Unit V Sustainability Practices

SUSTAINABLE HABITAT

Sustainable habitat means the maintenance of our natural home.

Definition

A sustainable habitat is an ecosystem that produces food and shelter for people andother organisms without resource depletion ie., no external waste is produced.

Objectives of national mission on sustainable habitat

1. To reduce energy demand by promoting alternative technologies and energy conservationpractices in both residential and commercial areas.
2. Better urban planning like

(i) using better disaster management

(ii) lesser use of private transport

(iii) more usage of public transport

3. Encourage community involvement and participation of stake holders.
4. Conservation of natural resources such as clean air,water, flora and fauna.
5. Facilitate the growth of small and medium cities.
6. To create sustainable habitats, engineers and architects should not consider any element asa waste product.

How to maintain sustainable habitat

For maintaining our sustainable habitat, we should

(i) Promote energy efficiency.

(ii) Promote the use of eco-friendly fuels.

(iii) Better manage municipal solid waste.

(iv) Promote to public transport.

GREEN BUILDINGS

Definition

Green building is an efficient method of construction that produces healthier buildings,which have less impact on the environment and climate. It requires less cost to maintain.Green buildings preserve previous natural resources and improve our quality of life.

Features of Green building

(i) Efficient use of energy, water and other resources.

(ii) Use of renewable energy such as solar energy.

(iii) Pollution and waste reduction measures ie., reuse and recycling.

(iv) Good indoor environmental air quality.

(v) Use of materials that are non-toxic, ethical and sustainable.

(vi) A design that enables adaptation to environment.

(vii) Consideration of the quality of life of occupant in design, construction and operation.

(viii) Construction of the environment in construction and operation.

Principles of Green building

The five principles of green building are

(i) Livable communities.

(ii) Energy efficiency.

(iii) Indoor air quality.

(iv) Resource conservation.

(v) Water conservation.

Components of green building

Seven important components of green buildings are

1. Aluminium weather resistant insulated access panel.It helps regulate in door temperatureand prevent moisture and pest from entering.
2. Energy efficient windows.
3. Green roof.
4. Solar power.
5. Water conservation.
6. Recycling.
7. Landscaping.

Advantages and Disadvantages of Green buildingAdvantages of Green building

1. Green buildings are energy efficient.
2. Higher fraction of eco-friendly materials.
3. Water - efficient devices.
4. Reduction in waste.
5. Less air pollution.
6. Reduction in green house gas emissions.
7. Protection of our natural resources.
8. Indoor air quality is improved.
9. Use of recycled metal and other construction materials.
10. Emphasis on renewable energies.
11. Day lighting is utilized as best as possible.
12. Use of renewable plant materials.
13. Higher market value.
14. Rainwater collection and use of compost bins.
15. Overall health improvements.

Disadvantages of Green building

1. High initial costs.
2. Energy supply may depend on weather condition.
3. Technology problems are more.
4. Maintenance may be difficult.
5. Indoor air temperature may greatly vary over time.
6. Experienced green construction workers may be rare.
7. Green construction is not suitable for all locations.
8. Availability of green construction materials.
9. Funding problems for green buildings.

GREEN MATERIALS

Definition

Green materials also called eco-friendly materials,building construction materials that have low impact on the environment. Due to the properties of non-toxic,organic and recycling, green materials are widely used in various industrial applications.

Examples : Naturally occurring materials like wood,ceramics, glass, clay, sand, stone.

Characteristics of green materials

Common characteristics of green material are

1. Green materials are energy efficient products, it uses less energy to do the same task.
2. It lowers energy cost and less in pollution.
3. Green materials are mostly renewable, can be regenerated again and again.

Example : Bamboo grows quickly while pine grows more slowly, but both are renewable.

4. Green materials are recyclable (or) made recycled material. So, they save energy and reducewaste.
5. Green materials are non-toxic, they do not emit odors, irritants (or) hazardous compoundsthat affect human health.
6. They are durable and no need to upgrade (or) repair. They preserve resources and energy.
7. They are cost-effective.
8. They can be locally sourced, so transport cost canbe reduced.

Important green building material

Green building is construction that primarily uses natural materials and renewableresources. These structure look really cool.

1. Stone: It is low maintenance and durable.
2. Cob: (mud mixture of natural ingredients like soil.sand, straw and lime). It is cheap andenergy efficient.
3. Bamboo : It is durable and light weight.

