a large reservoir that holds back water
- Control gates: gates built on the inside of the dam, when opened the water flows due to gravity through the penstock and towards the turbines
- Penstock: a pipe which is connected between dam and turbine blades, used to increase the kinetic energy of water
- Turbine: as water falls on the blades of the turbine, the kinetic and potential energy of water is converted into the rotational motion of the blades of the turbine
- Generators: generator produces electricity, as the turbine blades turn, so do a series of magnets inside the generator producing a magnetic field which is converted into electricity by electromagnetic field induction
- Transformer: the transformer inside the powerhouse takes the alternating current and converts it to higher-voltage current.
- Transmission lines: out of every power plant come four wires: the three phases of power being produced simultaneously plus a neutral or ground common to all three
- Outflow: used water is carried through pipelines, called tailraces, and re-enters the river downstream.



- The water in the reservoir is considered stored energy. The height of water in the reservoir decides how much potential energy the water possesses. The higher the height of water, the more its potential energy. The overall potential energy of water, helps to produce more electricity in the power generation unit.
 - When the control gates open, the water flows through the penstock becomes kinetic energy because it's in motion.
 - The amount of electricity that is generated is determined by the flow and the head. The flow of water through the penstock is controlled by the control gates. The head refers to the distance between the water surface and the turbines, usually dependent upon the amount of water in the reservoir.
 - Water flowing from the penstock is allowed to enter the power generation unit, which houses the turbine and the generator. When water falls on the blades of the turbine, the kinetic and potential energy of water is converted into the rotational motion of the blades of the turbine.
 - The rotating blades causes the shaft of the turbine to also rotate. The turbine shaft is enclosed inside the generator. In most hydroelectric power plants there is more than one power generation unit.
 - The shaft of the water turbine rotates in the generator, which produces alternating current in the coils of the generator. It is the rotation of the shaft inside the generator that produces magnetic field which is converted into electricity by electromagnetic field induction.
 - Hence the rotation of the shaft of the turbine is crucial for the production of electricity and this is achieved by the kinetic and potential energy of water.
 - The electricity produced is then stepped up in voltage through the hydroelectric power station transformers and sent across transmission lines.
 - The used water having performed its intended purpose is channelled out of the power generation station as outflow to the mainstream of the river to continue the cycle of power generation.
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Q.3.a) What is solid waste? Explain solid waste management by incineration. (5 M)

Ans:

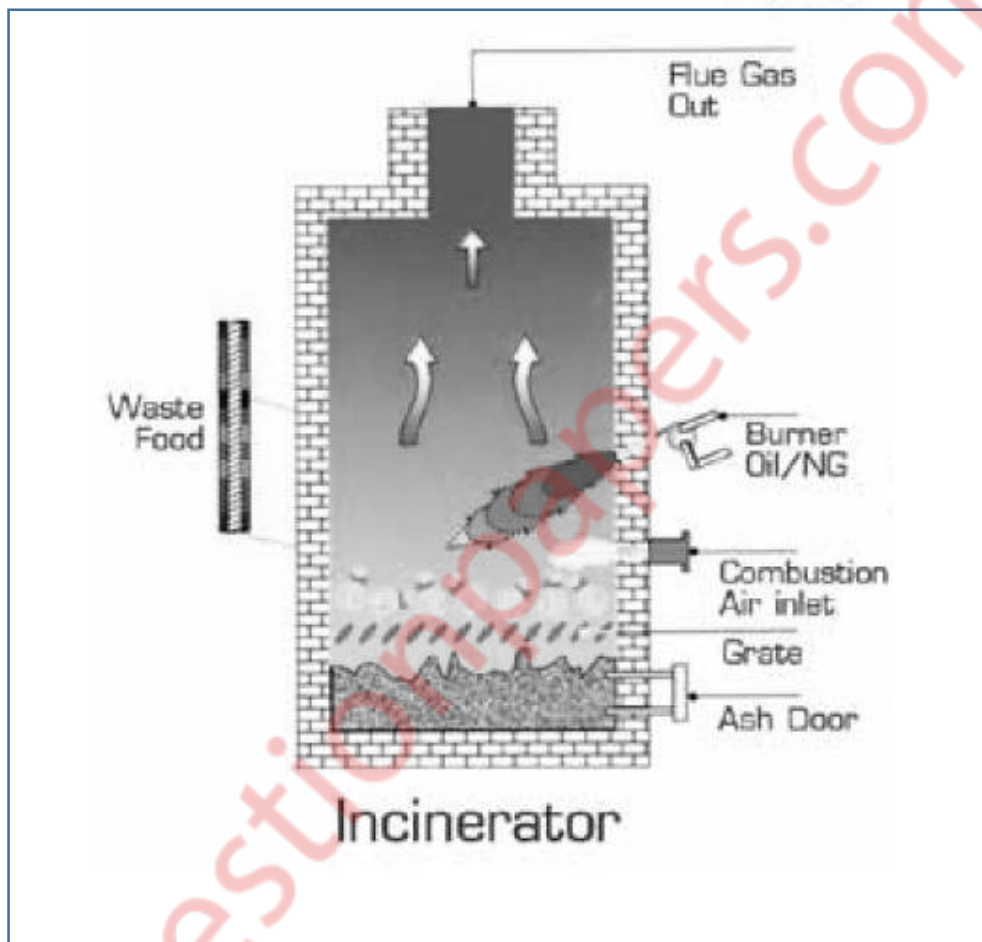
Solid waste is the unwanted or useless solid materials generated from human activities in residential, industrial or commercial areas.

