



WINTER – 2022 EXAMINATION

Subject Name: Environmental Technology

Model Answer

Subject Code:

22511

Important Instructions to examiners:

- 1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
- 2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
- 3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills).
- 4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
- 5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
- 6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
- 7) For programming language papers, credit may be given to any other program based on equivalent concept.
- 8) As per the policy decision of Maharashtra State Government, teaching in English/Marathi and Bilingual (English + Marathi) medium is introduced at first year of AICTE diploma Programme from academic year 2021-2022. Hence if the students in first year (first and second semesters) write answers in Marathi or bilingual language (English +Marathi), the Examiner shall consider the same and assess the answer based on matching of concepts with model answer.

Q. No.	Sub Q. N.	Answer	Marking Scheme
1	a	BOD It is the amount of oxygen required to degrade organic waste present in water by purely biological means. COD It is the amount of oxygen required to degrade organic waste present in water by purely chemical means.	1 mark 1 mark
1	b	Ozone depleting gases <ul style="list-style-type: none">• chlorofluorocarbons (CFCs)• hydrochlorofluorocarbons (HCFCs)• hydrobromofluorocarbons (HBFCs)• halons• methyl bromide• carbon tetrachloride• methyl chloroform	1/2 mark each for any four



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1	c	Ecology Ecology is the branch of biology that deals with the relations of organisms to one another and to their physical surroundings.	2 marks
1	d	Pollutants from nitric acid plant (Four) <ul style="list-style-type: none">• Nitrogen dioxide• Nitric oxide• Grease and oil• Nitric acid in waste water	½ mark each
1	e	Equipment for control of gaseous pollutants (any 4) <ul style="list-style-type: none">• Spray tower• Centrifugal scrubber• Venturi scrubber• Packed bed tower• Flare• Catalytic oxidizer• Thermal oxidizer• Fixed bed adsorber• Dry scrubber• Mist collector	½ mark each
1	f	Application of fabric filter <ul style="list-style-type: none">• Power plants• Steel mills• Cement plant• Metallurgical processing• Tobacco processing	1 mark each for any two
1	g	Sources of air pollution (any four) <ol style="list-style-type: none">1. Industries2. Transportation3. Burning of fossil fuel and fires	½ mark each for any four



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		4. Agricultural activities 5. Solid waste disposal 6. Construction activities 7. Deforestation	
2		Answer any three	12
2	a	3R principle Reuse: In today's world use and through materials is increasing and hence solid waste. Instead of throwing that material or item if it is used again, energy and environment can be saved. Solid waste generation also will be reduced. In industry various boxes, cans, pallets etc are used for material handling. These can be used again for same purpose. e.g. Catalyst drums can be used again to fill catalyst. Recycle : Recycling is a process to change materials (waste) into new products to prevent waste of potentially useful materials, reduce the consumption of fresh raw materials, reduce energy usage, reduce air pollution (from incineration) and water pollution (from landfilling) by reducing the need for "conventional" waste disposal, and lower greenhouse gas emissions as compared to plastic production. Recycling is a key component of modern waste reduction and is the third component of the "Reduce, Reuse, and Recycle" waste hierarchy. Recyclable materials include many kinds of glass, paper, metal, plastic, textiles, and electronics. In the strictest sense, recycling of a material would produce a fresh supply of the same material-for example, used office paper would be converted into new office paper, or used foamed polystyrene into new polystyrene. e.g. Plastic water bottles can be recycled to get plastic again. Reduce: When you avoid making garbage in the first place, you don't have to worry about disposing of waste or recycling it later. Changing your habits is the key - think about ways you can reduce your waste when you shop, work and play. There's a ton of ways for you to reduce waste, save yourself some time and money, and be good to the Earth at the same time. Buy products in bulk. Larger, economy-size products or ones in concentrated form use less packaging and usually cost less per ounce. e.g. Unnecessary use of plastic and paper can be avoided in packing.	4 marks
2	b	Benefits of ISO14000	½ mark each for



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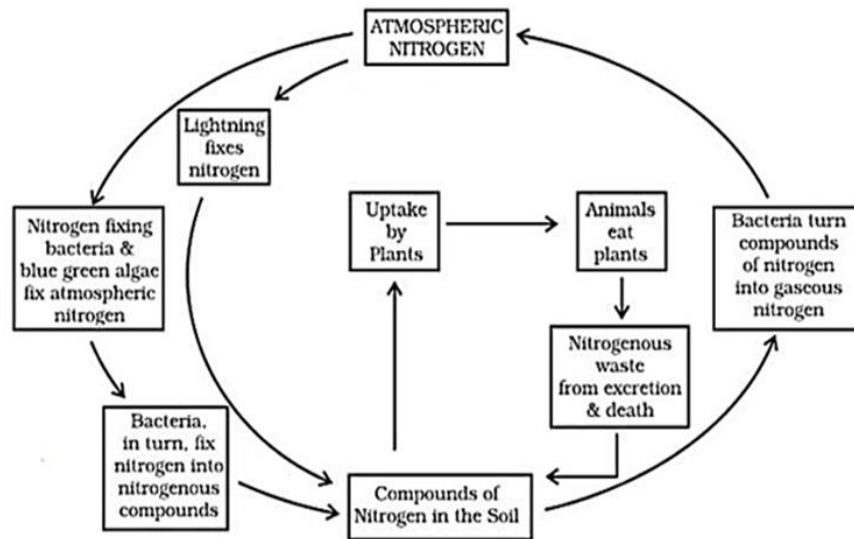
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1. Efficiency, discipline and operational integration with ISO 9000
2. Greater employee involvement in business operations with a more motivated workforce
3. Easier to obtain operational permits and authorizations
4. Assists in developing and transferring technology within the company
5. Helps reduce pollution
6. Fewer operating costs
7. Savings from safer workplace conditions
8. Reduction of costs associated with emissions, discharges, waste handling, transport & disposal
9. Improvements in the product as a result of process changes
10. Safer products
11. Minimizes hazardous and non-hazardous waste
12. Conserves natural resources - electricity, gas, space and water with resultant cost savings

