

**M. SC. (ENVIRONMENTAL SCIENCE)
(MSCENV)**

**Term-End
Examination**

December, 2022

**MEV-011 : FUNDAMENTALS OF
ENVIRONMENTAL SCIENCE AND
ECOLOGY**

Time: 3 Hours

Maximum Marks: 100

Note: Answer any **ten** questions. All questions carry equal marks.

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1. Describe structure and functions of various segments of environment. 10
 2. Write short notes on any *two* of the following: 5 each
 - (a) Levels of organization in ecology
 - (b) Biotic relationships
 - (c) Climatic and edaphic factors

3. What is succession? Give general process of succession.

10

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4. What are the impacts of natural resource depletion on the environment? 10
5. Explain global environmental issues with suitable examples. 10
6. Describe environmental sustainability, its targets and indicators. 10
7. Describe air, water and soil pollution and its impacts on environment. 10
8. Explain food chain, food web and ecological pyramid in an ecosystem. 10
9. Explain nitrogen cycle and carbon cycle with suitable diagrams. 10
10. Describe ecological restoration and various approaches of ecological restorations. 10
11. What is environmental economics? Describe its significance in environmental valuation. 10
12. What is environmental auditing? Describe the

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13. Write a note on environmental education and its significance in solving environmental problems. 10
14. Describe various sustainable ecofriendly technologies for solving environmental problems. 10

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Answers:

Q1. Describe structure and functions of various segments of environment.

Ans:

The environment can be divided into various segments or components, each of which plays a unique role in supporting life on Earth. Here's a brief overview of the structure and functions of some of these segments:

Atmosphere: The atmosphere is the layer of gases that surrounds the Earth. It is made up of nitrogen (78%), oxygen (21%), and other gases such as carbon dioxide and water vapor. The atmosphere plays several important roles, including protecting the Earth from harmful radiation, regulating the planet's temperature, and providing the oxygen that living things need to breathe.

Hydrosphere: The hydrosphere is the Earth's water system, which includes oceans, rivers, lakes, and groundwater. The hydrosphere plays a vital role in supporting life on Earth by providing water for drinking, irrigation, and other uses. It also helps to regulate the Earth's temperature and climate by absorbing and releasing heat.

Lithosphere: The lithosphere is the Earth's solid outer layer, which includes the crust and upper mantle. It is home to a diverse array of life, including plants and animals that live on land. The lithosphere also provides important resources such as minerals and fuels and plays a crucial role in regulating the Earth's climate.

Biosphere: The biosphere is the part of the Earth that supports life, including all living organisms and their interactions with the environment. The biosphere includes both terrestrial and aquatic ecosystems and plays a vital role in regulating the Earth's climate, maintaining biodiversity, and providing important ecosystem services such as pollination and nutrient cycling.

These segments of the environment are interconnected and influence each other in complex ways. For example, changes in the atmosphere, such as increased levels of greenhouse gases, can affect the temperature of the Earth's surface, which in turn can affect the distribution of water in the hydrosphere and the growth of plants in the biosphere. Understanding the structure and functions of these different segments is essential for addressing environmental challenges such as climate change and biodiversity loss.

Q2. Write short notes on any two of the following:

(a) Levels of organization in ecology

(b) Biotic relationships

(c) Climatic and edaphic factors

Ans:

(a) Levels of organization in ecology

Ecology is the study of how living organisms interact with each other and their environment. One way to understand these interactions is to examine the levels of organization in ecology, which range from individual organisms to entire ecosystems.

At the lowest level of organization are individual organisms, which are the basic building blocks of all living things. At the next level are populations, which are groups of individuals of the same species that live in the same area and interact with each other. Communities are the next level of organization and are composed of different populations that interact with each other.

At the ecosystem level, organisms interact with each other and with their physical environment to form a self-regulating system. The biosphere, which is the highest level of organization, encompasses all of the Earth's ecosystems and their interactions with each other.

