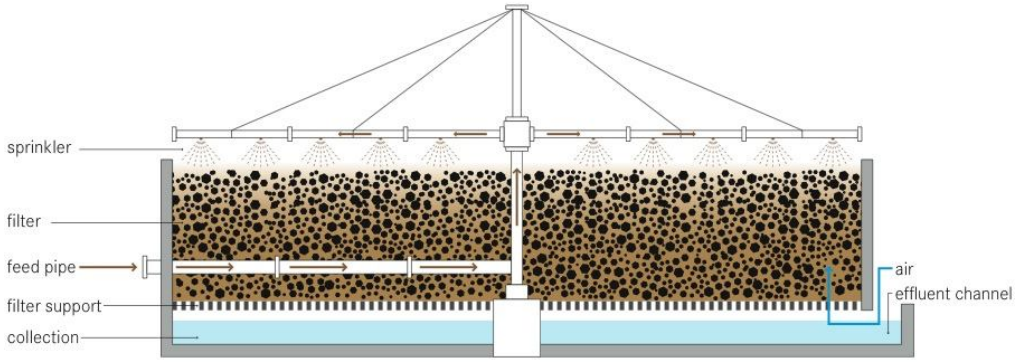
MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION

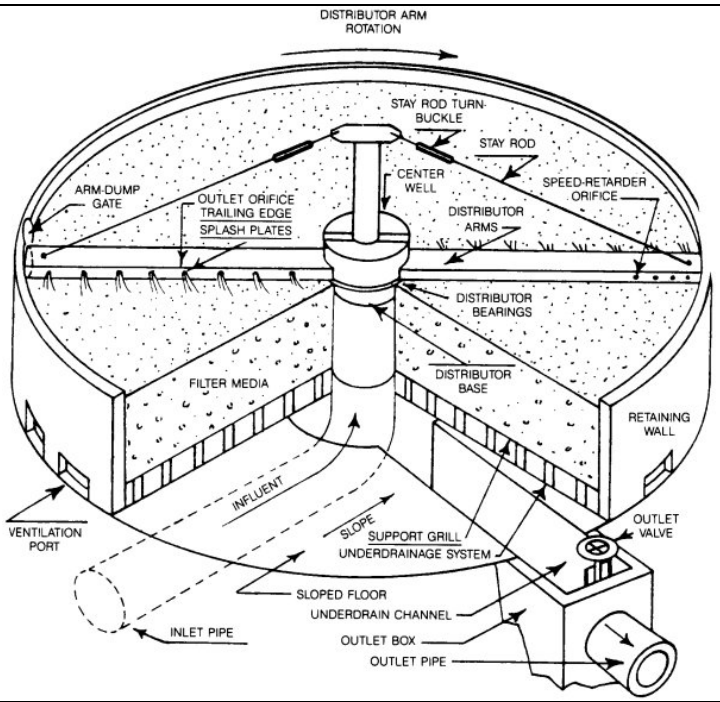
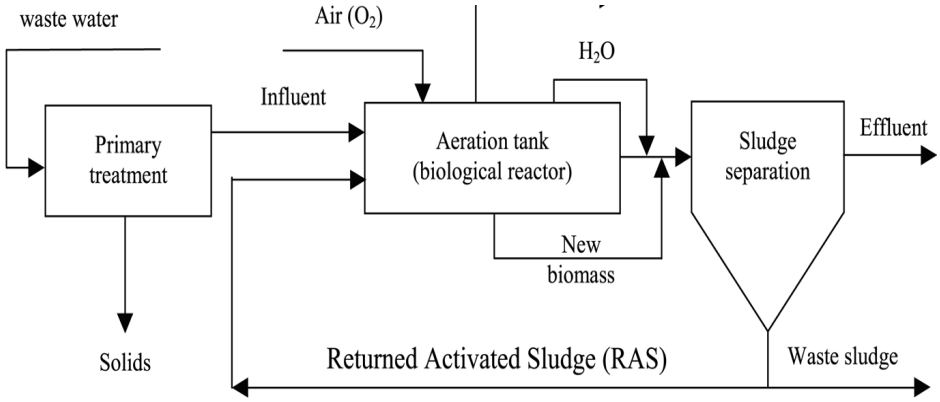
WINTER-12 EXAMINATION

Model Answer

Subject code: EVT (12298)

Q. No	Answer	Remarks
1-A a)	Classification of air pollutants **According to origin** 1) Primary Pollutants: These are directly emitted to environment from sourse. CO, CO2, SO2 2) Secondary Pollutants: These are derived from primary pollutants. Ozone, PAN, smog **According to State of Matter** 1) Gaseous pollutants: In gaseous form. CO, CO2, Sox, NOx, HC 2) Particulate matter: Dispersed in air. Other than gas a) Dust : Particle size 1 to 200 micrometer b) Smoke : Particle size 0.01 to 1 micrometer c) Fumes : Particle size 0.1 to 1 micrometer d) Mist : Liquid droplets smaller than 10 micrometers condensed in air. e) Fog : Water droplets in air. f) Aerosols : All air born suspension either liquid or gases.	1mark 3marks
b)	**Grab Sampling:** It is sampling of waste water is a single sample taken at specific time. *Advantages:* It is useful to determine effects of extreme conditions. Grab samples do provide an immediate sample, and are thus to be preferred for some tests. *Disadvantages:* It is showing only prevailing conditions at the time of sampling. Grab samples are most appropriate to small plants with low flows. **Composite sampling** : A composite sample, also known as an integrated sample, is a sample which consists of a mixture of several individual grab samples collected at regular and specified time periods, each sample taken in proportion to the amount of flow at that time. *Advantages:* It takes into account changes in flow and other characteristics of the water over time. Hence provide meaningful data. *Disadvantages:* Composite samples cannot be used for tests of water Characteristics which change during storage (such as dissolved gases) or of water characteristics which change when samples are mixed together (such as pH.)	2marks 2marks
c)	3 R Principle **Recycle :** Recycling is processing used materials (waste) into new products to prevent waste of potentially useful materials, reduce the consumption of fresh	4marks