any 8

2 c

Nitrogen Cycle



2 marks

The atmospheric nitrogen can directly not be consumed by plants and animals and hence it is first of all converted into ammonia by ammonification of N_2 under the influence of Rhizobium bacteria

The NH_3 then converted into nitrates and nitrites by nitrification of ammonia and get deposited in soil

The nitrates in the soil are then consumed by plants as a feeding source

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		<p>The plants are then eaten by animals and after the death of animals they are decomposed it again into nitrates.</p> <p>In this was four major step are</p> <ol style="list-style-type: none"> 1. Nitrogen Fixation 2. Ammonification/ Decay 3. Nitrification 4. De-nitrification 	2 marks
2	d	<p>Flotation:</p> <p>In wastewater treatment plants there are numerous methods used to treat the contaminated water. Froth floatation is one of them which has wide applications in waste water treatments</p> <p>Froth floatation is the process which involves the removal of grits or suspended solids present in the water by forming the flocs of particles using the suitable surfactants/adsorbents and skimmed it off from the liquid surface. In the wastewater treatment plants the assembly of froth floatation has an application in preliminary treatment for removal of grits and suspended particles which is placed after the screens. Along with the settling tanks the froth floatation assembly can also replace the thickening tanks of sludge since it has more efficiency than the sludge thickeners</p>	2 marks
			2 marks
3		Answer any three	12
3	a	<p>Role of pollution control board</p> <ol style="list-style-type: none"> 1) Advise the 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 	1 mark for each role (any four)



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- abatement of water and air pollution;
- 3) Plan and organise training of persons engaged in programmes for prevention, control or abatement of water and air pollution;
 - 4) Organise through mass media, a comprehensive mass awareness programme on prevention, control or abatement of water and air pollution;
 - 5) Collect, compile and publish technical and statistical data relating to water and air pollution and the measures devised for their effective prevention, control and abatement;
 - 6) 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;
 - 7) Disseminate information in respect of matters relating to water and air pollution and their prevention and control;
 - 8) Lay down, modify or annul, in consultation with the State Government concerned, the standards for stream or well, and lay down standards for quality of air;
 - 9) Establish or recognize laboratories to enable the Board to perform

3 b **Structure of ecosystem**

The ecosystem is the basic functional unit of organism and their environment interacting with each other. The function of ecosystem is related to the energy flow, decomposition, nutrient cycling and major biomes.

Structure

Generally ecosystems consist of two basic components.

1. Abiotic component.

2. Biotic component.

1. Abiotic components

It includes basic in-organic (soil, water, oxygen, calcium carbonates, phosphates etc.) and organic compounds. It also includes physical factors such as moisture, wind currents and solar radiation. Radiant energy of sun is the only significant energy source for any ecosystem.

2. Biotic components

Include producers, consumers and decomposers.

Producer : These are the autotrophic, chlorophyll-bearing organisms, which produce their

3 marks

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own food.

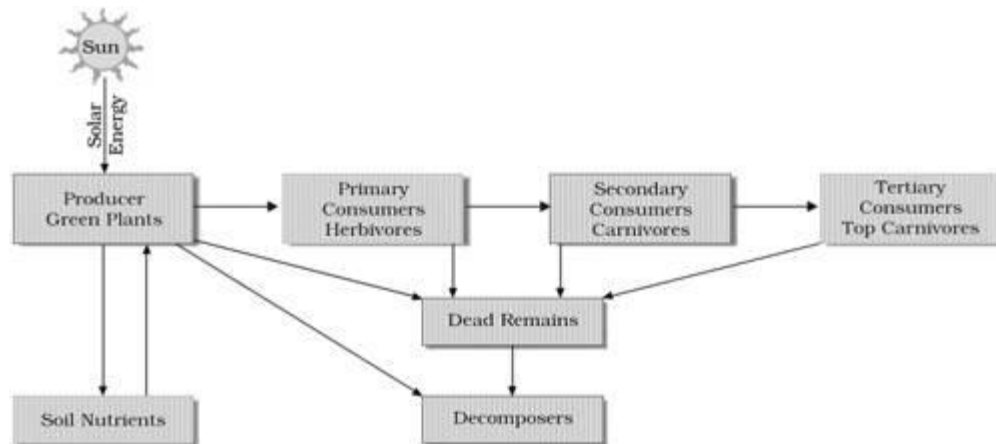
Consumers : A consumer which gets nutrition by eating plants is called **Primary consumers** (herbivore) (eg) Rabbit, deer and cow.

The Secondary Consumer: (carnivores) is an animal that eats the flesh of herbivores (eg) cats and dogs.

Tertiary Consumers: are the type of carnivores, which prey upon other carnivores. (eg) Lion, tiger and vulture.