Understanding these levels of organization in ecology is important for understanding how living organisms interact with their environment, how ecosystems function, and how human activities can impact these interactions

(b) Biotic relationships

Biotic relationships are the interactions that occur between living organisms in an ecosystem. These relationships can be beneficial, harmful, or neutral for the organisms involved. Examples of beneficial relationships include mutualism, where both organisms benefit, and commensalism, where one organism benefits and the other is unaffected. Parasitism is an example of a harmful relationship, where one organism benefits at the expense of the other. Predation is another harmful relationship, where one organism hunts and kills another for food.

Biotic relationships are essential for maintaining the balance and functioning of ecosystems. They can influence population sizes, distribution, and evolution of species. Human activities, such as habitat destruction and introduction of

invasive species, can disrupt biotic relationships and have negative impacts on ecosystems. Therefore, understanding and managing biotic relationships is crucial for conserving biodiversity and maintaining healthy ecosystems.

(c) Climatic and edaphic factors

Climatic and edaphic factors are two important environmental factors that influence the growth and distribution of plant and animal species. Climatic factors include temperature, precipitation, humidity, wind, and sunlight, while edaphic factors include soil type, nutrients, pH, and water availability.

Climatic factors play a crucial role in determining the types of vegetation that can grow in a particular region. For example, tropical rainforests are found in areas with high temperatures and rainfall, while deserts are found in areas with low rainfall and high temperatures.

Edaphic factors are also important, as they determine the types of soil and nutrients available to support plant growth. Different plant species have adapted to thrive in different soil types, pH levels, and nutrient availability.

Understanding climatic and edaphic factors is essential for managing and conserving natural ecosystems, as human activities such as deforestation and agriculture can alter these factors and have negative impacts on biodiversity and ecosystem health.

Q3. What is succession? Give general process of succession.

Ans:

Succession is the process by which a community of living organisms changes over time, as one group of species is replaced by another. It is driven by a combination of biotic and abiotic factors, such as competition, predation, environmental conditions, and disturbances such as fires, floods, and human activities.

The general process of succession begins with a disturbance that removes most or all of the existing vegetation in an area, such as a forest fire or a volcanic eruption. This creates a blank slate on which new species can establish themselves.

The first species to colonize the area are typically fast-growing and tolerant of harsh environmental conditions, such as lichens and mosses. These species are called pioneers and they create a new environment that is more favourable to other, more complex species.

As the pioneers grow and spread, they change the environment by adding organic matter and increasing soil moisture and nutrients. This enables other species, such as grasses and shrubs, to establish themselves.

Over time, the community becomes more diverse and complex, with different species occupying different niches and interacting with each other in various ways. Eventually, a stable community of species is established, known as a climax community. The climax community is in balance with the environmental conditions and is able to persist for long periods of time, barring any major disturbances.

Succession can occur over a range of time scales, from decades to centuries or even millennia, depending on the specific ecosystem and the rate of environmental change. Understanding the process of succession is important for managing and conserving ecosystems, as disturbances such as logging and land-use change can disrupt succession and have negative impacts on biodiversity and ecosystem health.

Q4. What are the impacts of natural resource depletion on the environment?

Ans: Natural resource depletion refers to the exhaustion or overuse of natural resources such as water, air, soil, minerals, and energy sources. The impacts of natural resource depletion on the environment are wide-ranging and can have significant consequences for the health and well-being of ecosystems and human populations.

One of the most significant impacts of natural resource depletion is the loss of biodiversity. As natural habitats are destroyed or altered, many plant and animal species may become endangered or extinct, reducing the overall richness and diversity of ecosystems.

Depletion of natural resources can also lead to soil erosion, desertification, and water scarcity, which can in turn lead to crop failures, reduced agricultural productivity, and food shortages.

The extraction and burning of fossil fuels can contribute to air pollution, climate change, and global warming, which can have far-reaching impacts on the environment and human health.

Furthermore, natural resource depletion can also have social and economic impacts, such as loss of livelihoods, increased poverty, and social unrest.

To mitigate the impacts of natural resource depletion, it is important to adopt sustainable practices that conserve and protect natural resources, such as reducing waste and pollution, promoting renewable energy sources, and using resources more efficiently.

Q5. Explain global environmental issues with suitable examples.