	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. Mostly metals, glass and water is recycled in various industries. **Recover:** Recovery is the process of material recovery. Plastic, metals and glass can be recovered from waste. Some the important precious materials are also recovered. In the process industry a useful chemical can be recovered from by products and waste. It will be helpful to reduce environmental pollution. **Reuse:** To reuse is to use an item again after it has been used. This includes conventional reuse where the item is used again for the same function and new-life reuse where it is used for a different function. In contrast, recycling is the breaking down of the used item into raw materials which are used to make new items. By taking useful products and exchanging those, without reprocessing, reuse help save time, money, energy, and resources.	
d)	Trickling Filter  	Any one, 4 marks

		
1-B a)	Primary and secondary treatment removes the majority of BOD and Suspended Solids found in wastewaters. However, in an increasing number of cases this level of treatment has proved to be insufficient to protect the receiving waters or to provide reusable water for industrial and/or domestic recycle. Thus, additional treatment steps have been added to wastewater treatment plants to provide for further organic and solids removals or to provide for removal of nutrients and/or toxic materials. 	2marks 4marks
b)	**Role of pollution control board :-** 1. To promote cleanliness of streams and wells in different areas of the States through prevention, control and abatement of water pollution; 2. To improve the quality of air and to prevent, control or abate air pollution in the country; 3. Advise the Government on any matter concerning prevention and control of water and air pollution and improvement of the quality of air;	Any six, One mark each

	4. Plan and cause to be executed a nation-wide programme for the prevention, control or abatement of water and air pollution; 5. Plan and organise training of persons engaged in programmes for prevention, control or abatement of water and air pollution; 6. Organise through mass media, a comprehensive mass awareness programme on prevention, control or abatement of water and air pollution; 7. Collect, compile and publish technical and statistical data relating to water and air pollution and the measures devised for their effective prevention, control and abatement; 8. Prepare manuals, codes and guidelines relating to treatment and disposal of sewage and trade effluents as well as for stack gas cleaning devises, stacks and ducts; 9. Disseminate information in respect of matters relating to water and air pollution and their prevention and control; 10. Lay down, modify or annul, in consultation with the State Government concerned, the standards for stream or well, and lay down standards for quality of air; 11. Establish or recognize laboratories to enable the Board to perform; and 12. Perform such other functions as and when prescribed by the Government of India. 13. To issue directions to any industry, local bodies, or other authority for violation of the notified general emission and effluent standards, and rules relating to hazardous waste, bio-medical waste, hazardous chemicals, industrial solid waste, municipal solid waste including plastic waste under the Environment (Protection) Rules, 1986.	
2- a)	**Electrostatic Precipitator** **Principle :** Electrostatic precipitation is a method of dust collection that uses electrostatic forces, and consists of discharge wires and collecting plates. A high voltage is applied to the discharge wires to form an electrical field between the wires and the collecting plates, and also ionizes the gas around the discharge wires to supply ions. When gas that contains an aerosol (dust, mist) flows between the collecting plates and the discharge wires, the aerosol particles in the gas are charged by the ions. The Coulomb force caused by the electric field causes the charged particles to be collected on the collecting plates, and the gas is purified **Construction:** The most basic precipitator contains a row of thin vertical wires, and followed by a stack of large flat metal plates oriented vertically, with the plates typically spaced about 1 cm to 18 cm apart, depending on the application. In cylindrical design a wire is hanged with weight inside a cylinder. The air or gas stream flows horizontally through the spaces between the wires, and then passes through the stack of plates. A negative voltage of several thousand volts is applied between wire and plate. If the applied voltage is high enough an electric (corona) discharge ionizes the gas around the electrodes. Negative ions flow to the plates and charge the gas-	3marks 4marks

	flow particles. The ionized particles, following the negative electric field created by the power supply, move to the grounded plates. **Application :** In power plant to reduce fine ash particles In cement industry In metal industry	1mark
b)	**River Pollution :** River pollution is caused by the manmade activities. The discharge of chemicals into river causes its pollution. Following are the main causes of river pollution. a) Fertilizers If large amounts of fertilizer or farm waste drain into a river the concentration of nitrate and phosphate in the water increases considerably. Algae use these substances to grow and multiply rapidly turning the water green. This massive growth of algae, called eutrophication, leads to pollution. When the algae die they are broken down by the action of the bacteria which quickly multiply, using up all the oxygen in the water which leads to the death of many animals. b) Industrial Waste Chemical waste products from industrial processes are sometimes accidentally discharged into rivers. Examples of such pollutants include cyanide, zinc, lead, copper, cadmin and mercury. These substances may enter the water in such high concentrations that fish and other animals are killed immediately. Sometimes the pollutants enter a food chain and accumulate until they reach toxic levels, eventually killing birds, fish and mammals. c) Oil Pollution If oil enters a slow-moving river it forms a rainbow-coloured film over the entire surface preventing oxygen from entering the water. On larger stretches of water the oil contaminates the feathers of water birds and when they preen the oil enters the gut and kills them. d) Warm Water Industry often uses water for cooling processes, sometimes discharging large quantities of warm water back into rivers. Raising the temperature of the water lowers the level of dissolved oxygen and upsets the balance of life in the water. e) Domestic or municipal waste Population in the cities is increasing day by day causing Burdon on existing infrastructure. A domestic waste of municipal areas is send to the river. Mithi river in Mumbai a classic example of it.	5marks