Decomposers

Decomposers attack the dead remains of producers and consumers and degrade the complex organic substances into simpler compounds to derive their nutrients. The decomposers play very important role in maintaining the dynamic nature of ecosystem.



1 mark

3 c

Effect of Carbon monoxide:

Carbon monoxide has a great affinity for the hemoglobin in the blood and combines with blood to form carboxyhemoglobin. This reduces the ability of hemoglobin to carry oxygen to the body tissues.

Effect of Sulfur dioxide (SO₂)

i) SO₂ is an irritant gas which can easily get oxidized to sulfur trioxide and in the presence of water, these can form sulfurous and sulfuric acid

ii) The health problems related to the mucous membrane and respiratory tract are due to sulfate aerosols.

iii) Chronic effects of SO₂ include increased probabilities of bronchitis, "colds" of long

2 marks

2 marks

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duration and suppression of immune system.

3

d

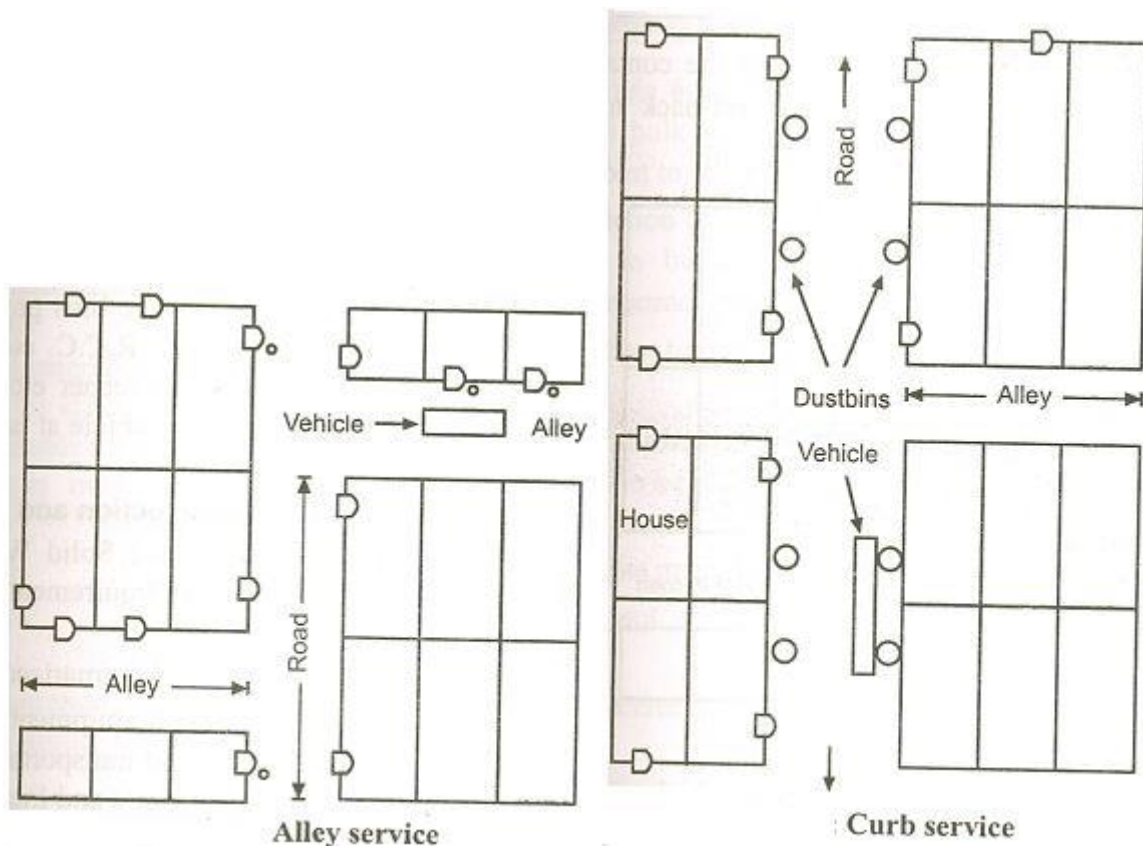
Solid waste collection method

Communal storage point: - Waste is collected in concrete bins located at one point. Daily it is transferred to deposal area by vehicle.

Block collection: - in block collection the waste is brought in a container by individuals to a waiting vehicle which travels a regular route twice or thrice a week. The containers are emptied by the vehicle crew and returned to the individuals.

Ghanta Gadi: - In this method vehicle is coming near the building by sounding bail. Peoples are transferring waste from their house to ghantagadi

4 marks



Curb side collection, or Kerbside collection, is a service provided to households, typically in urban and suburban areas, of removing household waste. It is usually accomplished by personnel using purpose built vehicles to pick up household waste in containers acceptable to or prescribed by the municipality. Kerbside collection is today often referred to as a