4. Cork: (Cork canes from oak trees)

It is a very good thermal insulator and mold resistant

5. Adobe briek : (brick made of glay and straw)

Natural noise protection and posses unique design (can be easily cut and transformed).

6. Stram bale

Easily renewable and cheap.

7. Cord wood

Affordable (cheap and easy construction) thermal efficiency.

8. Earth bags (or) sand bags

Locally sourced and provide natural insulation.

9. Mycelium (or) mushroom rootsStrong and

light weight.

ENERGY AND EFFICIENCY

Definition

Energy efficiency is the use of less energy to perform the same task (or) produce the same result.Energy efficient homes and buildings use less energy to heat, cool and run appliances and electronics.

Energy efficiency logoMethods of

achieveing Energy efficiency

Energy efficiency can be achieved by the following methods.

(i) Alternative waste treatment.

(ii) Avoided emissions from diverting legacy waste from landfill for process engineered fuelmanufacture.

(iii) Avoided emissions from diverting legacy waste from landfill through a compostingalternative waste technology.

(iv) Capture and combustion of landfill gas.

Advantages (or) benefits of energy efficiency

1. Using energy more efficiently is one of the fastest,most cost - effective ways to save money.
2. Increased energy efficiency can lower green house gas emissions and other pollutants.
3. Energy efficiency also decreases water use.
4. It can lower individual utility bills, create jobs and help stabilize electricity prices.
5. It provides long-term benefits by lowering overall electricity demand, thus reducing the needto invest in new electricity generation and transmission infrastructure.
6. Energy efficient construction is environmentally -friendly as it does not emit harmful carbondioxide into the atmosphere.

Example

Energy - efficient LED light bulbs are able to produce the same amount of light asincandescent light bulbs by using 75 to 80% less electricity.

Disadvantages (or) limitations of energy efficiency

1. Energy efficient construction is the high cost of enforcing ie., addition cost is required tobuild and plan such buildings.
2. Building materials are not always availalble.
3. Although energy efficient construction is environmentally friendly, it produces less carbonemissions and has slight unfavorable effects on the human health.
4. Indoor air is 3 to 7 times more polluted than outdoor air.

SUSTAINABLE TRANSPORT

Definition

Sustainable transport refers to any means of transportation that is "green" and has lowimpact on the environment.

Examples

1. walking
2. cycling
3. transit
4. carpooling
5. car sharing
6. green vehicles

Sustainable transport can carry people for more efficiently than cars. Electric cars pollute lessand reduce individual carbon foot prints.

Sustainable TransportImportance of

Sustainable Transport

(i) Sustainable transport contributes to reduction in CO_2 emission and therefore to a reductionin atmospheric pollution and improved air quality in cities.

(ii) The aim of this type of transport is to reduce the negative impacts on the environment.

How to promote sustainable transport

Followings are steps for promoting sustainable transport.

1. Enhancing puplic transportation

It is not only less polluting means of transportation,but also promoting HSE (Health,safety and environment) policy.

2. Encouraging car pooling : It reduces the volume of CO_2, emitted per inhabitant.

3. Encouraging bicycle use : It is reliable and non-polluting means of transportation.

4. Tele working : It reduces employee travel and therefore their carbon food print.

SUSTAINABILITY ENERGY

Definition

Sustainable energy is the energy which meets the needs of present withoutcompromising the ability of future generations to meet their own needs.

It should be encouraged as it does not cause any harm to the environment and isavailable widely at free of cost.

Sources of Sustainable energy

Followings are the sustainable enery sources as they are stable and available in plenty.

1. Wind energy.
2. Solar energy.
3. Ocean energy.
4. Hydro power.
5. Geothermal energy.

Merits of Non Conventional energy resources

1. Unlimited supply.
2. Provides energy security.
3. Fits into sustainable development concept.
4. Reliable and the devices are modular in size.
5. Decentralized energy production.

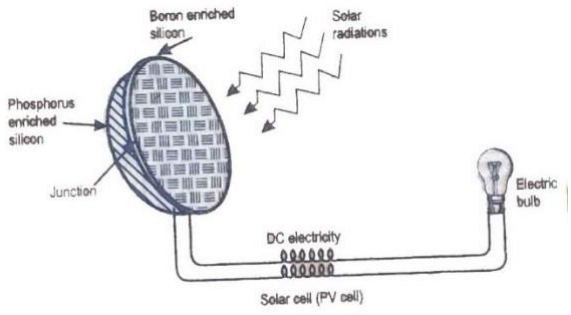
Solor Energy

The energy that we get directly from the sun is called solar energy.The nuclear fusion reactions occurring inside the sun release enormous amount of energy in the form of heat and light. Several techniques are available for collecting,converting and using solar energy.

