

Day: Sunday

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Date: 22-Dec-2024

Mock-6

CS5-2025

Environmental Science

Question No:-3

Part (a)

What is Climate:-

Climate refers to the long-term patterns of temperature, humidity, wind, precipitation and other atmospheric conditions in a specific area over extended periods, typically 30 years or more. It contrasts with weather, which describes short-term atmospheric conditions. Understanding climate is critical for studying environmental systems, agriculture, water resources and predicting future climate-related challenges.

Weather Variables:-

Weather is characterized by several variables that directly influence climate and daily atmospheric conditions:

1. Temperature:-

The measure of heat energy in the atmosphere.

2. Precipitation:-

Water released from clouds in forms like rain, snow, sleet or hail.

3. Humidity:-

The amount of water vapour in the air.

4. Wind:-

Air movement caused by pressure differences in the atmosphere.

5. Air Pressure:-

The weight of the atmosphere pressing down on Earth's surface.

6. Cloud cover:-

The fraction of the sky covered by clouds.

7. Solar radiation:-

The amount of energy received from the sun.

LA NINA and EL NINO Phenomena:-

The El Nino-Southern Oscillation (ENSO) cycle represents fluctuations in ocean-atmosphere interactions across the equatorial Pacific Ocean, significantly impacting global climate distribution.

The two main phases of ENSO are El Niño and La Niña:

EL Niño:-

Definition:-

Refers to the warming of sea surface temperatures (SSTs) in the central and eastern Pacific Ocean near the equator.

Mechanism:-

Weakening or reversal of the trade winds allow warm water from the western Pacific to shift eastward.

Global Impacts:-

- i. Dry Regions: Droughts in Australia, Southeast Asia and parts of Africa.
- ii. Wet Regions: Heavy rainfall and floods in South America and Southern United States.
- iii. Temperature: Global temperatures typically rise during strong El Niño events.

La Niña:-

Definition:-

Characterized by cooler-than-average SSTs in the central and eastern Pacific Ocean.

Mechanism:-

Strengthening of the trade winds pushes warm water westward, allowing

Colder water to upwell in the eastern Pacific.

Global impacts:-

i- Wet regions:- Increased rainfall in Australia, Southeast Asia and parts of South Asia.

ii- Dry regions:- Drier conditions in South America and the Southern United States.

iii- Temperature:- Tends to lower global temperatures slightly.

Global Climate Distribution:-

Both El Niño and La Niña influence global climate distribution by altering atmospheric circulation patterns:

1) Jet streams:-

Changes in jet stream positions can disrupt weather systems across continents.

2) Monsoons:-

South Asian monsoons weaken during El Niño but intensify during La Niña.

3) Hurricane Activity:-

i) El Niño:- suppresses Atlantic hurricanes but enhances Pacific storms.

ii) La Niña:-

Increases the frequency and intensity of Atlantic hurricanes.

Part (b):-

Definition of Eutrophication:-

Eutrophication is the excessive enrichment of water bodies with nutrients primarily nitrogen and phosphorus, leading to overgrowth of algae and aquatic plants. This phenomenon disrupts ecosystems, depletes oxygen levels, and affects water quality. It is commonly observed in lakes, rivers, estuaries and coastal areas due to agricultural runoff, industrial discharges and untreated sewage.

Process of Eutrophication:-

Eutrophication occurs through the following stages:-

1) Nutrient Enrichment:-

Excessive nutrients particularly nitrates and phosphates, enter water bodies from fertilizers, detergents and sewage.

2) Algal Bloom:-

High nutrient level promote rapid growth of algae on the water surface.

3) Decomposition:-

When algae die, their decomposition consumes oxygen in the water.

4) Oxygen depletion:-

The breakdown of organic matter by bacteria leads to hypoxic (low oxygen) or anoxic (no oxygen) conditions.

5) Aquatic life impacts:-

Low oxygen levels make the water uninhabitable for fish and other organisms, disrupting the ecosystem.