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		<p>strategy of local authorities to collect recyclable items from the consumer. Kerbside collection is considered a low-risk strategy to reduce waste volumes and increase recycling rates. Materials are typically collected in large bins, coloured bags, or small open plastic tubs, specifically designated for content.</p> <p>Alley service: this method is similar to the previous one, except that the containers are placed at the alley line instead of curb.</p>	
4		Answer any three	12
4	a	<p>Salient features of air (Prevention and control of pollution) act 1981</p> <p>Section 3- The Central and State Pollution Control Boards have the responsibility to exercise the powers provided under this Act without prejudice.</p> <p>Section 4- In states where there is a Water Pollution Control Board established, the same shall be given the joint responsibility of controlling and monitoring air pollution, and will be called State Pollution Control Board.</p> <p>Section 5- In states where there is no Water Pollution Control Board, a new Pollution Control Board will be set up.</p> <p>Section 16 describes the functions of the Central Pollution Control Board, some of which includes-</p> <ol style="list-style-type: none">1. Advice the Central government on matters pertaining to air and air pollution.2. Advice and support State Boards in carrying out their functions.3. Carry out research related to air pollution.4. Through mass media, spread awareness and information about air and air pollution.5. Plan and organize the training of personnel.6. Set the standards for Air Quality in India	1 mark each for any four
4	b	<p>Describe segregation, storage and transportation in case of biomedical waste</p> <p>Segregation of bio medical waste:</p> <p>No untreated bio-medical waste shall be mixed with other wastes.</p> <p>The bio-medical waste shall be segregated as per categories applicable, into containers or bags at the point of generation e.g., all patient care activity areas, diagnostic service areas, operation theatre areas, treatment rooms etc. prior to its storage, transportation, treatment and disposal. Containers and bags are labelled with relevant bio-hazard symbol. Waste is</p>	4 marks



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segregated into colour coded bags as specified. Bins used for holding the colour coded bags should be of the same colour. In case a bin of the same colour is not available due to some reason, a neutral colour bin may be used with a prominent sticker of the colour of the bag pasted on the lid and/or body. The size of the sticker must be approximately of half the size of the lid of the bin. All bags, containers or bins directly used in the collection of bio-medical wastes are labelled with appropriate Hazard Symbol

Storage:

The collection of biomedical waste involves use of different types of container from various sources of biomedical wastes like Operation Theatre, laboratory, wards, kitchen, corridor etc. The containers/ bins should be placed in such a way that 100 % collection is achieved. Sharps must always be kept in puncture-proof containers to avoid injuries and infection to the workers handling them.

Once collection occurs then biomedical waste is stored in a proper place. Segregated wastes of different categories need to be collected in identifiable containers. The duration of storage should not exceed for 8-10 hrs in big hospitals (more than 250 bedded) and 24 hrs in nursing homes. Each container may be clearly labelled to show the ward or room where it is kept. The reason for this labelling is that it may be necessary to trace the waste back to its source. Besides this, storage area should be marked with a caution sign.

Transportation:

The waste should be transported for treatment either in trolleys or in covered wheelbarrow. Manual loading should be avoided as far as possible. The bags / Container containing BMWs should be tied/ lidded before transportation. Before transporting the bag containing BMWs, it should be accompanied with a signed document by Nurse/ Doctor mentioning date, shift, quantity and destination.

Special vehicles must be used so as to prevent access to, and direct contact with, the waste by the transportation operators, the scavengers and the public. The transport containers should be properly enclosed. The effects of traffic accidents should be considered in the design, and the driver must be trained in the procedures he must follow in case of an accidental spillage. It should also be possible to wash the interior of the containers thoroughly.

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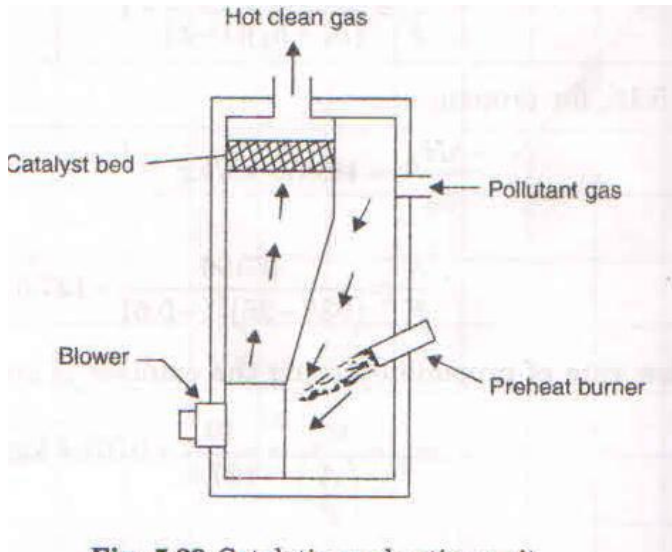
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4

c

Catalytic Converter (Incinerator)



The catalysts used for effective pollution control are the precious metals, primarily platinum and palladium or their alloys. These are arranged in such a way as to provide the maximum possible surface area for contact with the gas. The catalyst is coated onto suitable elements such as metal ribbons, ceramic rods or alumina pellets. These elements are then packed into the Catalyst bed. A catalytic combustion unit consists of a reaction vessel or converter in which the catalyst is arranged in single or multiple fixed beds preceded by a preheat section, if necessary. In the preheat section, only the pollutant gas stream is heated to the temperature required to support catalytic combustion. The preheated gas is then passed through the catalyst bed where the combustion occurs. To maintain the catalyst in an active state and to achieve complete combustion about 1% excess oxygen is required. Product gases are simple compounds like carbon dioxide and water.

4 marks

4

d

Chemical Characteristics of waste water (any 4)

(i) pH Value:

The test for pH value of wastewater is carried out to determine whether it- is acidic or alkaline in nature. Fresh sewage is generally alkaline in nature, (its pH value between 7.3 to 7.5). However, as the time passes, pH value tends to fall due to production of acids by bacterial action, and the sewage tends to become acidic. However, after oxidation when it is relatively stable, it becomes alkaline again.