Methods of Harvesting Solor Energy

Some important solar energy harvesting devices are given below.

1. Solor cells (or) photovoltaic cells (or) PV cells



Solor Cell

Solar cells consists of a p-type semiconductor (suchas Si doped with B) and n-type semiconductor (such asSi doped with P). They are in close contact with each other. When the solar rays fall on the top. layer of P-type semiconductor, the electrons from the valence band gets promoted to the conduction band and cross the P-N junction into N-type semiconductor. There by potential difference between two layers is created, which causes flow of electrons (ie., an electric current).

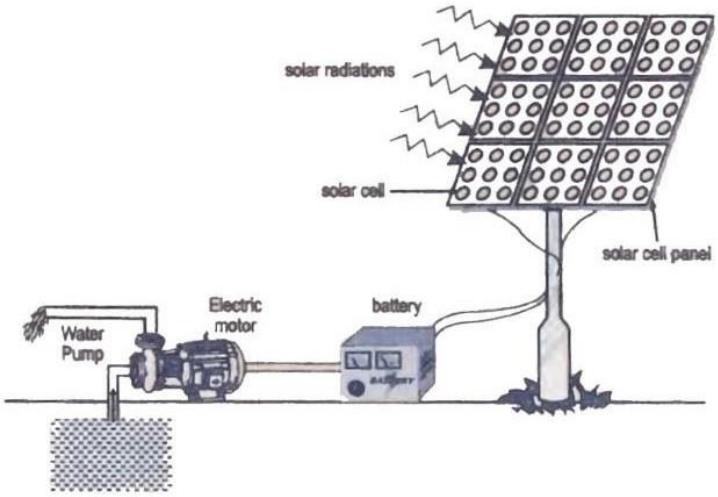
Uses

Used in calculators, electronic watches, street lights,water pumps to run radios and TV

s.

Solor Battery

When a large number of solar cells are connected in series it form a solar battery..



1.Solor pumb run by solor cells (Battery)

Solar battery produce more electricity which is enough to run water pump, street lights etc.,They are used in remote areas where conventional electricity supply is a problem.

2. Solor heat collectors

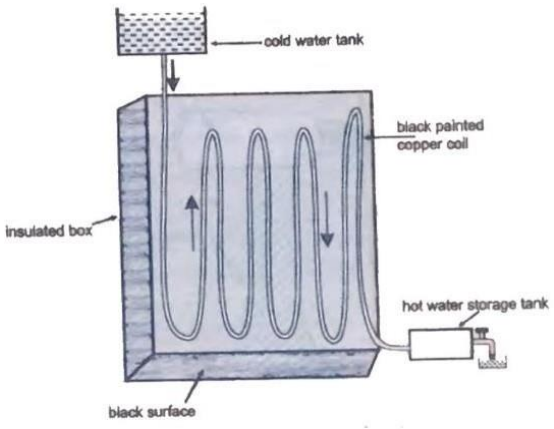
Solar heat collectors consist of natural materials like stones, bricks (or) materials likeglass, which can absorb heat during the day time and release it slowly at night.

Uses

It is generally used in cold places, where houses are kept in hot condition using solar heat collectors.

3. Solor water heater

It consists of an insulated box inside of which is painted with black paint. It is also provided with a glass lid to receive and store solar heat. Inside the box it has black painted copper coil, through which cold water is allowed to flow in,which gets heated up and flows outinto a storage tank. From the storage tank water is thensupplied through pipes.



Solor Water Heater

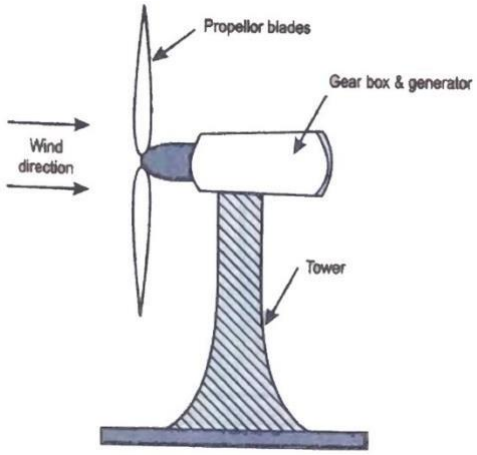
Wind Energy

Moving air is called wind. Energy recovered from the force of the wind is called wind energy. The energy possessed by wind is because of its high speed. The wind energy is harnessed by making use of wind mills.

