WINTER-19 EXAMINATION
Model Answer

Subject Name: Environmental Technology **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 judgment 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.

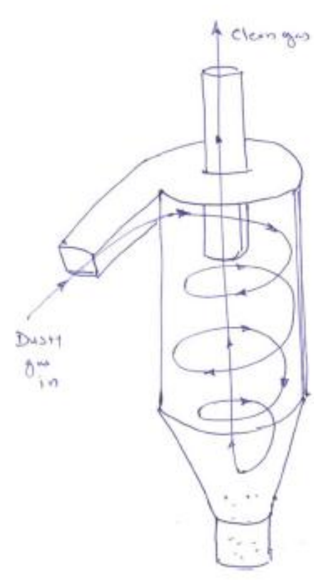
Q. No	Sub Q. N.	Answer	Marking Scheme
1.		**Attempt any Five of the following**	**10**
	a)	**Ecology** Ecology is the branch of biology that deals with the relations of organisms to one another and to their physical surroundings.	2
	b)	**Biotic Components** • Animal • Plants • Fungi • Bacteria **Abiotic Components** • Temperature • Oxygen • Water • Mineral	1 mark each for any 1 1 mark each for any 1
	c)	**Air Pollutants (Four)** • Carbon dioxide	1/2 mark each for any 4

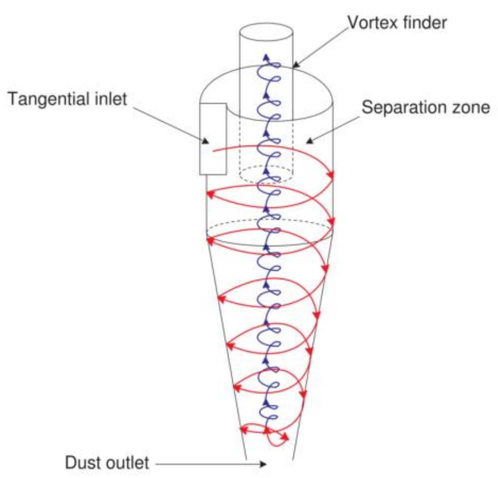
		• Carbon Monoxide • Sulfur Dioxide • Sulfur Trioxide • Methane • Particulate matter • Smoke • Fumes	
	d)	**Pollutants from nitric acid plant (Four)** Nitrogen dioxide Nitric oxide Grease and oil Nitric acid in waste water	½ mark each for any 4
	e)	**COD** It is the amount of oxygen required to degrade organic waste present in water by purely chemical means.	2
	f)	**Water Pollutants (four)** • Oxygen demanding waste • Grease and oil • Temperature • Turbidity • Pathogens • Nutrients from fertilizers • Radioactive waste	½ mark each for any 4
	g)	**Function of pollution control board (two)** 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 abatement of water and air pollution;	1 mark each for any 2

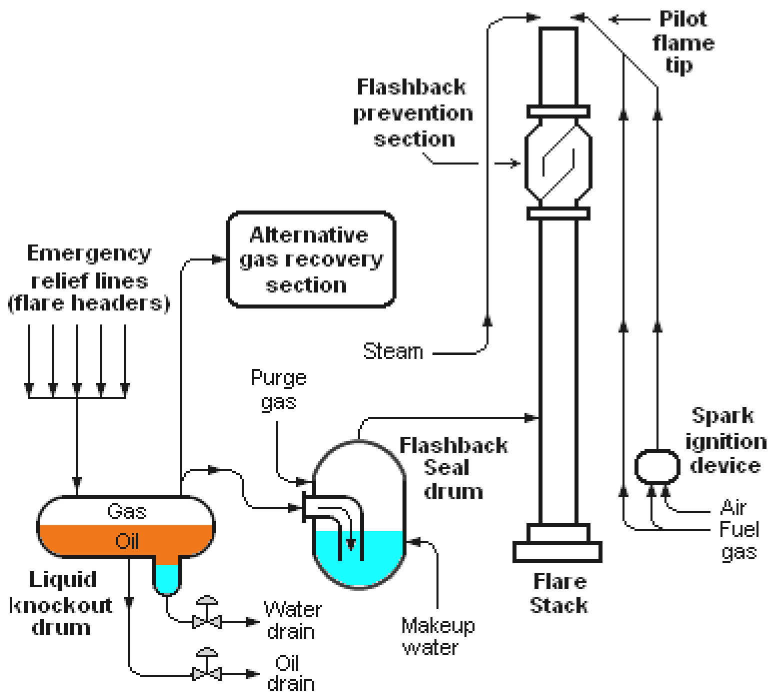
		3) Plan and organise training of persons engaged in programmes for prevention, control or abatement of water and air pollution; 4) Organise through mass media, a comprehensive mass awareness programme on prevention, control or abatement of water and air pollution; 5) Collect, compile and publish technical 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 devises, 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	
2.		**Attempt any THREE of the following**	**12**
	a)	**Terrestrial Ecosystem** An ecosystem is a collection of communities of both living and non-living things that are interrelated. While many ecosystems exist on land and in the waters of the world, terrestrial ecosystems are those that are found only on land. The biotic, or living things found in an ecosystem, include various life forms, such as plants and animals. The abiotic, or non-living things found in an ecosystem, include the various land-forms and the climate. Six primary terrestrial ecosystems exist: tundra, taiga, temperate deciduous forest, tropical rain forest, grassland and desert. The ecosystem functions through several biogeochemical cycles and energy transfer mechanisms. Every living organism is in some way dependent on other organisms. Plants are food for herbivorous animals which are in turn food for carnivorous animals. Thus there are different tropic levels in the ecosystem. Plants are the 'producers' in the ecosystem as they manufacture their food by using energy from the sun. In the forest these form communities of plant life. In the sea these include tiny	4