(ii) Chlorides Content:

1 mark each for any four



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Chlorides are mineral salts and, therefore, are not affected by biological action of sewage. Chlorides in natural water result from the leaching of chloride-containing rocks and soils with which the water comes in contact. Chlorides found in domestic sewage are derived from kitchen wastes, human faeces and urinary discharges etc. Human excreta, for example, contain about 6 g of chlorides per person per day.

(iii) Nitrogen Contents:

The presence of nitrogen in waste-water indicates the presence of organic matter in it. Nitrogen is essential to the growth of Protista and plants and as such is known as nutrient or bio-stimulant. Since nitrogen is an essential building element in the synthesis of protein, nitrogen data is required to evaluate the treatability of waste-water by biological processes.

(iv) Fats, Grease and Oils:

Fats and oils are mainly contributed from kitchen wastes, because they are major components of food stuffs such as butter, lard, margarine, and vegetable oils and fats. Fats are also commonly found in meats, seeds, nuts and some fruits.

Grease and oils are also discharged from industries like garages, workshops, factories etc. Fats and oils are compounds (esters) of alcohol or glycerol (glycerine) with fatty acids. Such matters float on the top of sedimentation tanks, often choke pipes in the winter, and clog filters.

(v) Surfactants:

Surfactants come primarily from synthetic detergents. These are discharged from bathrooms, kitchens, washing machines etc. Surfactants (or surface-active agents) are large organic molecules which cause foaming in wastewater treatment. Due to this, aeration of wastewater is hindered. Alkyl-benzene-sulphonate (ABS), a type of surfactant commonly used in synthetic detergents, is more troublesome since it is not biodegradable.

(vi) Phenols, Pesticides and Agricultural Chemicals:

Phenols are mostly found in industrial wastewater. If such wastewaters are directly discharged into receiving streams, they cause serious taste problems in drinking water, specially when water is disinfected by chlorination. However, phenols can be biologically oxidized if the concentrations are upto 500 mg/l.

(vii) Toxic Compounds:



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Copper, lead, silver, chromium, arsenic and boron are some of the cations which are toxic to micro-organisms resulting in the malfunctioning of the biological treatment plants. These results from industrial wastewaters. Some toxic anions, including cyanides and chromates, present in some industrial wastes also hinder the wastewater treatment facilities. Hence their presence should be taken into consideration in the design of biological treatment plants.

(viii) Sulphates, Sulphides and H₂S Gas:

Sulphates and sulphides are formed due to decomposition of various sulphur containing substances present in wastewater. The sulphate ions (SO₄) occur naturally in most water supplies and hence they are also present in wastewater.

(c) Oxygen Demand:

The presence of oxygen is essential for the livelihood of organisms. The aerobic action continues only till the oxygen is present in wastewater, and after that anaerobic action begins resulting in putrefaction. Thus, oxygen is demanded in wastewater for the oxidation of both inorganic as well as organic matter.

Thus demand of oxygen may be expressed in the following ways:

- (i) Biochemical oxygen demand (BOD)
- (ii) Chemical oxygen demand (COD)
- (iii) Total oxygen demand (TOD)
- (iv) Theoretical oxygen demand (Th. OD).

In addition to these, the amount of organic matter present may also be determined by the total organic carbon (TOC) test.

4

e

RO for waste water treatment

Osmotic pressure is the minimum pressure required to stop solvent flow through the semipermeable membrane. Therefore, when the solution side (the side where the solute concentration is high) is subjected to a pressure greater than the osmotic pressure, the solvent particles on the solution side move through the semipermeable membrane to the region where the solute concentration is low. Such inverse solvent movement through the semipermeable membrane is called reverse osmosis.

RO works by removing impurities from contaminated water. It does this through the process

4 marks

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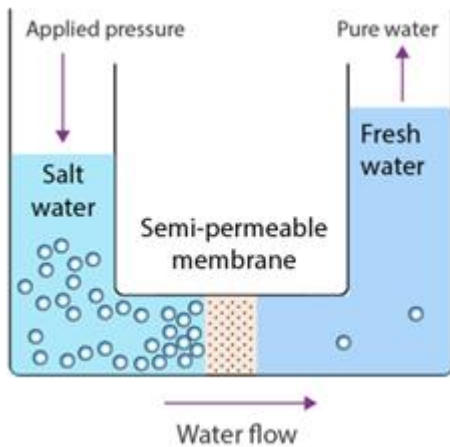
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of pressure, forcing the contaminated solution through membranes. After the water is treated it can be reused in production or can be disposed of safely. It is important to note that the pressure applied to the solution side must be higher than the osmotic pressure for the reverse osmosis process to proceed. Osmotic pressure is a colligative property, which depends on the concentration of the solution. In water purification, the reverse osmosis process is very important. Many water purifiers used today use reverse osmosis in the purification process as one of the steps.

Reverse osmosis involves the application of pressure (usually greater than the osmotic pressure) on one side of the solution where a semipermeable membrane is placed in between the solutions. This membrane is used to filter out contaminants down to the smallest particles. The contaminants are often referred to as RO concentrate.