1. Wind mills

The strike of blowing wind on the blades of the windmill makes it rotating continuously.The rotational motion of the blade drives a number of machines like water pump,flour mills and electric generators.

Wind mill



2. Wind forms

When a large number of wind mills are installed and joined together in a definite patternit forms a wind farm.

The wind fans, produce a large amount of electricity.

Condition

The minimum speed required for satisfactory working of a wind generator is 15 km 1hr.

Advantages

1. It does not cause any air pollution.
2. It is very cheap.

Ocean Energy

Ocean can also be used for generating energy in the following ways.

1. Tidal Energy (or) Tital powerOcean tides, produced by gravitation & forces of sun and moon, contain enormous amount of energy. The 'high tide' and 'low tide' refers to the rise and fall of water in the oceans. The tidal energy can be harnessed byconstructing a tidal barrage.

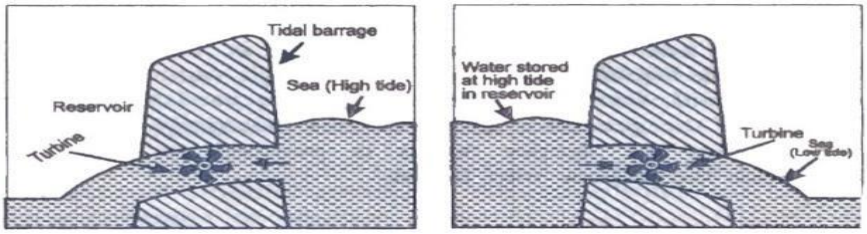


Fig (a) Water flows into the reservoir from sea

Fig (b) Water flows out from the reservoir to the sea

(a) During high tide, the sea-water is allowed to flow into the reservoir of the barrage androtates the turbine, which inturn produces electricity by rotating the generators.

(b) During low tide, when the sea level is low, the sea water stored in the barrage reservoir isallowed to flow into the sea and again rotates the turbine.

2. Ocean Thermol Energy (OTE)

There is often large temperature difference between the surface level and deeper levelof the tropical oceans.This temperature difference can be utilized to generate electricity. Theenergy available due to the difference in temperature of water is called ocean thermal energy. **Condition**

The temperature difference should be of 20°C (or) more is required between surfacewater and deeper water.

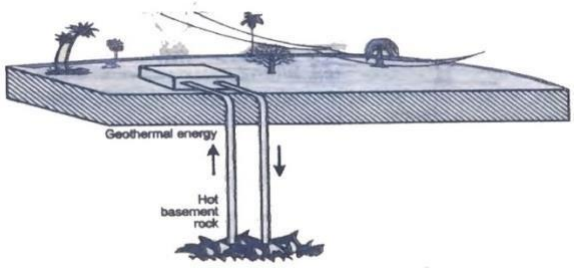
Process

The warm surface water of ocean is used to boil a low boiling liquid like ammonia. The high vapour pressure of the liquid, formed by boiling, is then used to tum the turbine of the generator and generates electricity. The cold water from the deeper ocean is pumped to cool and condense the vapour into liquid.

3. Geo thermal energy

Temperature of the earth increases at a rate of 20- 75°C per km, when we move down the -earth surface.High temperature and high pressure steam fields exist below the earth's surface in many places. The energy harnessed from the high temperature present inside theearthis called geothermal energy.

Geo-Thermol Energy



1. Natural geysers

In some places, the hot water (or) steam comes out of the ground through cracksnaturally in the form of natural geysers.

2. Artificial geysers

In some places, we can artificially drill a hole upto the hot region and by sending a pipein it, we can make the hot water (or) steam to rush out through the pipe withvery high pressure.

Thus, the hot water (or) steam coming out from the natural (or) artificial geysers isallowed to rotate the turbine of a generator to produce electricity.

Biomass energy

Biomass is the organic matter, produced by plants (or) animals, used as sources ofenergy. Most of the biomass is burned directly for heating, cooling and industrial purposes.