Ans: Global environmental issues are problems that affect the entire planet and have the potential to cause widespread ecological, social, and economic impacts. Here are some examples of global environmental issues:

Climate change: Climate change is caused by the build-up of greenhouse gases, primarily carbon dioxide, in the atmosphere. It is leading to rising temperatures, melting glaciers, sea-level rise, and more frequent extreme weather events such as droughts, heatwaves, floods, and hurricanes.

Loss of biodiversity: The loss of biodiversity is caused by habitat destruction, pollution, overfishing, and climate change. It is leading to the extinction of many species and the destabilization of ecosystems, which can have cascading effects on the food web and ecosystem services.

Ocean acidification: Ocean acidification is caused by the absorption of excess carbon dioxide from the atmosphere by the oceans, leading to a decrease in pH. This is causing the degradation of coral reefs, the death of shellfish and other marine life, and disrupting the food web.

Deforestation: Deforestation is caused by human activities such as logging, clearing land for agriculture, and urbanization. It is leading to the loss of habitat for many species, increased greenhouse gas emissions, soil erosion, and loss of cultural heritage.

Water pollution: Water pollution is caused by industrial, agricultural, and domestic activities, which release contaminants such as chemicals, plastics, and nutrients into water bodies. It is leading to the degradation of aquatic ecosystems, loss of biodiversity, and threats to human health.

These global environmental issues are complex and interconnected, requiring coordinated efforts from individuals, governments, and organizations to address and mitigate their impacts.

Q6. Describe environmental sustainability, its targets and indicators.

Ans: Environmental sustainability is the ability to maintain the natural resources and ecological balance of the planet over the long term, while also ensuring that human needs are met. It involves using natural resources in a way that does not degrade the environment or compromise the ability of future generations to meet their own needs.

The targets of environmental sustainability include reducing greenhouse gas emissions, protecting biodiversity, conserving natural resources, promoting sustainable agriculture and fisheries, and reducing waste and pollution. These targets are often based on the principles of the triple bottom line, which seeks to balance economic, social, and environmental considerations.

Indicators are used to measure progress towards environmental sustainability targets. They provide information about the state of the environment, as well as the impacts of human activities on natural resources and ecosystems. Some common indicators of environmental sustainability include:

Carbon footprint: Measures the amount of greenhouse gas emissions generated by human activities, such as transportation, energy production, and agriculture.

Biodiversity: Measures the variety and abundance of plant and animal species, as well as the health and functioning of ecosystems.

Water quality: Measures the levels of contaminants in freshwater and marine ecosystems, including pollutants and excess nutrients.

Waste generation: Measures the amount and types of waste generated by human activities, including solid waste, hazardous waste, and electronic waste.

Resource use: Measures the consumption of natural resources, such as water, energy, minerals, and timber.

By tracking and analyzing these indicators, policymakers and stakeholders can make informed decisions about how to promote environmental sustainability and reduce the impacts of human activities on the planet.

Q7. Describe air, water and soil pollution and its impacts on environment.

Ans: Air, water, and soil pollution are three major types of environmental pollution that can have significant impacts on the environment and human health.

Air pollution is caused by the release of pollutants into the atmosphere, primarily from transportation, industrial activities, and burning of fossil fuels. This can lead to respiratory problems, heart disease, and other health problems for humans and animals. Air pollution can also lead to acid rain, which can damage crops, forests, and waterways, and contribute to the degradation of buildings and cultural heritage sites.

Water pollution is caused by the release of contaminants into water bodies, including chemicals, plastics, and excess nutrients. This can lead to the degradation of aquatic ecosystems, loss of biodiversity, and threats to human health. Water pollution can also lead to the spread of waterborne diseases such as cholera and dysentery, which can be fatal.

Soil pollution is caused by the release of pollutants into the soil, including chemicals from industrial activities, mining, and agricultural practices. This can lead to the degradation of soil quality, reducing crop yields and making land unsuitable for farming. Soil pollution can also lead to the contamination of groundwater and surface water, leading to health problems for humans and animals.

The impacts of air, water, and soil pollution on the environment are wide-ranging and can have long-term consequences. They can lead to the loss of biodiversity, the degradation of ecosystems, and the destabilization of the climate. These impacts can in turn have social and economic consequences, such as loss of livelihoods, increased poverty, and social unrest.