Incineration:

1. Incineration is a waste treatment technology, which includes the combustion of waste for recovering energy. Incineration coupled with high temperature waste treatments are recognized as thermal treatment.
2. During the process of incineration, the waste material that is treated is converted in to gases, particles and heat. These products are later used for generation of electricity. The gases, flue gases are first treated for removal of pollutants before going in to atmosphere.
3. Incineration reduces the mass of the waste from 95 to 96 percent. This reduction depends upon the recovery degree and composition of materials. This means that

incineration however, does not replace the need for landfilling but it reduced the amount to be thrown in it.

4. Incineration comes with a number of benefits in specific areas like medical wastes and other life risking waste. In this process, toxins are destroyed when waste is treated with high temperature.
5. Incinerator can be understood more precisely as a furnace where waste is burnt. Modern incinerators are equipped with pollution improvement systems, which play their part in cleaning up the flue gas and such toxicants.



Q.3.b) Write important functions and powers of State Pollution Control Board.

(5 M)

Ans:

1. To plan comprehensive program for the prevention, control or abatement of pollution and secure executions thereof,
2. To collect and disseminate information relating to pollution and the prevention, control or abatement thereof,

3. To inspect sewage or trade effluent treatment and disposal facilities, and air pollution control systems and to review plans, specification or any other data relating to the treatment plants, disposal systems and air pollution control systems in connection with the consent granted,
 4. To support and encourage the developments in the fields of pollution control, waste recycle reuse, eco-friendly practices etc.
 5. To educate and guide the entrepreneurs in improving environment by suggesting appropriate pollution control technologies and techniques
 6. To create public awareness about the clean and healthy environment and attend to the public complaints regarding pollution.
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Q.3.c) Write a case study on Cloudburst and Landslides at kedarnath in june 2013.

(5 M)

Ans:

- The early monsoons have brought misery in the life of the people in Uttrakhand, specially 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 Govindgarh 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 Uttarkashi 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.
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Q.4.a) Explain global environmental crisis pertaining to population. (5 M)

Ans:

- The total human population has expanded since the introduction of agriculture, around 12,000 years ago, and its rate of growth has generally increased over time
 - The increase in in population growth rate is largely as a result of increased food production, improved sanitation and health care.
 - Achieving the first one billion of human population took most of human history, whilst the most recent increase of one billion was achieved in little more than a decade.
 - However, recent declines in the rate of growth of population have occurred in many parts of the world, and in some countries populations are now declining.
 - The United Nations projects that the world's population will be anywhere between 7.7 billion to 11.2 billion by 2050, that's an average of 9.5 billion by that time.
 - Human population growth and overconsumption are at the root of our most pressing environmental issues like depletion of resources, environmental pollution, species extinction crisis, habitat loss and climate change.
 - Significant differences exist in cultural attitudes to the issues of human population size and the rate of population growth.
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Q.4.b) Explain environmental consent and authorisation mechanism. (5 M)

Ans:

Consent:

- Under the provisions of the Water and Air Acts, an entrepreneur running or establishing any industry or process, and discharging effluent/emitting pollutants into any water resources or on land/air and polluting thereby the environmental water/air is required to obtain consent, which needs to be obtained in three phases;
- Consent to Establish: All the industries and activities needing consent must obtain consent to establish before actual commencement of the works for establishing the industry/activity.
- Consent to Operate: This consent needs to be taken before actual commencement of production including trial production. This consent is valid for certain duration.