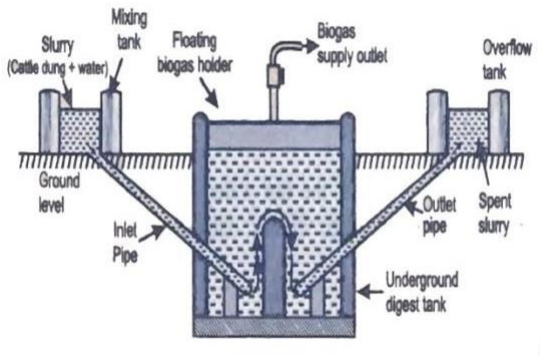
Examples

Wood, crop residues, seeds, cattle dung, sewage, agricultural wastes etc., Biomassenergies are of any one of the following.

1. Biogas

Biogas is a mixture of gases such as methane, carbondioxide, hydrogen sulphide, etc.,It contains about 65% of methane gas as a major constituent.

Biogas is obtained by the anaerobic fermentation of animal dung (or) plant wastes inthe presence of water.



Biogas Plant

2. Biofuels

Biofuels are the fuels, obtained by the fermentation of biomass.

Examples : Ethanol, methanol.

(a) Ethanal : Ethanol can be produced from the sugarcane. Its calorific value is less whencompared to petrol, and produces much less heat than petrol.

(b) Methanol : Methanol can be easily obtained from ethanol (or) sugar-containing plants. Itscalorific value also too low when compared to gasoline and diesel.

(c) Gasohol : Gasohol is a mixture of ethanol + gasoline.In India trial is being carried out to use Gasohol in cars and buses.

(d) Hydrogen fuel : Hydrogen can be produced by thermal dissociation (or) photolysis (or) electrolysis of water. It possess high calorific value. It is non -polluting, because the combustion product is water.

$2H_2 + O_2 \rightarrow 2H_2O + 150$ kJ

Disadvantages of Hydrogen fuel

1. Hydrogen is highly inflammable and explosive in nature.
2. Safe handling is required.
3. It is difficult to store and transport.

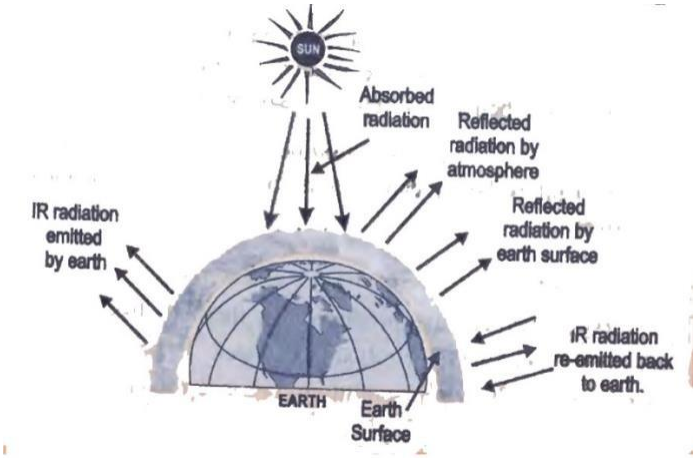
ENERGY CYCLES

Energy cycle, is the interactions between energy sources within the Earth'senvironment.

These interactions are very complex and even small changes in them can lead tosignificant changes in long-term climate behavior.

Mastration

A simple illustration of the major elements of the energy cycle is shown in the figure.



Energy Cycles

Soil moisture is an important factor in the absorption and reflection of the sun's energyby the earth's surface.

Important energy cycles

(i) Carbon cycle.

(ii) Nitrogen cycle.

(iii) Phosphorus cycle.

Carbon cyclesDefinition

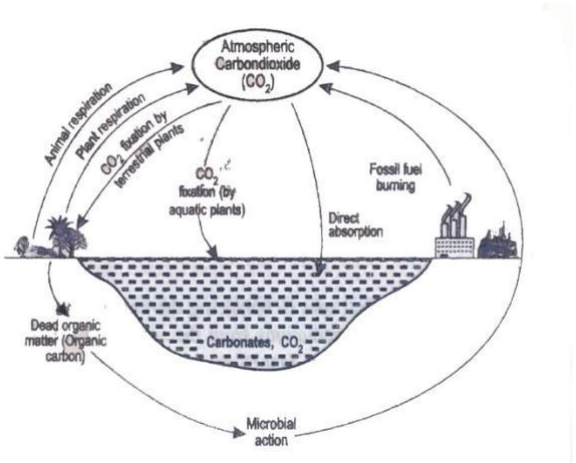
Carbon cycle is the movement of carbon (or) carbon compounds continuously from theatmosphere to the earth and then back into the atmosphere.