To address these issues, it is important to adopt sustainable practices that reduce waste and pollution, promote renewable energy sources, and use resources more efficiently. This can help to mitigate the impacts of pollution and promote environmental sustainability.

Q8. Explain food chain, food web and ecological pyramid in an ecosystem.

Ans: A food chain is a linear sequence of organisms in which each organism is eaten by the next organism in the chain. For example, a simple food chain in a grassland ecosystem may start with grass, which is eaten by a grasshopper, which is eaten by a mouse, which is eaten by a snake.

A food web is a more complex representation of the feeding relationships in an ecosystem. It shows the interconnected network of food chains and the various

pathways through which energy and nutrients flow within the ecosystem. For example, in a forest ecosystem, a food web may show how a variety of plants and animals interact with each other, with some organisms serving as both predator and prey.

An ecological pyramid is a graphical representation of the trophic levels in an ecosystem, with each level representing a different level of energy transfer. The base of the pyramid represents the primary producers, such as plants, which convert the sun's energy into food through photosynthesis. The next level represents the herbivores, such as insects or grazing animals, that feed on the primary producers. The subsequent levels represent the carnivores or omnivores that feed on the herbivores, with the top of the pyramid representing the apex predators.

Ecological pyramids can also represent the biomass or number of individuals at each trophic level, with each level representing a smaller amount of biomass or fewer individuals. This is due to the fact that energy is lost as it moves up the trophic levels, with only a small percentage of energy being transferred from one level to the next.

Together, food chains, food webs, and ecological pyramids help us to understand the complex interactions between organisms in an ecosystem and the flow of energy and nutrients through the food chain.

Q9. Explain nitrogen cycle and carbon cycle with suitable diagrams.

Ans: The nitrogen cycle and carbon cycle are two important biogeochemical cycles in the Earth's ecosystem. They both involve the movement and transformation of important elements necessary for life.

The nitrogen cycle involves the conversion of nitrogen gas (N_2) into a form that can be used by plants and animals. This process is carried out by a series of bacteria that live in soil and water. The nitrogen cycle can be divided into four main stages: nitrogen fixation, ammonification, nitrification, and denitrification.

The carbon cycle involves the movement of carbon through the atmosphere, biosphere, geosphere, and hydrosphere. Carbon is essential for the formation of organic compounds, which are the building blocks of life. The carbon cycle can be divided into three main stages: photosynthesis, respiration, and decomposition.

Here are simplified diagrams of the nitrogen cycle and carbon cycle:

Nitrogen Cycle

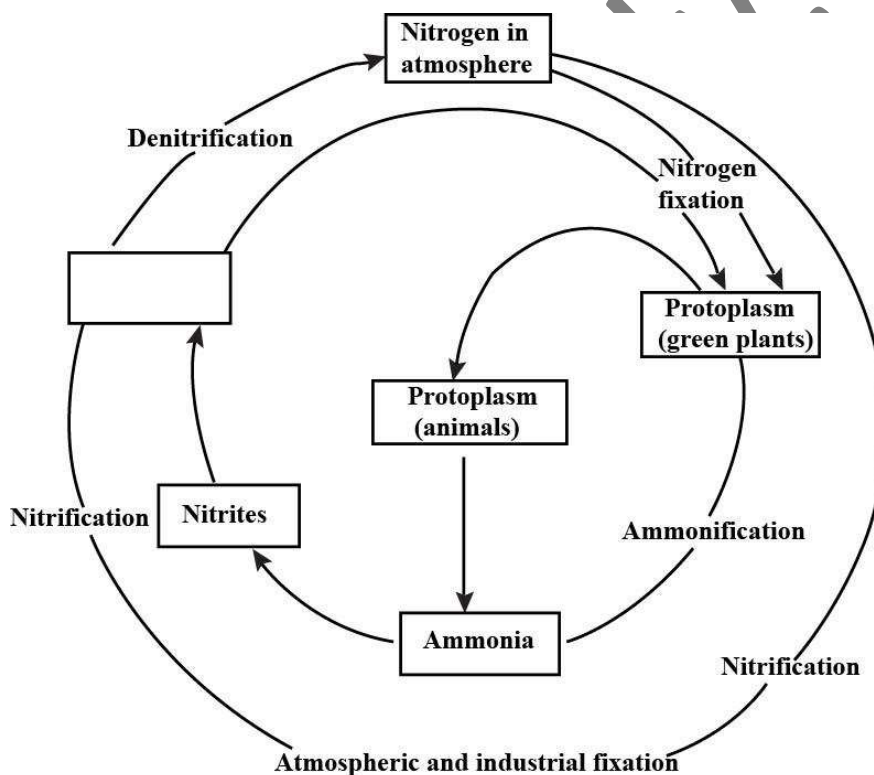
Nitrogen fixation: nitrogen gas in the atmosphere is converted into ammonia (NH_3) or ammonium ions (NH_4^+) by nitrogen-fixing bacteria found in soil, water, and plant roots.