Sea Pollution: 3marks

The seas and oceans receive the brunt of human waste, whether it is by deliberate dumping or by natural run-off from the land. In fact over 80% of all marine pollution comes from land-based activities and many pollutants are deposited in estuaries and coastal waters. Here the pollutants enter marine food chains, building up their concentrations until they reach toxic levels. It often takes human casualties to alert us to pollution and such was the case in Minimata Bay in Japan when many people died as a result of a pollutant building up in food chains. A factory was discharging waste containing methyl mercury in low concentrations into the sea and as this pollutant passed through food chains it became more concentrated in the tissues of marine organisms until it reached toxic levels. Black tar-like oil is sometimes washed onto beaches not only causing a nuisance to holidaymakers but also killing many sea-birds. The oil mainly comes from tankers which wash out their holds while out at sea to save time in port.

c) 4marks

Regular Waste	Biomedical Waste
It consists of non hazardous material.	It consists of hazardous a material.
Harmful bacteria and viruses are not present.	Harmful bacteria and viruses are n present
Main constituents are metals, paper, glass, plastic, vegetables etc.	Main constituents are blood, boc parts, cotton, syringes etc.

Precautions : 4marks

1. Keep all sores and cuts covered.
2. Replace any wet bandages with clean, dry bandages.
3. Wear disposable latex gloves when handling biomedical waste. Discard the gloves immediately after use.
4. Wear an apron or another type of cover to protect your clothes from contact with the waste. If your clothes become soiled, put on fresh clothes, and take a shower, if possible.
5. Launder or throw away clothes soiled with biomedical waste.
6. Never handle syringes, needles, or lancets with your hands. Use a towel, shovel, and/or broom and a dustpan to pick up these sharp objects.

3- a) **Environmental Audit** 4marks

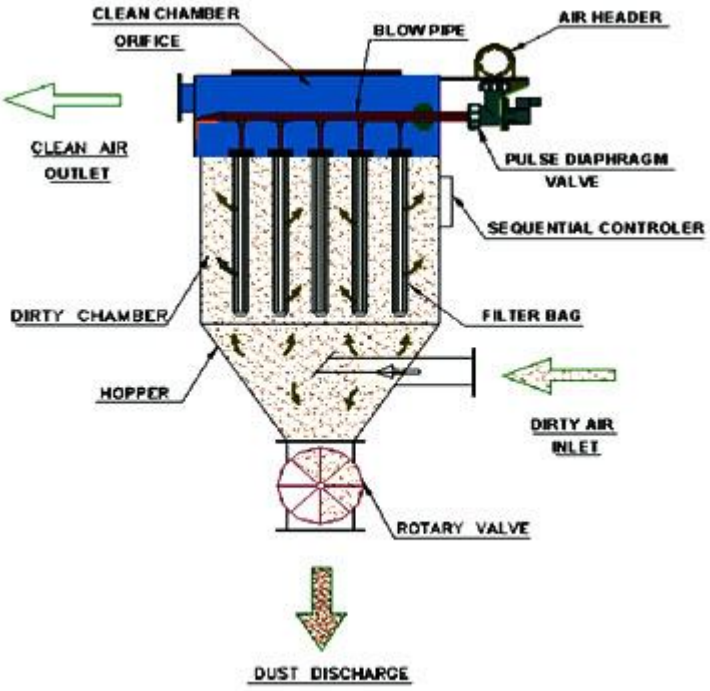
Audit process consists of following stages.

- Planning for the audit.
  For planning for successful audit assignments, the auditor needs to understand the auditees' commitments in terms of environmental norms, compliance requirements and performance expectations.

  For performance audits, audit objectives need to be identified at the very beginning and can relate to areas like:

	✓ Existence and adequacy of environment policies / laws /strategies. ✓ Adequacy of data for evaluating impact on pollution on environment. ✓ Identifications of risks caused by pollution to health and environment. ✓ Allocation of responsibility amongst the various stakeholders involved in pollution control. ✓ Adequacy of monitoring and evaluation of environment laws. ✓ Adequacy of infrastructure and funding. • Conducting field audit. Conducting field audit consists of the following steps: ➢ Conducting an opening meeting with the audit entity in order to explain audit objectives, criteria and methodology to be followed by audit. ➢ Collecting audit evidence through questionnaires, interviews, document scrutiny, photographs, direct testing of samples collected by audit etc. ➢ Conducting a closing meeting with the audit entity in order to share the preliminary audit findings • Audit reporting. The steps taken during post audit in compliance, performance and financial audit are: - Preparing a draft report after analyzing the audit evidence and drawing audit conclusions. - Conducting an exit conference with the audit entity to discuss the draft report. - Eliciting audit entity's responses to the draft report. - Preparing final report after taking into account the audit entity's responses to audit conclusions and suggesting recommendations. • Follow up review	
b)	**BOD: -** It is the amount of oxygen required to degrade organic waste present in water by purely biological means. The biological oxygen demand, ie, BOD in wastewater, is a measure of the quantity of bio-organic substances in wastewater. These can be in the form of fat, oils, carbohydrates and proteins. BOD also helps determine the quantum of organic chemicals contained in wastewater that are synthetic and biodegradable **COD: -** It is the amount of oxygen required to degrade organic waste present in water by purely chemical means. COD can help gauge the quantum of both biodegradable and non-biodegradable organics. It is quick method to determine strength of waste in water.	2marks 2marks

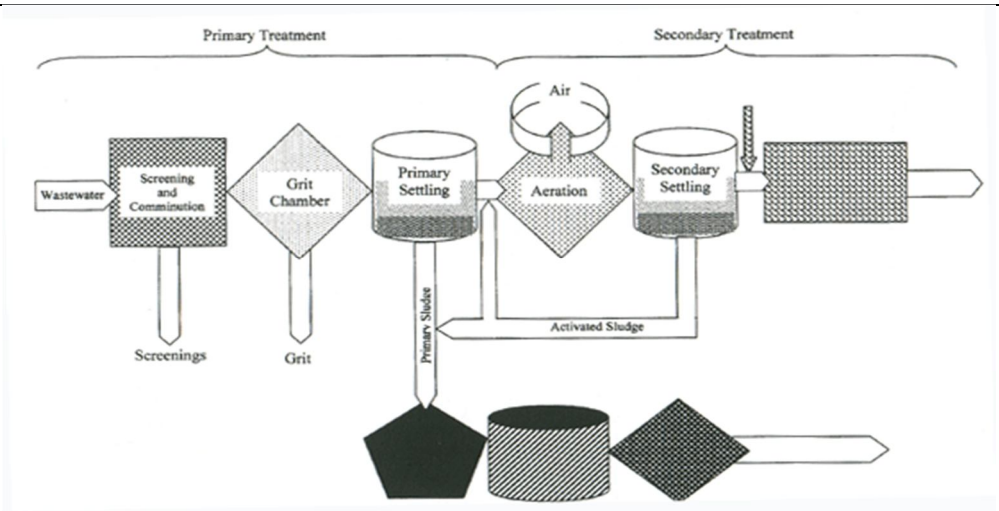
c)	**Turbidity** Turbidity is the cloudiness or haziness of a fluid caused by individual particles (suspended solids) that are generally invisible to the naked eye, similar to smoke in air. The measurement of turbidity is a key test of water quality. Fluids can contain suspended solid matter consisting of particles of many different sizes. While some suspended material will be large enough and heavy enough to settle rapidly to the bottom of the container if a liquid sample is left to stand (the settable solids), very small particles will settle only very slowly or not at all if the sample is regularly agitated or the particles are colloidal. These small solid particles cause the liquid to appear turbid. **Alkalinity** Alkalinity or AT measures the ability of a solution to neutralize acids to the equivalence point of carbonate or bicarbonate. The alkalinity is equal to the stoichiometric sum of the bases in solution. In the natural environment carbonate alkalinity tends to make up most of the total alkalinity due to the common occurrence and dissolution of carbonate rocks and presence of carbon dioxide in the atmosphere. Other common natural components that can contribute to alkalinity include borate, hydroxide, phosphate, silicate, nitrate, dissolved ammonia, the conjugate bases of some organic acids and sulfide. Solutions produced in a laboratory may contain a virtually limitless number of bases that contribute to alkalinity. Alkalinity is usually given in the unit mEq/L (mill equivalent per liter).	2marks 2marks
d)	**Garbage** Putrescible solids waste contains meat ,fruit ,vegetables **Rubbish** Contain combustible waste like paper, wood, rubber and non combustible waste like metal, glass, ceramics **Pathological waste** Dead animal, medicine, human body part, cotton, blood etc. **Industrial waste** It hazardous and non hazardous waste. It contains chemicals, paints, metal ore, fly ash, sludge etc. **Agricultural waste** Farm animal manure, crop residue etc.	4marks

e)	 Bag filter removes dust particles present in gas using bags. Bags are made up different materials according to the application of filter. It is used at the source of pollution like in cement or power industry. So that fine particles of cement or fly ash will not go the atmospheric airs helping to control pollution.	3 marks 1 mark
4-A a)	The primary sedimentation sludge and sludge from secondary clarifier are usually thickened and pumped to a digester. Most often, it is heated in an anaerobic (no oxygen) state at a temperature around 95 degrees Fahrenheit, in a "mesophilic anaerobic digester". This reduces and stabilizes the solids and microbes further. "Thermophilic" digesters operate well at temperatures between 110 and 140 degrees F. the product gas is methane and carbon dioxide. After approximately three weeks optimum, (16 days minimum), the solids are ready to pass through to the solids dewatering process. Factors affecting the time required for stabilization of the solids include the origin/type of solids, digester temperature, and pH. After anaerobic digestion the quantity of sludge will be reduced and it become stable.	4 marks
b)	**Benefits of ISO 14000** 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	any four, 4 marks