RO water systems can be used in a variety of industries such as pharmaceutical, healthcare, food & beverage and seawater desalination. Applications include decontamination, renal dialysis, wastewater recovery and process water production. RO works well in conjunction with other purification processes such as continuous electro-deionisation (CEDI) or ultrafiltration.

5 **Answer any two**

12

5 a **Construction and Working of Fabric(bag) Filter**

4 marks

- Fabric filter is an air pollution control device and dust collector that removes particulates or gas released from commercial processes out of the air.

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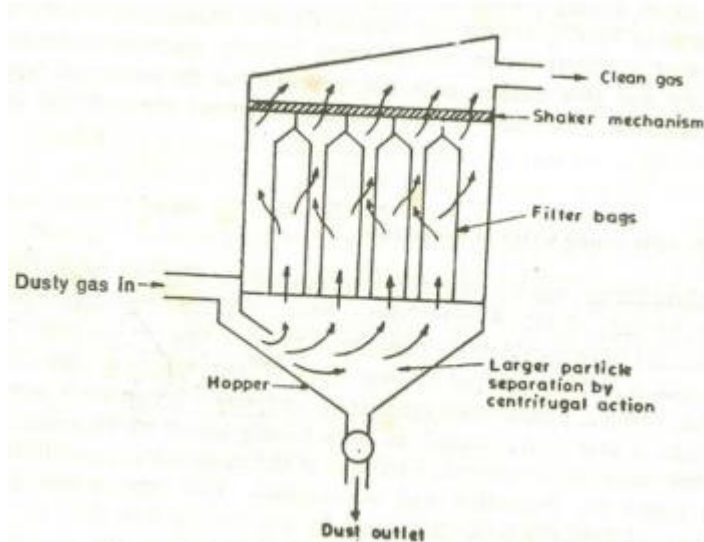
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- The filter contains tubular porous structured composed of granular or fibrous material which tends to retain particulate and allow to gas pass through the voids of filter.
- Dust-laden gas or air enters the bag house through hoppers and is directed into the bag house apartment.
- The gas entering through the inlet pipe strikes a baffle plate, which causes larger particles to fall down.
- The filter efficiency is increased with the help of pre-coat of accumulated dust which again act as a filter medium.
- The gas is drawn through the bags, either on the inside or the outside depending on cleaning method, and a layer of dust accumulates on the filter media surface until air can no longer move through it.

Diagram of Bag Filter:



2 Marks

5 b Activated sludge process

Principle

A biological wastewater treatment process which speeds up waste decomposition. Activated sludge is added to wastewater, and the mixture is aerated and agitated. After a certain amount of time, the activated sludge is allowed to settle out by sedimentation and is disposed of (wasted) or reused (returned to the aeration tank)

Working

4 Marks

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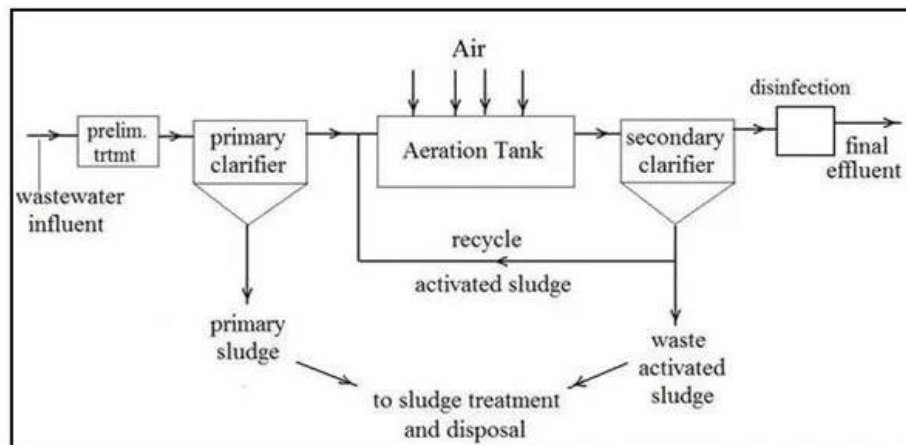
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A basic activated sludge process consists of several interrelated components:

- An aeration tank where the biological reactions occur
- An aeration source that provides oxygen and mixing
- A tank, known as the clarifier, where the solids settle and are separated from treated wastewater
- A means of collecting the solids either to return them to the aeration tank, (return activated sludge [RAS]), or to remove them from the process (waste activated sludge [WAS]).
- Aerobic bacteria thrive as they travel through the aeration tank. They multiply rapidly with sufficient food and oxygen.
- By the time the waste reaches the end of the tank (between four to eight hours), the bacteria has used most of the organic matter to produce new cells.
- The organisms settle to the bottom of the clarifier tank, separating from the clearer water.
- This sludge is pumped back to the aeration tank where it is mixed with the incoming wastewater or removed from the system as excess, a process called wasting.
- The relatively clear liquid above the sludge, the supernatant, is sent on for further treatment as required

Diagram of activated Sludge Process

2 Marks



Activated Sludge Wastewater Treatment Flow Diagram

5

c

Causes of Global Warming:

1. Burning of coal, oil and natural gases in factories.
2. Burning of fossil fuels at power stations.
3. Burning of fire wood and deforestation

2 Marks



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4. Use of diesel and petrol of automobiles, railway, aircraft etc.
5. Growing paddy and live stocks releases methane. Various farming activities produce carbon dioxide and methane gas. These add to the greenhouse gases in the atmosphere and increase the temperature of the earth.
6. An increase in population means more people breathing. This leads to an increase in the level of carbon dioxide, the primary gas causing global warming, in the atmosphere
7. With the excessive use of air conditioners and refrigerators, humans have been adding CFCs into the environment which affects the atmospheric ozone layer.