Ammonification: organic nitrogen compounds from dead organisms and waste products are broken down into ammonia by decomposer bacteria.

Nitrification: ammonia is converted into nitrite (NO_2^-) and then into nitrate (NO_3^-) by nitrifying bacteria.

Denitrification: nitrate is converted back into nitrogen gas by denitrifying bacteria, which completes the nitrogen cycle.

Diagram of Nitrogen cycle:



Nitrogen cycle

Carbon Cycle

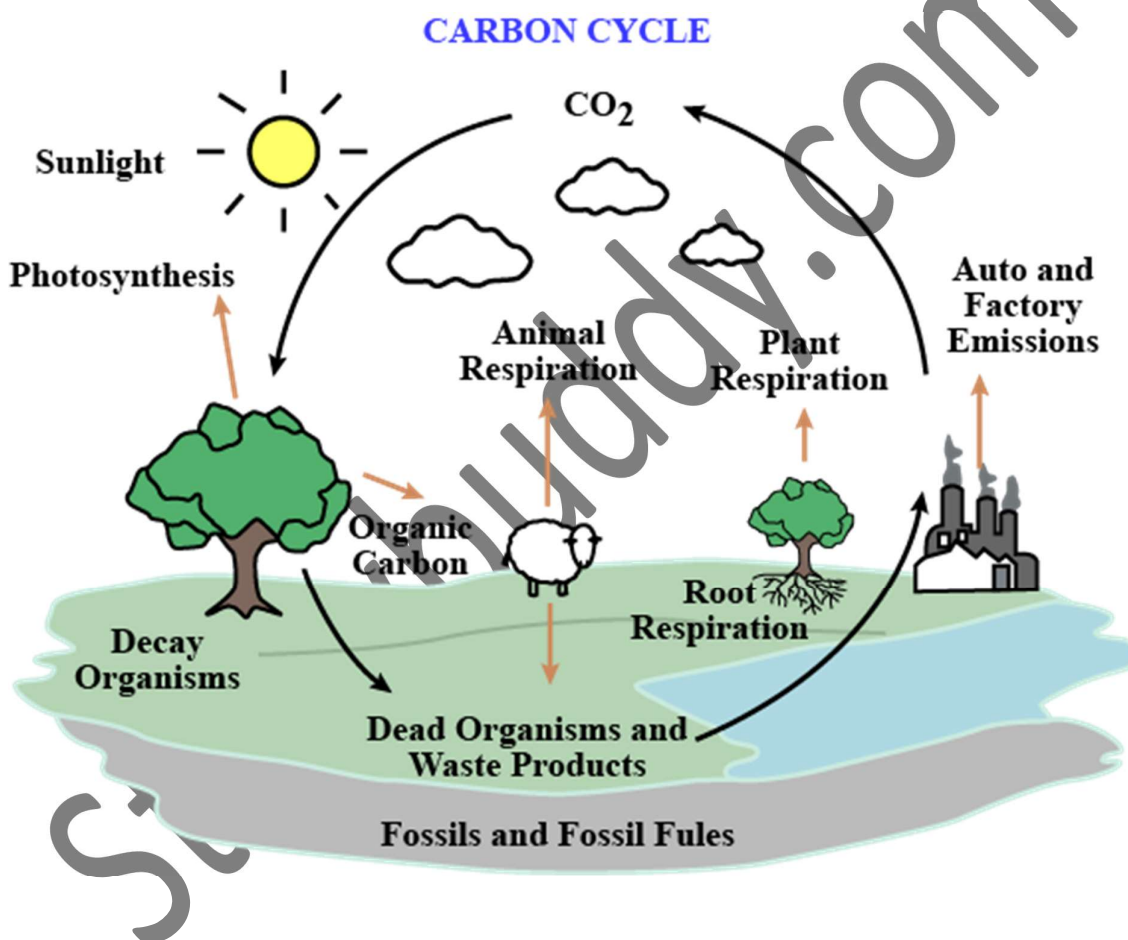
Photosynthesis: plants and other autotrophs absorb carbon dioxide from the atmosphere and use it to produce organic compounds.