(Or) Carbon cycle is the process where carbon compounds are interchanged among the biosphere,geosphere, hydrosphere and atmosphere of the earth.Carbon in the atmosphere is present in the form ofcarbon dioxide. Carbon enters the atmosphere through natural process such as respiration and industrial applications such as burning of fossil fuels sources of CO_2 inatmosphere.

1. During respiration, plants and animals liberates CO_2 in the atmosphere.
2. Combustion of fuels also release CO_2.
3. Volcanic eruptions also release CO_2.

Various steps involved in carbon cycle

Carbon cycle involves the following 5 important steps.



Carbon Cycles

Step 1: Carbon present in the atmosphere is absorbed by plants by the processes of photosynthesis,which involves the absorption of CO_2 by plants to produce carbohydrates (producers).

$CO_2 + H_2O + \text{energy} \rightarrow (CH_2O)_n + O_2$

Step 2: These plants are then consumed by animals and carbon gets bioaccumulated into their bodies (consumers).

Step 3: These animals and plants eventually die and decomposers eat the dead organism and return the carbon from their body back into the atmosphere (decomposers)

$(CH_2O)_n + O_2 \rightarrow CO_2 + H_2O + \text{energy}$

Step 4: Some of the carbon that is not released back into the atmosphere eventually become fossil fuels.

Step 5: These fossil fuels are then used for man-made activities, which pump more carbon back into the atmosphere.

Importants (or) benefits of carbon cycle

1. It plays a vital role in balancing the energy and traps the long-wave radiations from the sunie., it acts likea blanket. over the planet, avoids global warming.

2. Carbon cycle is an important aspect of the survivalof all life on earth.

3. Carbon is the building block of life and forms bonds with other elements necessary for life.

CARBON EMISSION AND SEQUESTRATION

Carbon emission

Carbon emission is the release of green house gases and their precursors into theatmosphere over a specified area and period of time.

Types of carbon omissions

Carbon (Green ho use gas) emissions are classified into two scopes.

1.Direct emissions

Direct emissions comes from company.

2.Indirect emissions

Indirect emissions from the generation of purchased energy (purchased electricitysteam, heat and cooling) from a utility provider (end user).

Sources (or) Causes of carbon emission

1. Natural sources of CO_2 emission

It includes

(a) Decomposition of matter.

(b) Ocean release.

(c) Respiration.

(d) Most animals, which exhale CO_2 as a waste product.

(e) Carbonate rocks.

2. Human sources of CO_2 emission

It includes

(i) Burning of fossil fuels like coal, natural gas and oil.

(ii) Deforestation.

(iii) Industrial activities like cement manufacture oil refineries and leatherindustries. '

(iv) Transportation sector generates largest amount of CO_2 in the atmosphere.

Harmful effects of carbon emissions

1.Carbon emission, nothing but emision of green house gas, affects the planet significantly.

2. It causes global warming and affects climate change.

Reduction of carbon emission

There are many ways to reduce green house gas emissions like

1. energy efficiency.
2. fuel switching.
3. combined heat and power.
4. use of renewable energy.
5. more efficient use.
6. recycling of materials.
7. plant more trees.
8. reduce air travel.
9. driving more efficient.

Carbon sequestrarion

It is the process of capturing and storing atmospheric carbondioxide. It is one method of reducing the amount of CO_2 in the atmosphere. Goal of carbon sequestration is to reduce global climate change. 25% of our carbon emissions have been captured by earth's forests, farms and grassland. Scientists and land managers are working to keep landscapes vegetated and soil hydrated for plants to grow and sequester carbon.30% of the carbon dioxide, we emit from burning fossil fuels, is absorbed by the upper layer of the ocean.45% of carbon dioxide stays in the atmosphere the rest in sequestered naturally by the environment.

Concept (or) Aim of carbon sequestrarion

The concept of carbon sequestration is to stabilize carbon in solid and dissolved forms so that it doesn't cause the atmosphere to warm. The process shows tremendous promise for reducing the human "carbon foot print".

Methods (or) Type of carbon sequestrarion

There are three main types of carbon sequestration.

1. Biological carbon sequestration.

It is the storage of CO_2 in vegetation like grassland,forests, soils and oceans.

2. Geological carbon sequestration

It is the process of storing CO_2 in underground geologic formations (or) rocks. Typically, CO_2 is captured from an industrial sourceslike steel (or) cement production,

power plant and injected into the porous rocks for long-term storage.

3. Technological carbon sequestration

Scientists are using innovative technologies to remove and store carbon from the atmosphere using innovative technologies.