Effects of Global Warming:

1. Receding many glaciers, melting of ice caps.
2. Can cause more evaporation of surface water.
3. Rise in sea level causes flooding.
4. The shifting of climatic zones due to change in circulation of wind.
5. Cyclones and hurricanes may occur.
6. Global warming has affected the coral reefs that can lead to the loss of plant and animal lives.

Greenhouse gases:

1. Water vapor (H₂O)
2. Carbon dioxide (CO₂)
3. Methane (CH₄)
4. Nitrous oxide (N₂O)
5. Ozone (O₃)
6. Chloro Floro Carbon (CFC)

2 Marks

2 Marks

6 Answer any two

12

6 a Trickling Filter

Construction:-

The retaining structure for trickling filters is usually a circular wall constructed of reinforced concrete, concrete block, or vitrified clay blocks. These walls may be constructed with openings or may be solid. With solid walls the filter can be flooded to correct some

4 marks



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operational problems while walls with openings provide better ventilation of the filter media. Various materials have been used for filter media. Hard stone (dolomite, hard limestone, and quartzite, etc.), various ceramics, redwood blocks or slats, and more recently synthetic (plastic) media of various kinds have been used. Historically stone media has been most commonly used. The new types of synthetic plastic media provide some advantages over stone. These advantages include greater surface area per cubic foot and a higher percentage of void spaces. This allows for greater hydraulic and organic loads. Common rock media is less expensive than plastic. A rotating arm is provide to sprinkle waste water over the top.

Working:-

- The wastewater in trickling filter is distributed over the top area of a vessel containing non-submerged packing material.
- Air circulation in the void space, by either natural draft or blowers, provides oxygen for the microorganisms growing as an attached biofilm.
- During operation, the organic material present in the wastewater is metabolised by the biomass attached to the medium. The biological slime grows in thickness as the organic matter abstracted from the flowing wastewater is synthesized into new cellular material.
- The thickness of the aerobic layer is limited by the depth of penetration of oxygen into the microbial layer.
- The micro-organisms near the medium face enter the endogenous phase as the substrate is metabolised before it can reach the micro-organisms near the medium face as a result of increased thickness of the slime layer and loose their ability to cling to the media surface. The liquid then washes the slime off the medium and a new slime layer starts to grow. This phenomenon of losing the slime layer is called *sloughing*.
- The sloughed off film and treated wastewater are collected by an underdrainage which also allows circulation of air through filter. The collected liquid is passed to a settling tank used for solid- liquid separation.

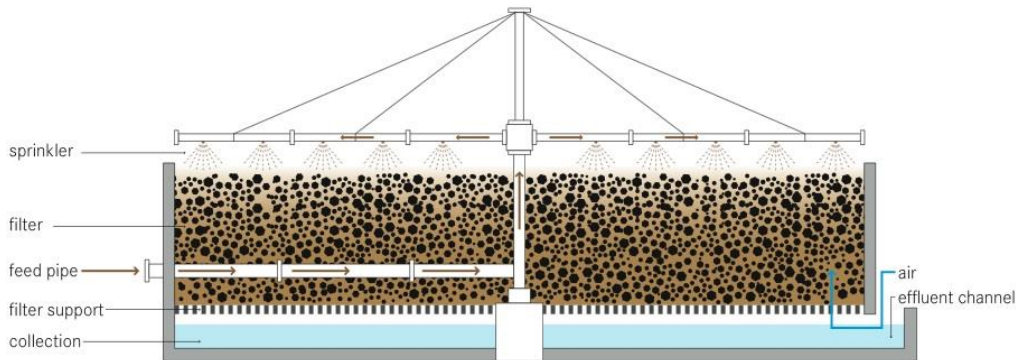
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2 marks

6

b

Electrostatic Precipitator:

Principle:

An electrostatic precipitator (ESP) removes particles from a gas stream by using electrical energy to charge particles either positively or negatively.

Working:

- Electrostatic precipitator is a physical process by which particles are removed from gaseous stream. The stream of gas is passed between a pair of electrodes, across which high potential difference is maintained.
- Due to high potential difference a powerful ionising field is formed. Under the action of electric field gas moves rapidly towards the collecting electrode and transfer their charge to the particles causes them to drift towards and deposit on the collecting electrode
- The particle deposited on the electrode loses their charge and then are removed mechanically by rapping or vibration to a hopper below the electrical zones and are collected for the disposal.
- When the particles are liquid droplets the collected droplets coalesce on the collecting electrode and dip off the bottom of that electrode into a collecting sump.