	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 13. Prevents pollution and reduces wastage 14. Demonstrates to customers that the firm has met environmental expectations 15. Meets potential national and international government purchasing requirements 16. Delivers profits from marketing "green" products 17. Provides a competitive marketing tool 18. Improves international competitiveness 19. Improves the organization's relationship with insurance companies 20. Elimination of costs associated with conformance to conflicting national standards 21. Process cost savings by reduction of material and energy input 22. Satisfying investor / shareholder criteria 23. Helps reduce liability and risk 24. Improved access to capital	
c)	**Advantages** 1. Minimum of land is needed compared to the dimensions of waste disposal sites. 2. The weight of the waste is reduced to 25% of the initial value. 3. The waste volume is reduced to almost 10% of the initial value. 4. Incineration plants can be located close to residential areas, which are the centres of the production of waste, and this helps to reduce the volume of traffic, pollution, noise and of course the costs for the waste transportation. 5. By using the ashes for environmentally appropriate construction, low costs are provided and furthermore the need for landfill capacity is reduced. 6. By using district heating single heating systems in houses can be replaced which helps to reduce the pollution of the environment and greenhouse gas emissions are diminished. 7. The produced residues, ash and slag as well as the developed flue gases, are odour-free compared to the partly offensive smells caused by dumps. 8. As the raw material needed for waste incineration, which is municipal waste, is said to be kind of renewable it helps to reduce the use of fossil fuels or non – renewable resources.	Any two , 2marks

	Disadvantages of incineration The air pollution controls required in incineration plants are extremely expensive. Very often up to one half of the costs of a plant are due to air pollution control facilities. As the laws can change and maybe require updates in the air pollution controls this could lead to much higher costs in the future. 1. Energy, produced by means of waste incineration is not likely to be practical for small communities. 2. The extremely high technical standards of the plants require skilled workers, which leads to the facts that rather high wages have to be paid. 3. The residues from the flue gas cleaning can contaminate the environment if they aren't handled appropriately and therefore they must be disposed of in controlled and well operated landfill to prevent groundwater- and surface pollution.	Any two , 2marks
d)	**Types of water pollutants** 1. Oxygen demanding waste : Organic waste, sewage, food industry waste, distillery. 2. Disease causing waste : Pathogens 3. Synthetic organic compounds: Industrial waste from petrochemical Plant. 4. Plant nutrients : Fertilizer from farms. 5. Inorganic chemicals: Waste from fertilizer, acid and chloro alkali Industry. 6. Thermal discharge : condenser water from thermal power plant. 7. Oil : oil from industrial equipment, crude oil tankers.	Any four, 4marks
4-B a)	**Objective of environment management** ▪ Endeavour to minimise use of potentially toxic materials. ▪ Aim to source materials from sustainable origins. ▪ Maximise use of recycled and recyclable materials ▪ Maximise consideration of the environment in the roll out of new recycling projects. ▪ Where packaging is used minimise pack size to future reduce waste . ▪ Expand practice of materials segregation to allow increased recovery and recycling of waste materials. ▪ Promote appropriate waste management practices to stakeholders. ▪ Continuous research to gain a greater understanding of management mechanisms for the benefit of the company and the community. ▪ Continuously identify ways of minimising energy consumption e.g. car share plan to control unnecessary mileage.	Any six, 6marks

	▪ Continually adopt fuel-efficient systems for any fleet transport and company vehicles. ▪ Promote energy management to employees. ▪ Sustainable development targets may be management or performance related. Management targets relate to the development of the management system, either to enhance the existing mechanism or to enlarge it to cover new areas. Performance targets are linked to inputs and outputs, aiming to improve these figures by a set percentage. ▪ To improve and develop further mechanisms for internal and external communication relating to corporate environmental issues. ▪ To report regularly on corporate environmental management issues. ▪ To research and gather more detailed data relating to the group's key impacts. ▪ Aim to increase the recycling of office waste collected ▪ To introduce a range of recycling projects across the group.	
b)	The objective of primary treatment to reduce large floating and suspended solids from water which could interfere with normal operation of subsequent treatment. Mainly it consist of following operations 1) Bar screen: It is used to remove grits , gravel and sand. Bar screens are used to remove it. 2) Comminutor :- It is used to convert a large solid waste material into smaller one. 3) Sedimentation: - It is used to remove setteleable solids by using different types of sedimentation tanks. 4) Flotation: - It is used to remove suspended solid present in waste water. **(Above techniques are used in primary treatment. Marks should be given for the explanation of at least any two types with diagram. Division of marks should be depend upon answer)**	6marks
5- a)	**Activated Sludge Treatment** The basic components of Activated Sludge treatment system include an aeration tank and a secondary settling basin or clarifier. Primary effluent is mixed with settled solids that are recycled from the secondary clarifier and then introduced in the aeration tank. Compressed air is injected continuously in the mixture through porous diffusers located at bottom of the tank along side.	1mark



2 marks

In the aeration tank microorganisms consume the dissolved organic pollutants as food. The microbes absorb and aerobically decompose the organics, using oxygen provided in compressed air, water, CO_2, and other stable compounds are formed. In addition to providing oxygen the compressed air thoroughly mixes the microbes and waste water together as it rapidly bubbles up to the surface from the diffusers. Sometimes mechanical propellers like mixers located at the liquid surface are used instead of compressed air and diffusers. The churning action of propeller blades mixes air with waste water and keeps the content of the tank in a uniform suspension.