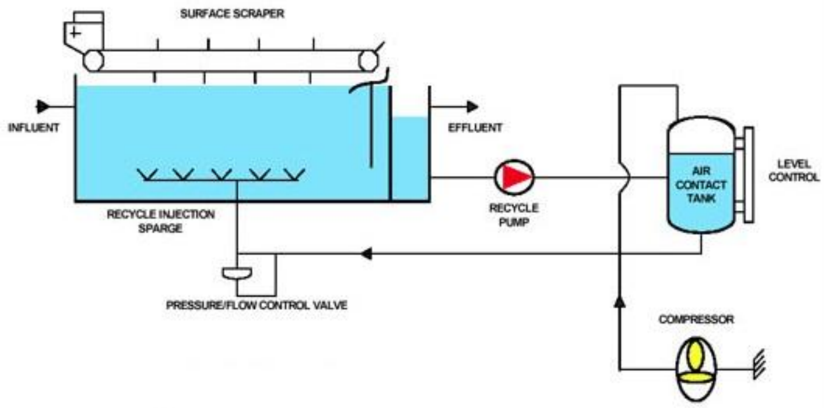
		algal forms to large seaweed. The herbivores animals are primary consumers as they live on the producers. In a forest, these are the Insects, Amphibia, Reptiles, Birds and Mammals. The herbivorous animals include for example Hare, Deer and Elephants that live on plant life. In grasslands, there are herbivores such as the blackbuck that feed on grass. In the semi-arid areas, there are species such as the Chinkara or Indian gazelle. At a higher tropic level, there are carnivores animals, or secondary consumers, which live on herbivorous animals. In our forests, the Carnivores animals are Tigers, Leopards, Jackals, Foxes and Small Wild Cats. Decomposers or Detrivores are a group of organisms consisting of small animals like worms, insects, bacteria and fungi, which break down dead organic material into smaller particles and finally into simpler substances that are used by plants as nutrition. Decomposition thus is a vital function in nature, as without this, all the nutrients would be tied up in dead matter and no new life could be produced.	
	b)	**Effect of air pollution on human health** 1) **Sulfur dioxide (SO_2)** 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 duration and suppression of immune system. 2) **Hydrocarbons** iv) The health effects of hydrocarbons have been noted in occupational exposures to tetra methyl lead, benzene, etc. v) Inhaling formaldehyde can cause irritation. vi) It is a major contributor to eye and respiratory irritation caused by photochemical smog. 3) **Carbon monoxide**	1 mark each for any four

		vii) 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. 4) **Oxide of Nitrogen** viii) NO reduces the oxygen carrying capacity of blood.	
	c)	**Biomedical Waste** Biomedical waste is any kind of waste containing infectious (or potentially infectious) materials. It may also include waste associated with the generation of biomedical waste that visually appears to be of medical or laboratory origin (e.g., packaging, unused bandages, infusion kits, etc.), as well research laboratory waste containing biomolecules or organisms that are mainly restricted from environmental release. As detailed below, discarded sharps are considered biomedical waste whether they are contaminated or not, due to the possibility of being contaminated with blood and their propensity to cause injury when not properly contained and disposed of. Biomedical waste is a type of biowaste. Biomedical waste may be solid or liquid. Examples of infectious waste include discarded blood, sharps, unwanted microbiological cultures and stocks, identifiable body parts (including those as a result of amputation), other human or animal tissue, used bandages and dressings, discarded gloves, other medical supplies that may have been in contact with blood and body fluids, and laboratory waste that exhibits the characteristics described above. Waste sharps include potentially contaminated used (and unused discarded) needles, scalpels, lancets and other devices capable of penetrating skin. Biomedical waste is generated from biological and medical sources and activities, such as the diagnosis, prevention, or treatment of diseases. Common generators (or producers) of biomedical waste include hospitals, health clinics, nursing homes, emergency medical services, medical research laboratories, offices of physicians, dentists, and veterinarians, home health care, and morgues or funeral homes. In healthcare facilities (i.e., hospitals, clinics, doctor's offices, veterinary hospitals and clinical laboratories), waste with these characteristics may alternatively be called medical or clinical waste.	4
	d)	**Features of air quality act**	1 mark each for