Types of Eutrophication:-

1) Natural Eutrophication:-

It is a slow and natural process occurring over centuries. Results from the gradual accumulation of nutrients through natural processes like sedimentation.

2) Cultural (Anthropogenic)

Eutrophication:-

Accelerated by human activities such as agriculture, urbanization and industrialization. Increase the nutrient load in water bodies within a short period.

Effects of Eutrophication:-

1) Ecological effects:-

i) loss of biodiversity:-

Oxygen depletion leads to death of aquatic organisms.

ii) Harmful Algal Blooms (HABs).

Some algal species release toxins, harming aquatic life and humans.

iii) Habitat Degradation:-

Loss of submerged vegetation due to reduced sunlight penetration.

2) Economic effects:-

Decreased fishery yields due to habitat destruction and increased water treatment costs for drinking water.

3) Health effects:-

Contaminated water can cause illnesses like diarrhea and liver damage in humans and animals. Bioaccumulation of toxins in seafood poses long-term health risks.

Controlling Measures :-

1. Source Reduction :-

Use of eco friendly fertilizers and reduce chemical runoff. Proper treatment of sewage and industrial effluents before discharge.

2- Buffer Zones :-

Create vegetative buffer strips along water bodies to absorb nutrients. Promote wetlands as natural nutrient filters to overcome pollution.

3- Algal Control :-

Introduce biological controls like herbivorous fish to manage algal growth and use aeration techniques to restore oxygen levels in water.

4- Policy and Awareness:-

Enforce regulations on nutrient discharge limits. Educate farmers, industrialists and public about sustainable practices to overcome eutrophication.

Question NO: 2

Part (a):

Industrial Revolution:-

The industrial revolution was a turning point in human history, transforming economies, societies and technology. However, its environmental consequences have been profound and far-reaching, setting the stage for many of the challenges we face today.

Consequences of Industrial Revolution:-

1. Deforestation and habitat loss:

The rise of industries required large quantities of raw materials, especially wood and later coal. Forests were cleared extensively to provide fuel, construction materials and agricultural land for growing industrial populations.

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Consequence :-

Loss of biodiversity as habitats were destroyed.

Example :-

The deforestation during the industrial revolution laid the groundwork for today's challenges in preserving forest ecosystems.

2. Air Pollution :-

The use of coal as a primary energy source led to a dramatic increase in air pollution.

Consequence :-

Emissions of harmful gases like sulfur dioxide caused respiratory issues and environmental phenomena such as acid rain.

Example -

London became famous for its smog during the 19th century, a direct result of industrial emissions.

3. Water Pollution :-

Factories dumped untreated chemical waste into rivers and lakes, severely polluting freshwater sources.

Consequence

This not only affected aquatic life but also communities relying on these water bodies for drinking and agriculture.

Example:- Rivers like Thames were heavily polluted during this era, posing significant health risk.

4. Climate Change:-

The industrial revolution marked the beginning of large-scale fossil fuel consumption, leading to increased greenhouse gases.

Consequence:-

Accelerated global warming and long term climate change impacts.

Example:-

CO₂ levels began to rise significantly from the 18th century, initiating a trend that continues to challenge global climate stability.

5. Resource Depletion:-

The extraction of minerals and other natural resources intensified during the industrial revolution, often unsustainably.

Consequence:-

Exhaustion of finite resources and disruption of natural ecosystems.

Example:-

Coal mines expanded rapidly, leaving behind environmental scars and setting the stage for energy crises.

6. Urbanization and Waste:-

The growth of industrial cities led to overcrowding and poor waste management.

Consequence:-

Health crises arose from poor sanitation and unmanaged industrial waste.

Example:-

Cities like Manchester grew rapidly but struggled to manage industrial and domestic waste effectively.

Modern Reflections :-

The environmental consequences of industrial revolution are still evident today.

Ongoing impacts:-

Climate change, pollution and deforestation are direct legacies.

Lessons learned:-

The need for sustainable development practices, renewable energy and better resource management.