5 marks

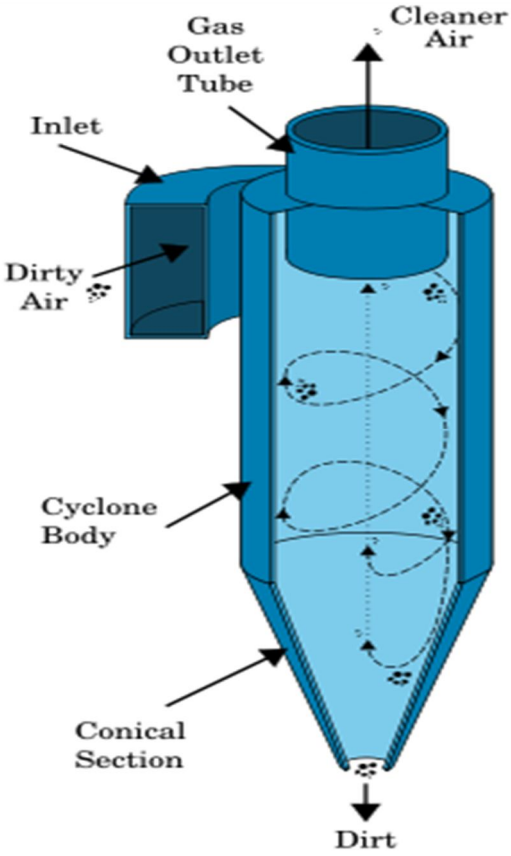
The aerobic microorganisms in the tank grow and multiply forming an active suspension of biological solids called activated sludge. The combination of activated sludge and waste water in aeration tank is called mixed liquor. In basic or conventional activated sludge treatment system a tank detention time of about six hour is required for thorough stabilisation in the mixed liquor.

After 6 hours of aeration the mixed liquor flows to secondary or final clarifier, in which activated sludge solids settle out by gravity. The clarified near the surface called supernatant is discharged over an effluent weir; the settled solid is pumped out from sludge hopper at the bottom of the tank.

Recycling is a portion of sludge back at the inlet of aeration tank is the essential characteristics of this treatment. The settled sludge is activate state in this process, in other words microbes are well accumulated in waste water will readily absorb and decomposes by metabolism.

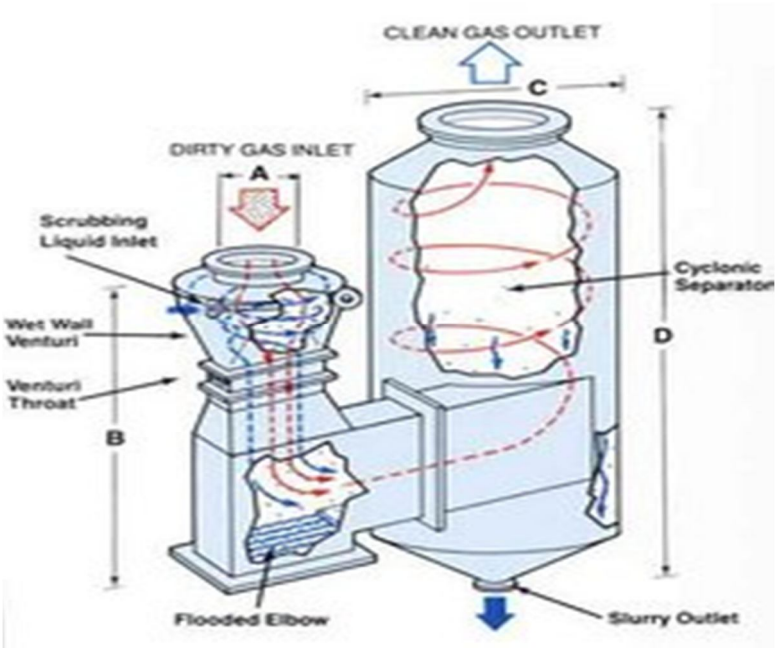
By pumping about 30% of waste water flow from bottom of clarifier back to the head of aeration tank, the activated sludge process can be maintained continuously.

	When mixed in the form of BOD , causing organics. Since the microbes multiply increase greatly in numbers it is not possible to recycle and return all sludge to aeration tank. The excess sludge called waste activated sludge must eventually be treated and disposed off. with primary effluent the hungry microbes quickly begin to absorb and metabolises the fresh food	
b)	**CONSTRUCTION:-** It consist of cylindrical shell, a conical base, dust hopper and an inlet where dust laden gas enters tangentially. Under the influence of centrifugal force generated by spinning gas, the solid particles are thrown to the walls of the cyclone in the gas spirals upward at the inside of the cone. The particles slide down the walls of the cone and into the hopper. The separating efficiency of cyclone depends upon centrifugal force exerted on the particles. Greater the centrifugal force greater the separating efficiency. The magnitude of centrifugal force generated depends upon particle mass, gas velocity within cyclone and cyclone diameter etc. This is the common type of separator are classified as centrifugal separators. It depends upon centrifugal force instead of gravity to separate particles from gas stream. Because the centrifugal force generated can be several times greater than gravitational force, particles that can be removed in centrifugal collectors are much smaller than those that can be removed in gravity settling chambers.	2marks 1 mark 2 marks