- Renewal of Consent to Operate: The consent to operate is renewed after certain period.
- Any industry, operation or process or an extension and addition thereto, which is likely to discharge sewerage or trade effluent into the environment or likely to emit any air pollution into the atmosphere will have to obtain consent of the State Pollution Control Board under the provisions of Water (P & CP) Act, 1974 and Air (P & CP) Act, 1981.
- Similarly any industry / process generating, storing, transporting, disposing or handling hazardous waste as defined Hazardous waste (Handling and Management) Rules, 1989, as amended in 2000 are required to obtain authorization from MPC Board under the said rules.
- The medical institutions generating biomedical waste as defined in Biomedical Waste (Handling and Management) Rules, 1989 are required to obtain Authorisation under the said rules.

Authorisation:

- The standards are prescribed by the Ministry of Environment & Forest and Government of India, which are minimum uniform national standards, which cannot be relaxed by any authority including CPCB and MPCB. But MPCB can prescribe more stringent standards than whatever laid down by the Ministry of Environment & Forest and Government of India, taking into consideration the local conditions.
- The authorization for collection/reception/treatment /transport/storage/disposal of Hazardous wastes and Biomedical wastes as defined under the rules needs to be obtained by Board.
- Monitoring of the industrial unit means sending out the monitoring teams comprised of skilled technical & scientific officers to verify the compliance of conditions imposed in NOC, Consent, Authorization etc.

Q.4.c) Draw a neat diagram of wind turbine and explain how it helps in energy production. (5 M)

Ans:

Wind Turbines:

Principle:

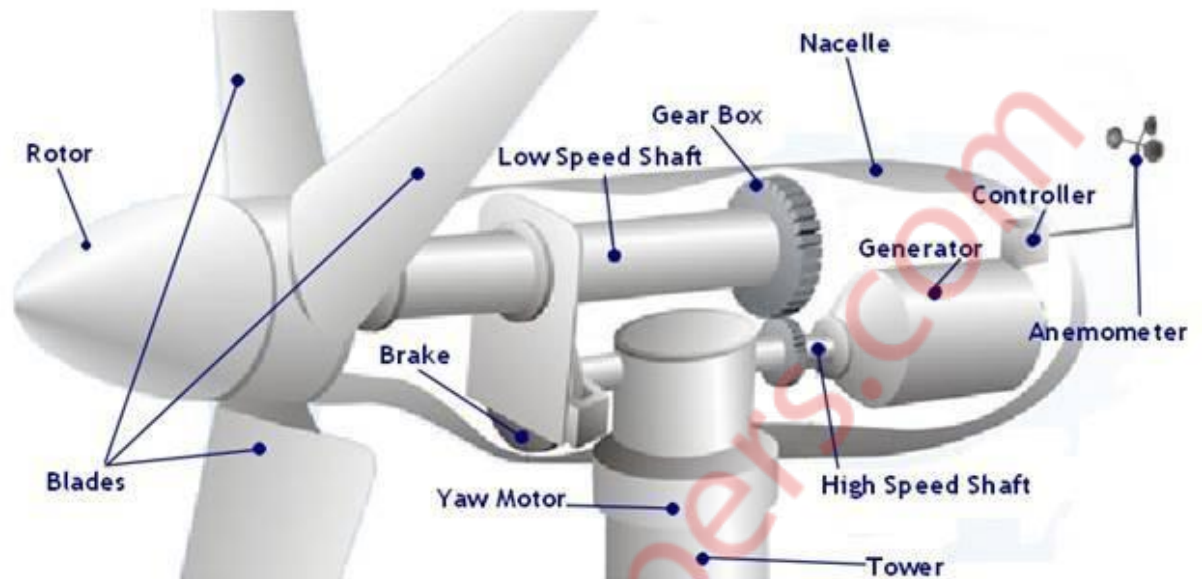
Wind turbines convert the kinetic energy in the wind into mechanical power. A generator can convert mechanical power into electricity. The mechanical power can also be utilized directly for specific tasks such as pumping water.