Diagram of Electrostatic Precipitator:

3 marks

3 marks

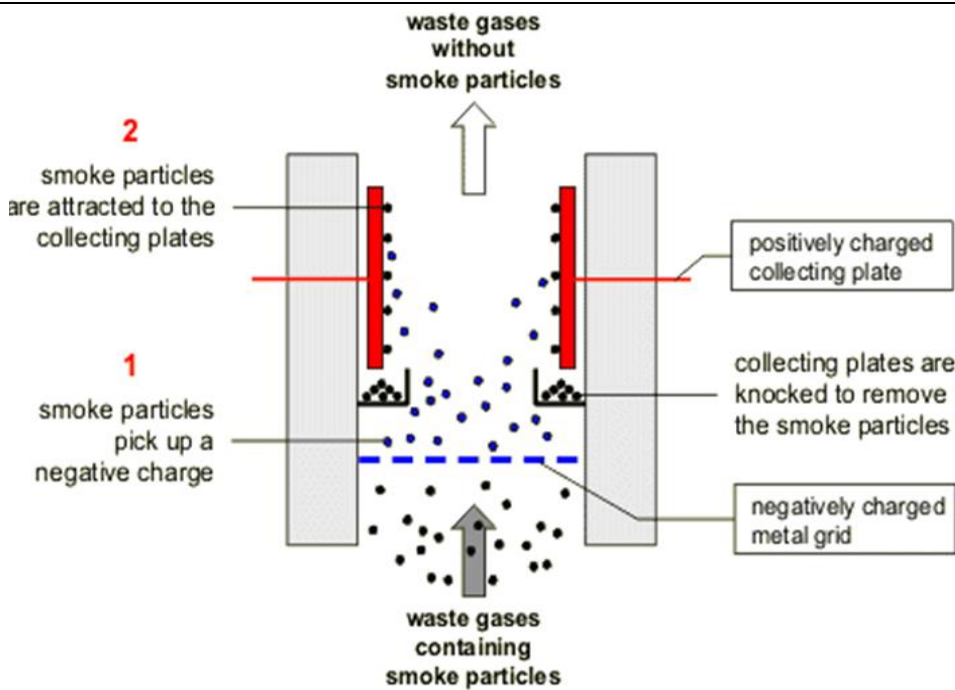
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Treatment Methods of Bio- Medical Waste

Mechanical Process

Principle:- To change the physical form or characteristics of the waste.

The primary processes are:-

Compaction:- To reduce the volume

Shredding:- Granulation, grinding, pulping, etc.

Use:- To facilitate waste handling or to process the waste in conjunction with other process.

Mechanical process are not considered as acceptable medical waste treatment system.

Thermal Process

Principle:- To heat the waste to decontaminate or destroy medical waste.

Temperature range:- 49 to 91 °C (Micro-organisms) and 100°C- above (living organisms).

Low heat systems:- Steam, hot water, or electromagnetic radiation.

High heat systems:- Combustion, pyrolysis, and Plasma, they are ranging from 600 to 5500°C

Autoclaving

2 marks each for any three processes



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In this method steam is used for the sterilization. It is brought in direct contact with waste. Steam, autoclaving combines moisture, heat, and pressure to inactivate microorganisms. This process has been used for sterilizing medical instruments in hospitals for many years and the validation of autoclaving as a sterilization technique for medical equipment and supplies is well documented. All autoclaves are constructed with a metal chamber to withstand the increased pressure/temperature required to insure destruction of bacteria, viruses, and bacterial spores. Autoclaves come in two basic varieties, gravity displacement autoclaves and pre vacuum autoclaves. The size of the device may vary from bench top models designed to hold a single bag of waste to large commercial devices that can treat more than a ton of waste per cycle. Any test method developed for assessing the efficacy of treating biomedical waste in a steam autoclave should be applicable to all types and sizes of autoclaves that may be used as waste treatment devices.

Microwave treatment method

In microwaving, microbial inactivation occurs as a result of the thermal effect of electromagnetic radiation spectrum lying between the frequencies 300 and 300,000 MHz. Microwave heating is an inter-molecular heating process. The heating occurs inside the waste material in the presence of steam. The Microwave disinfection unit (MDU) disinfects infectious medical waste through the application of steam and microwave radiation. The infectious material is temporarily held in a waste container(s), which in turn, are emptied into an in-feed hopper via a charging system. The charging system is located at the front of the MDU. The infectious waste is fed to a shredder by the feed arm where it is shredded. The shredded material is conveyed through the microwave section and temperature holding section, respectively for disinfection. The outlet of the temperature holding section protrudes near the back end of the unit and is designed to transport the disinfected waste into waste disposal containers (or compaction units). From there the material can be transported to a local municipal landfill for disposal or to a refuse recycling plant or wherever ordinary household solid waste is disposed.

Incineration

Incineration destroys harmful microorganisms and toxic substances often contained in



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biomedical waste. It is also the method for destroying recognizable human anatomical remains at very high temperature using fuel. The disadvantage of this method is that it releases persistent pollutants to the air, including dioxin and toxic metals such as mercury. Medical waste incinerators are a major contributor of dioxin pollution to the environment

Chemical Process

Principle: Disinfection of waste is done with the use of chemicals.

Chemical used:- Chlorine compounds, phenolic compounds, iodine, alcohols, formaldehyde-alcohol combinations etc.

Water is needed to bring the chemicals and micro-organisms together as necessary to achieve inactivation.

This process needs pre shredding for efficient contact.

Irradiation Process

Principle:- Exposing of wastes to the ultraviolet or ionizing radiation in an enclosed container.

Working:- Uses Cobalt-40 and electron beam accelerator unit for irradiation and sterilising the medical waste.

Requires post shredding to render the waste unrecognisable.

Biological Process

Principle:- Using the biological enzymes for treating medical waste.

Working:- It is claimed that biological reactions will not only decontaminate the waste but also cause the destruction of all organic constituents so that only plastics, glass and other inert will remain in the residue.