		3 marks
c)	**Composting** method is the method of disposal is very similar to landfilling but it yields a stable end product early due to controlled microbial reactions. From the refuse, decomposed organic matter is separated and composed to produce a stable matter, which is used for reclining waste land or growing crops. Following are two methods of composting:- a. Open window composting b. Mechanical composting **a. Open window composting:-** In this method, the refuse preferably having 2.5 to 4.0 cm particle size, is placed in 1.5 m high and 2.5 m wide piles at about 60 % moisture content. Due to biological activity, heat starts developing upto70 o C in the refuse piles and microbial reaction shifts from mesophillic to avoid anaerobic reactions. The moisture contents are adjusted at about 60%, the temperature of refuse pile again rises to 70 o C and the process of turning and cooling is repeated. After some turning the temperature will not rise and will come to atmospheric temperature indicating the stabilization of compositing. The complete process takes about	1mark 2 marks

	7 to 10 weeks. **b. Mechanical composting:-** in this method the process of stabilization is expedited by mechanical devices of turning the compost. It is recommended to use refuse of 1.5 cm particle size in this method. The moisture content and aeration of the refuse are continuously adjusted. Care is taken to see that quantity of air should not exceed 2m3/kg of volatile solids per day, otherwise ,it will dry the refuse causing compost only within 3 to 6 days. **Diagram**- Types of mechanical composting:- 1. Indore method 2. Bangalore method	2 marks 2 marks 1 mark
6- a)	**ORIGIN:-Particulate matter:** - these pollutants are present in lower atmosphere i.e. troposphere and stratosphere. These pollutants stay here for a long period. They consist of smoke ,dust, fumes, mist, and spray particles. These may be organic or inorganic in nature. **EFFECT**: - Its effect is divided as:-1.**effect on Human health:-** a. The particulate matter of size less than one micron enter into alveoli of lungs and damages lung tissues. b. Asbestos fibres may cause cancer to industrial workers. c. Lead from automobile exhaust may cause effect on children's brain. d Lead interferes with development and maturation of red blood cells. e. Insoluble aerosols may create toxicity to respiratory. **2. Effect on plants:-** a. The deposition of particulate matter or pollutants containing toxic materials makes unsuitable growth of plants. b. The particulates inhibit the action of plant enzyme system. c. Arsenic inhibits the growth of plants. **3. effect on materials:**- a. Corrosive particulates causes severe damage.	2marks

	b. Particulates cause cracks and fading in pointed surfaces. c. Particulates accumulate on soil surfaces causing soil erosion d. Particulates causes smog formation. B.SO_X:-ORIGIN**:-** The sulphur oxides includes SO_2,SO_3 as the dominant oxides in atmosphere.SO_2 is a non-flammable, non-explosive gas.SO_2 gets partially converted into SO_3 and sulphuric acid by various chemical process. ---------- 1/2 marks **EFFECTS**: - Its effect divided as :- a. **effect on human health**:- 1. It causes intense irritation even at 2.5 ppm. 2. Increase in SO_2 Concentration in the atmosphere may lead to lung cancer. 3. SO_2 may obstruct breathing 4. At 1-5 ppm it causes tightness to chest. 5. SO_2 is a severe allergenic agent. b. **effect on plants/v**egetation:- 1. SO_2 damages vegetable crops and affects plant growth. 2. At 1.00 ppm concentration of SO_2, trees may lead to chlorosis diseases. 3. At high concentration SO_2, plant tissues/leaf tissues may die. c. **effect on materials:-** 1) Paper absorbs SO_2 which is oxidised to H_2SO_4 causing the paper to become brittle and fragile. 2) Leather loses strength and may disintegrate. 3) The famous Taj Mahal in Agra is getting deteriorated because of SO_2 emission from industries. 4)long exposure to SO2 increases the drying and hardening time for Zn steel , Fe,Cu.	2 marks
b)	**Advantages of wet scrubber**:- 1. Wet scrubbers has an additional advantage if some gases and particulates are to be removed simultaneously. for	2marks

	example:- if SO_2 or NH_3 are the gases to be removed then, $SO_2 \pm H_20 \longrightarrow H_2SO_4$ (a valuable product) $2NH_3 \pm H_2SO_4 \longrightarrow (NH_4)_2SO_4$ (a valuable product) SULPHURIC ACID AND AMMONIUM SULPHATE are valuable byproducts. 2. High removal efficiencies even for submicron sized particulates.  	2 marks
c)	CONSTRUCTING THE LANDFILL The basic element of a sanitary landfill is the refuse cell. This is a confined portion of the site in which refuse is spread and compacted in thin layers. Several layers may be compacted on top of one another to a maximum depth of about 3 metres (10 feet). The compacted refuse occupies about one-quarter of its original loose volume. At the end of each day's operation, the refuse is covered with a layer of soil to eliminate windblown litter, odours, and insect or rodent problems. One refuse cell thus contains the daily volume of compacted refuse and soil cover. Several adjacent refuse cells make up a lift, and eventually a landfill may comprise two or more lifts stacked one on top of the other. The final cap for a completed landfill may also be covered with a layer of topsoil that can support vegetative growth. Daily cover soil may be available on-site, or it may be hauled in and stockpiled from	4marks