Example : Graphene production

The use of CO_2 as a raw material to produce graphene (a technological material). Graphene is used to create screens for smart phones and other technical devices.Graphene production is an example of how CO_2 can be used as a resource and a solution in reducing emissions from atmosphere.

Advantages and Disadvantages of carbon sequestrationAdvantages

(Merits)

1. Carbon sequestration prevents the occurrence of climate change.
2. Deep injection of CO_2 improves the extraction of fuels like oil and methane from theirreserves in addition to removing excess pollutants from the air.
3. Since the gas can be easily liquefied it can be easily transmitted through pipelines.
4. No CO_2 leaking out from the injection site. It lowers carbon emission by 80% to 85% whileusing fossil fuels.

Disadvantages (or) Limitations

1. Due to carbon sequestration, in power plants, 40% additional coal is consumed and hencecost of energy gets increased by 1 to 5% per kilowatt hour.
2. CO_2 from power plant emissions must be captured and liquified, which uses a lot of electricalpower.
3. It can be disastrous if the injected gas leaks due to structural flaws in the geologicalformation.
4. The ocean can become acidic due to the large amounts of carbon dioxide being injected intoit,endangering aquatic life.
5. Planting trees, with the intention of storing and absorbing carbon, requires more time for thetrees to mature.
6. There is no enough available geological resources to sequester carbon.
7. The concentration of CO_2, from power plant exhaustis too low for being effectively liquified.

GREEN ENGINEERING

Definition

Green engineering is the design, commercialization and use of processes and products that minimizes pollution, promotes sustainability and promotes human health without affectingenvironment.

Examples for green engineering

1. Biodegradable cups and straws.
2. Enhanced industrial emission filters.
3. Waste water treatment.
4. Radiant floors (heat homes efficiently by installing warming tubes under a floor).

5. Plant-based cooling (an alternate cooling solution using plants and trees installed around (or)on a building)

Goal of green engineering

1. Decrease in the amount of pollution that is generated by a construction.
2. Minimization of human population exposure to potential hazards (reducing toxicity).
3. Improved uses of matter and energy throughout the life cycle of the product.
4. Maintaining economic efficiency and viability.
5. Reduces energy and water consumption.
6. Reduces waste and our carbon footprint.
7. Improves business efficiency by lowering costs while improving the product design andcreating new jobs.

Principles of Green engineering

1. All materials and energy inputs and outputs are inherently non-hazardous as possible.
2. It is better to prevent waste that to treat (or) cleanup waste after it is formed.
3. Separation and purification operations should bedesigned to minimize energy consumptionand material use.
4. Products, processes and systems must be designed to maximize mass, energy, space and timeefficiency.
5. Products processes and system should .be "output " pulled" rather than "input pushed"through the use of energy and materials.
6. Complexity must be viewed as an investment when making design choices on recycle, reuse.
7. Durability rather than immortality should be a design goal.
8. Material diversity in multi-component products should be minimized.
9. Design of products, processes and system must include integration and inter-connectivitywith available energy and materials flow.
10. Products should be designed for performance in a commercial "after life".
11. Material and energy inputs should be renewable rather than depleting.

Benefits of green engineering

1. This process enhances business practices byeliminating improper production methods.
2. It improves a company's reputation by showing consumers it cares about the environment.
3. It minimizes energy (or) production waste.
4. It provides tax incentives.
5. It helps the global environment.
6. It reduces air, water and soil pollutions.
7. It provides new business opportunities.

Limitations (or) disadvantages of green engineering

1. R &D costs, production and implementation costs are high.
2. Implementation will take many years.
3. Green technology is still quite immature.
4. Some companies may go out of business.
5. Job losses.
6. Sophisticated regulatory frame work needed.
7. Not everything that is labeled as green is actually green.

SUSTAINABLE URBANIZATION

Urbanization is the movement of human population from rural areas to urban areas for the want of better education, communication, health, employment, etc.,without affecting the environment and needs of future generations.