Respiration: organisms break down organic compounds to release energy, releasing carbon dioxide back into the atmosphere.

Decomposition: dead organisms and waste products are broken down by decomposer bacteria, releasing carbon dioxide and other compounds into the soil or water.

Combustion: fossil fuels are burned and release carbon dioxide into the atmosphere.

Diagram of Carbon Cycle:



Q10. Describe ecological restoration and various approaches of ecological restorations.

Ans: Ecological restoration is the process of repairing or restoring damaged or degraded ecosystems to their natural or original state. This involves restoring the physical, chemical, and biological processes and components of the

ecosystem, as well as restoring the biodiversity and ecosystem services that the ecosystem provides.

There are several different approaches to ecological restoration, including:

Passive Restoration: This involves allowing natural ecological processes to take place without any human intervention. For example, allowing a damaged wetland to naturally regenerate by removing human disturbances and letting the ecosystem recover on its own.

Active Restoration: This involves human intervention to facilitate the recovery process. This can include planting native species, removing invasive species, or restoring natural hydrological processes.

Rehabilitation: This approach is used in heavily degraded ecosystems where the natural processes and components cannot be restored. The goal is to create a new, functional ecosystem that provides similar ecosystem services as the original ecosystem.

Reclamation: This approach is used in areas that have been heavily disturbed by human activities such as mining or industrial development. The goal is to restore the area to a functional state that can support human activities while also providing ecosystem services.

Mitigation: This approach is used to offset the environmental damage caused by human activities. For example, if a new development is going to destroy a wetland, the developer may be required to restore or create a new wetland elsewhere to offset the damage.

Ecological restoration can be a complex and long-term process that requires careful planning, monitoring, and evaluation to ensure that the restored ecosystem is functioning properly and providing the intended ecosystem services.

Q11. What is environmental economics? Describe its significance in environmental valuation.

Ans: Environmental economics is a branch of economics that studies the economic impact of environmental policies, regulations, and practices. It applies economic principles and methods to analyse environmental problems and develop solutions that balance economic and environmental considerations.

One important aspect of environmental economics is environmental valuation, which involves estimating the economic value of natural resources and ecosystem services. This is important because it allows decision-makers to make informed choices about how to allocate resources and prioritize environmental protection efforts.

Environmental valuation involves several methods, including market-based valuation, stated preference valuation, and revealed preference valuation. Market-based valuation involves estimating the economic value of natural resources and ecosystem services based on their market prices. Stated preference valuation involves asking people how much they are willing to pay for environmental goods and services, while revealed preference valuation involves analysing people's actual behaviour in response to changes in the environment.

The significance of environmental valuation is that it allows policymakers to make more informed decisions about environmental management and protection. It can help identify the economic benefits and costs of different environmental policies and practices and can inform decisions about how to allocate resources to protect the environment.

Overall, environmental economics plays an important role in promoting sustainable development and ensuring that environmental protection efforts are economically efficient and effective.

Q12. What is environmental auditing? Describe the different steps of environmental auditing.

Ans: Environmental auditing is a systematic and comprehensive evaluation of an organization's compliance with environmental laws, regulations, and policies. It is a management tool used to identify environmental risks and opportunities, evaluate the effectiveness of environmental management systems, and assess the environmental performance of an organization.

The different steps of environmental auditing include:

Planning: The first step in environmental auditing is to develop an audit plan that outlines the scope, objectives, and methodology of the audit. This involves identifying the environmental risks and areas of concern that need to be assessed and selecting the appropriate audit tools and techniques.