Construction and Working:

The basic components of the wind turbine include:

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

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



The schematic of the wind turbine components are shown here.

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

Q.5.a) Explain how resource utilisation as per carrying capacity is an important control measure for sustainable development. (5 M)

Ans:

Resource Utilization as per Carrying Capacity:

- Carrying capacity refers to the number of individuals who can be supported in a given area within natural resource limits, and without degrading the natural, social, cultural and economic environment for present and future generations.
- The carrying capacity for any given area is not fixed. The carrying capacity of an environment may vary for different species and may change over time due to a variety of factors, including: food availability, water supply, environmental conditions and living space. As the environment is degraded, carrying capacity actually shrinks, leaving the environment no longer able to support even the number of individuals who could formerly have lived in the area on a sustainable basis.
- No population can live beyond the environment's carrying capacity for very long.
- In case of human beings, the carrying capacity concept becomes all the more complex. It is because unlike other animals, human beings, not only need food to live, but need so many other things to maintain the quality of life. Technology is an important factor in the dynamics of carrying capacity. Carrying capacity can be altered by improved technology, but mostly it is changed for the worse by pressures which accompany a population increase.
- Thus carrying capacity is mainly governed by number of population, their needs & consumption and the technology adopted to cater the needs of population; this led Paul R. Ehrlich to develop the equation:
 - $I = P \cdot A \cdot T$ where:
 - I is the impact on the environment (resource depletion or waste accumulation) ,
 - P is the population (size of human population),
 - A is the affluence (consumption by population),
 - T is the technology (processes used to obtain resources and transform them into useful goods and wastes)
- Sustainability of a system depends largely upon the carrying capacity of the system. If the carrying capacity of a system is crossed (say, by over exploitation of a resource), environmental degradation starts and continues till it reaches a point of no return.
- Carrying capacity has two basic components:
 - i. Supporting capacity is the capacity to regenerate. That is it is the ability to allow withdrawal (water, raw materials) of resources without causing lasting damage to the environment.
 - ii. Assimilative capacity is the capacity to tolerate stress. That is it is the ability of the environment to absorb without ill-effects.

In order to attain sustainability it is very important to utilize the resources based upon the above two properties of the system. Consumption should not exceed regeneration and changes should not be allowed to occur beyond the tolerance capacity of the system.

Q.5.b) Write a case study on pollution of Ganga river.

(5 M)

Ans:

- The Ganges River is 2,525 km, rising in the western Himalayas in the Indian state of Uttarakhand, and flows south and east through the Gangetic Plain of North India into Bangladesh, where it empties into the Bay of Bengal. It is the longest river of India and ranks among the world's top 20 rivers by amount of water discharge.
 - The Ganges basin formed, is the most heavily populated river basin in the world.
- Pollution in the Ganges River
- The settlements built along the river, as well as the dumping of waste water have resulted in the serious pollution in the Ganges.
 - Some people even cremate and dump the bodies of the deceased into the river during holy rituals.
 - Despite this, people still use the river to wash their clothes, bath and carry out their daily activities. The World Health Organisation has stated that the Coliform bacteria in the Ganges River are over 2800 times higher than the level considered safe for humans.
 - Worse, the leather industry dumps water polluted with chromium into the Ganges, making water there toxic and poisonous.

Consequences of pollution of Ganges River

- More than 420 million people depend on the Ganges River and they will be affected very badly due to the pollution.
 - People utilising the water, no matter if it is consuming the water or just using the water to bathe, wash clothes, they might suffer from water-borne disease such as diarrhoea and cholera
 - Marine animals living inside the Ganges River will die as a result of poisoning from the pollutants.
 - The government has to spend a lot of money to clean up the pollution in the Ganges River, affecting the economy
 - Fishing will also be affected as the fish population will decrease due to poisoning from the toxic waste.
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Q.5.c) Draw a schematic and explain principle and working of photovoltaic cell. (5 M)

Ans:

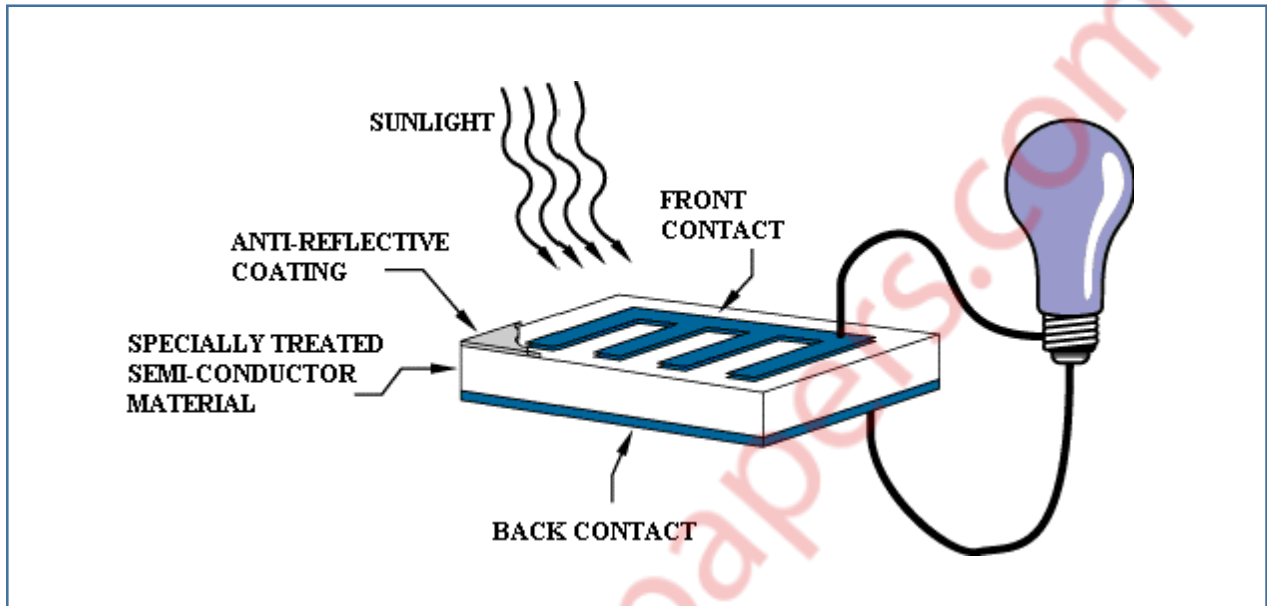
Principle:

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.

Q.6.a) Explain the causes and effects of depletion of natural water resources. (5 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.
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Q.6.b) Write a note on industrial waste water treatment. (5 M)

Ans:

- Water pollution refers to the addition of any substance to water that may cause changes in its physical and chemical properties and interfere with its use for legitimate purposes. The following are indications that water is polluted:
 1. Bad taste or offensive odour
 2. Reduction in number of aquatic lives in rivers, fresh water, seas.
 3. Oil or grease floating on the surface of water.
 4. Unchecked growth of aquatic weeds.
 5. Outbreak of an endemic.
- Treatment of industrial waste water: The treatment procedure for industrial waste water is the same and consists of the preliminary, primary, secondary and tertiary treatments. The nature of the pollutant determines the type of treatment employed

for industrial waste water. For example, waste water from dairy and food industries require biological treatment, metal plating industrial waste are chemically treated. Many industrial wastes may even require neutralization prior to chemical or biological treatment methods.

Q.6.c) What is disaster Management? Explain how techniques of disaster management are implemented in the events of earthquake. (5 M)

Ans:

Natural calamities of different types & intensities (Earthquakes, Hailstorms, Cyclones, Hurricanes, Flood, Avalanches, Landslides, Tsunami, etc.) Affect Nations all over the World. Not all natural calamities can be predicted and prevented, but a state of preparedness and ability to respond quickly to the natural calamity can considerably mitigate loss of life & property and restore normalcy at the earliest is referred as Disaster Management.

Earthquake disaster management:

- All new building structures must be engineered structures to withstand ground shaking.
 - Architectural and engineering inputs must be put together to improve building design and construction practice and do not build structures on soft soil.
 - Building codes and standards including land use control and restriction on density and heights of buildings must be enforced.
 - Retrofitting and strengthening of all lifeline buildings like hospitals must be done as they need to be functional after a disaster.
 - Upgrading safety levels of all hospitals, fire service buildings and multi-storeyed building as per National Building code.
 - Raising public awareness of the risks posed by earthquakes and the possible measures to manage these risks.
 - Training NGOs, engineers, local builders, social and community leaders presently working in earthquake prone areas on preparedness and mitigation.
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