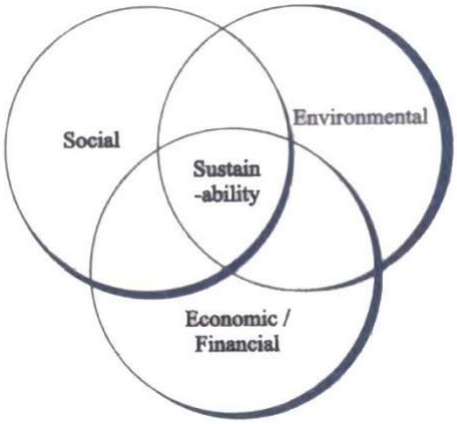
Rules to develop a sustainable urbanization

1. Sustainable transportation.
2. Sustainable urban development.
3. Climate change mitigation and landscape architecture.
4. Resilient design (regarding natural hazards).
5. Applying ecological design.
6. Improving water efficiency.
7. Increasing energy efficiency.
8. Using low impact materials.

By following the above rules, urbanization can be made into sustainable.

Pillers of sustainable urbanization

Sustainahility is based on three functional areas ie.,social, environmental and financial econoniical. These functional areas are inter connected and must considered together. The place where these all meet and are balanced is the goal of sustainability.



Functional areas of sustainable urbanization

The goal of urban sustainability is to prevent resource availability issues for existing (or) futuregenerations. It also minimizes an urban area's impact on its ecosystem

Advantages and Disadvantages of sustainable urbanizationAdvantages

1. Urbanization creates convenience.
2. Urban economies can be better than rural ones.
3. Provides better education.
4. Get better housing.
5. Provides better social life.
6. Provides better healthcare services.
7. More security and police availability.
8. More entertainment options.
9. More tourist attractions.
10. More places to shop in urban areas.

Disadvantages

1. Over crowding in urban areas.
2. Buying a house might be a challenge.
3. Decline in rural area.
4. Too much crime occurs in urban area.
5. Unemployment problem is more.
6. Cost of living is higher.
7. No privacy.
8. Pollution problem is more.

SOCIO-ECONOMICAL CHANGE ON SUSTAINABLE URBANIZATION

Urbanization has many adverse effects on thestructure of society because,

(i) Gigantic concentrations of people compete for limited resources.

(ii) Rapid housing construction leads to over crowding.

(iii) Slums, which experience major problems such as poverty, poor sanitation, unemployment.

(iv) It leads to higher crime rates and pollutipn.

(v) It also leads to increased levels of inequality and social exclusion.

(vi) Environmental degradation is occurring very rapidly causing problems like land insecurity,excessive air pollution, waste disposal problems.

Technological change on sustainable urbanization

Technological change involves the introduction of something new (or) a new idea, method (or) device.Technological innovations, as part of technological change,allows organisations to test new ideas at speeds and prices that were never anticipated a decade ago.

1. Technological innovation has changed the overall effectiveness and benevolence over timeand with regard to sustainability.

2. Upgrading of industrial structure improves the sustainable urbanization.

3. Technological change and sustainability are closely related to each other.

Both factors form the innovation inorder to improve the effectiveness of environmental andsocial development and economic progress.

5. The combination of digital technology in the' business model will establish and empower acity to be more sustainable,.

PART B QUESTIONS

1. What is zero waste? Explain its concept and principles.
2. Explain the various steps to achieve zero waste? And advantages and disadvantages of zerowaste.
3. What is R concept? Explain its concept andadvantages and disadvantages of R concept.
4. What is circular eco:pomy? Explain various steps involved in achieving a circular economy.
5. What are ISO and IS014000 series? List out any 5 IS014000 series standards.
6. What are the core elements of ISO 14000.? Explain its merits and demerits.
7. What is life cycle assessment? Explain the various steps involved in life cycle assessment.
8. What is environmental impact assessment? Explain the objectives and benefits of EIA.
9. Explain the various elements of EIA.
10. What is sustainable habitat? Explain its characteristics and objectives of it.
11. What is green building? Explain its criteria and features.
12. Explain the principles, components, merits and demerits of green building.
13. What are green materials? Give examples. Explain important green building materials.
14. What is energy efficiency? Explain methods of achieving energy efficiency? How tocalculate it.
15. Explain the advantages and disadvantages of energyefficiency.
16. What is sustainable transport? Explain the key elements of sustainable transport.
17. What is sustainable energy? Explain advantages and disadvantages of it.
18. Write notes on non-conventional sources of energy.
19. What is energy cycle? Explain the carbon ,cycle witha neat diagram.
20. What is carbon emission? Explain its types andremedy.
21. Defme carbon sequestration. Explain the various types of carbon sequestration.
22. Explain the principle, goal and benefits of green engineering.
23. What is sustainable urbanization? Explain the rules todevelop sustainable urbanization.
24. Write notes on socio-economical change onsustainable urbanization.