Preparation: The next step is to prepare for the audit by gathering information and data about the organization's environmental management practices, policies, and procedures. This may involve reviewing documents, conducting interviews with staff, and conducting site visits.

Fieldwork: The fieldwork stage involves conducting the audit according to the audit plan. This may involve conducting on-site inspections, collecting data, and interviewing staff to assess compliance with environmental laws and regulations.

Analysis: The data collected during the audit is analyzed to identify areas of non-compliance, environmental risks, and opportunities for improvement. The analysis also identifies the root causes of any environmental issues and evaluates the effectiveness of the organization's environmental management systems.

Reporting: The findings of the environmental audit are documented in an audit report, which includes recommendations for improving the organization's environmental performance. The report may also include an action plan for addressing any identified environmental risks and areas of non-compliance.

Follow-up: The final step in environmental auditing is to follow up on the recommendations and actions identified in the audit report. This involves monitoring and tracking the implementation of the action plan and evaluating the effectiveness of the improvements made.

Overall, environmental auditing is an important tool for promoting environmental sustainability and ensuring that organizations comply with environmental regulations and policies. It helps organizations identify environmental risks and opportunities for improvement and can contribute to the development of more effective environmental management systems.

Q13. Write a note on environmental education and its significance in solving environmental problems.

Ans: Environmental education refers to the process of raising awareness and providing knowledge and skills related to the environment, sustainability, and the impact of human activities on the natural world. It is a crucial component of efforts to promote sustainable development and address environmental challenges.

Environmental education is significant in solving environmental problems because it helps individuals understand the interconnectedness of environmental issues and the impact of their actions on the environment. It also promotes critical thinking and problem-solving skills, enabling individuals to make informed decisions and take responsible actions to protect the environment.

Through environmental education, individuals can learn about sustainable practices and technologies, as well as the importance of biodiversity, conservation, and natural resource management. This knowledge can lead to changes in behaviour and attitudes, such as reducing waste, conserving energy, and supporting sustainable agriculture and production practices.

Environmental education can also lead to the development of a more informed and engaged citizenry, which can advocate for policies and practices that promote environmental sustainability. It can foster partnerships between government, businesses, and civil society to address environmental challenges collaboratively.

In conclusion, environmental education is essential in solving environmental problems. It can increase public awareness, promote sustainable behaviour and practices, and empower individuals to take action to protect the environment. By investing in environmental education, we can build a more sustainable and resilient future for ourselves and future generations.

Q14. Describe various sustainable eco-friendly technologies for solving environmental problems.

Ans: There are various sustainable eco-friendly technologies that can be used to address environmental problems. Some of these technologies are:

Renewable Energy Technologies: Renewable energy technologies such as solar, wind, hydro, and geothermal energy are eco-friendly and sustainable sources of energy. These technologies do not produce greenhouse gases and are less polluting than conventional energy sources.

Green Building Technologies: Green building technologies such as green roofs, rainwater harvesting, and energy-efficient building materials are designed to reduce the environmental impact of buildings. These technologies can help

reduce energy consumption, reduce greenhouse gas emissions, and improve the indoor air quality of buildings.

Sustainable Agriculture Technologies: Sustainable agriculture technologies such as organic farming, agroforestry, and permaculture are designed to promote sustainable food production and reduce the environmental impact of agriculture. These technologies can help reduce water consumption, prevent soil erosion, and promote biodiversity.

Waste Management Technologies: Waste management technologies such as recycling, composting, and waste-to-energy technologies can help reduce the amount of waste sent to landfills and promote the sustainable use of resources. These technologies can help reduce greenhouse gas emissions and conserve natural resources.

Electric Vehicles: Electric vehicles are a sustainable transportation technology that can help reduce greenhouse gas emissions and air pollution. These vehicles are powered by batteries and do not produce tailpipe emissions.

Overall, sustainable eco-friendly technologies can help solve environmental problems by reducing greenhouse gas emissions, conserving natural resources, promoting sustainable production and consumption practices, and improving environmental quality. By adopting these technologies, we can create a more sustainable and resilient future for ourselves and future generations