	off-site sources. Various types of heavy machinery, such as crawler tractors or rubber-tired dozers, are used to spread and compact the refuse and soil. Heavy steel-wheeled compactors may also be employed to achieve high-density compaction of the refuse. The area and depth of a new landfill are carefully staked out, and the base is prepared for construction of any required liner and leachate-collection system. Where a plastic liner is used, at least 30 cm (12 inches) of sand is carefully spread over it to provide protection from landfill vehicles. At sites where excavations can be made below grade, the trench method of construction may be followed. Where this is not feasible because of topography or groundwater conditions, the area method may be practiced, resulting in a mound or hill rising above the original ground. Since no ground is excavated in the area method, soil usually must be hauled to the site from some other location. Variations of the area method may be employed where a landfill site is located on sloping ground, in a valley, or in a ravine. The completed landfill eventually blends in with the landscape. OR IMPORTANCE IN WASTE MANAGEMENT In communities where appropriate sites are available, sanitary landfills usually provide the most economical option for disposal of nonrecyclable refuse. However, it is becoming increasingly difficult to find sites that offer adequate capacity, accessibility, and environmental conditions. Nevertheless, landfills will always play a key role in solid-waste management. It is not possible to recycle all components of solid waste, and there will always be residues from incineration and other treatment processes that will eventually require disposal underground. In addition, landfills can actually improve poor-quality land. In some communities properly completed landfills are converted into recreational parks, playgrounds, or golf courses. **Recycling** Separating, recovering, and reusing components of solid waste that may still have economic value is called recycling. One type of recycling is the recovery and reuse of heat energy, a practice discussed separately in Incineration. Composting can also be considered a recycling process, since it reclaims the organic parts of solid waste for reuse as mulch or soil conditioner. Still other waste materials have potential for reuse. These include paper, metal, glass, plastic, and rubber, and their recovery is discussed here.	
d)	**ADVANTAGES** 1. The complex nature of various industries and environmental conditions will require industry-specific and site specific approach for environmental audit. 2) A verification that environmental regulations and standards are being innovative	Any 4 Points 1 mark each

	and flexible by environmental audit. 3) Environmental audit helps in finding many new possibilities in making industrial process more productive and safe and sound. 4) I t may save industrial units from adverse action by authority or imposition of punishment by court of law and claims for damages 5) Environmental audit provides significant operational data, snapshots of aspects of management and operators which are useful for process modification and also useful in meeting the emergencies of employees , creditors and customers 6) Provided the management is prepared to used environmental audit as a tool for policies , processed and procedures which will benefit in future 7) It also helps in project formulation rather than it is not a component of environmental audit 8) It contains a degree of objectivity, multi disciplinary task, inputs and ecological concerns that are not present in accounts audit.	
e)	**DEFINATION :**Thermal pollution include the waste chiefly from atomic, nuclear and thermal power plants. the discharge of unutilised heat is highest in the thermal power plants which adversely affect the aquatic environment .apart from electric power plants ,various industries with cooling requirement contribute thermal loading. Recently ,it is reported that about 20 % more heat is given to cooling waters in nuclear power plants than fossil fuels plant of equivalent size. Municipal sewage also contributes to thermal pollution. Domestic sewage normally has a higher temperature than receiving water. When sewage is discharged into water streams not only the stream temperature rises to measurable extent but there are other effects also. The thermal pollution of water creates two major problems:- 1. The activity of biological life is more at higher temperature and hence as temperature of water rises, there is more demand of dissolved oxygen. 2. As temperature of water rises, the amount of dissolved oxygen in water decreases. **CONTROL MEASURES** 1. Industrial wastewater:-About 75 to 82 percent of thermal pollution is generated by power plants. The remainder is from industrial sources such as petroleum refineries, pulp and paper	1mark Any 3 points

	mills, chemical plants, steel mills and smelters. Heated water from these sources may be controlled with: • cooling ponds, man-made bodies of water designed for cooling by evaporation, convection, and radiation • cooling towers, which transfer waste heat to the atmosphere through evaporation and/or heat transfer • cogeneration, a process where waste heat is recycled for domestic and/or industrial heating purposes. 2. Thermal power stations and other industries are also great sources of wastewater; which affects (the community of living organisms) of complex natural ecological system of water basins. These industries and thermal stations employ various schemes of water treatment before discharging the wastes into water bodies. But in most of the cases either the wastewater is directly disposed into water basin or is, not treated properly to insure the properties composition of water upto maximum permissible concentrations of harmful substances. 3. Petroleum products (various oils, sulphurous fuel oil, kerosene etc.) present in wastewaters of thermal power stations and practically any industrial enterprise can enter water basins in emulsified, colloidal or dissolved state.These products can cause serious harm to water basins by forming films on water surface and thus in-habiting natural aeration. On the other hand, heavy products form bottom deposits, thus isolating the bottom flora and fauna from the remaining portion of the basin. 4. The ash formed on the combustion of solid fuels at thermal power stations is transported to ash dumps through dry and wet or hydraulic systems. In the latter system the ash is mixed with water to form pulp which is disposed to ash dumps. The ash contains a large number of inorganic compounds and minor quantities of toxic compounds of geranium, vanadium, arsenic, mercury, beryllium and fluorine, which are of certain value for the national economy. Some carcinogenic substances can also form during fuel combustion and pass from ash to w	1 mark each