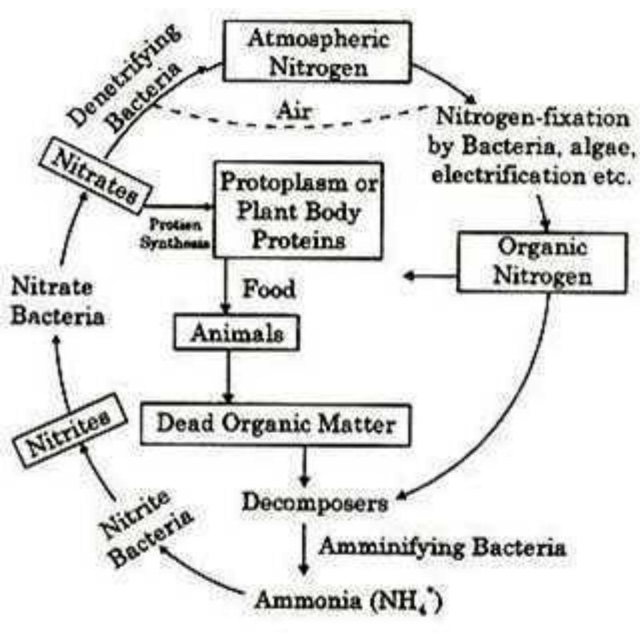
		The major sections and features of this Act are- Section 3- The Central and State Pollution Control Boards have the responsibility to exercise the powers provided under this Act without prejudice. Section 4- In states where there is a Water Pollution Control Board established, the same shall be given the joint responsibility of controlling and monitoring air pollution, and will be called State Pollution Control Board. Section 5- In states where there is no Water Pollution Control Board, a new Pollution Control Board will be set up. Section 16 describes the functions of the Central Pollution Control Board, some of which includes- 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	any 4
3.		**Attempt any THREE of the following**	**12**
	a)	**Cyclone separator** 	4

		or  	
	b)	**Working of flare (Thermal incinerator)** Flares are open flames used for disposing of waste gases during normal operations and emergencies. Flares are an open combustion process in which surrounding air supplies oxygen to the flame. They are operated either at ground level (usually with enclosed multiple burner heads) or at elevated positions. Elevated flares use steam injection to improve combustion by increasing mixing or turbulence and pulling in additional combustion air. Properly operated flares can achieve destruction efficiencies of at least 98%. Figure 1 is a schematic of the components of a flare system. Flares are typically used when the heating value of the waste gases cannot be recovered economically because of intermittent or uncertain flow or when the value of the recovered product is low. In some cases, flares are operated in conjunction with baseload gas recovery systems (e.g., condensers). Flares handle process upset and emergency gas releases that the baseload system is not designed to recover. Several types of flare exist. The most common are the steam assisted, air assisted, and pressure head flares. Typical flare operations can be classified as “smokeless,” “nonsmokeless,” and “fired” or “endothermic.” For smokeless operation, flares use outside momentum sources (usually steam or air) to provide efficient gas–air mixing and turbulence for complete combustion. Smokeless flaring is required for the destruction of organics heavier than methane.	4

		Polluted gas is mixed with steam and fuel gas to create turbulence. Pilot flames are used to ignite the mixture.  	
	c)	**Application of froth Flotation:** 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 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	4



	d)	**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.	2
		Recovery Resources are used for process to produce product. Waste generated from the process contains part of raw material. It is a part of resource. 3 R principle is used to reuse, reduce and recycle waste. Apart from it a combination of various metals and non metals are available in various used products. In chemical industry silver is used as a catalyst in oxidation process which is to be replaced frequently. It can be recovered from catalyst. Like wise plastic can be recovered from used electronic items. RDF is recovered form municipal solid waste. This recovery can be done by various methods like • Fiber recovery by wet processing • Fiber recovery from dry processing • Composting • Magnetic separation • Aluminum recovery by wet process • Aluminum recovery by dry process • Glass recovery • Plastic recovery from electronic parts	2

		• Silver recovery from catalyst • Gold recovery from gold testing lab waste	
4.		**Attempt any THREE of the following**	**12**
	a)	**Nitrogen Cycle**  Nitrogen-Cycle 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 N2 under the influence of Rhizobium bacteria The NH3 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 The plants are then eaten by animals and after the death of animals they are decomposed it again into nitrates. In this was four major step are 1. Nitrogen Fixation 2. Ammonification/ Decay 3. Nitrification	4

		4. De-nitrification	
	b)	**Recovery of energy from waste** There are a number of other new and emerging technologies that are able to produce energy from waste and other fuels without direct combustion. Many of these technologies have the potential to produce more electric power from the same amount of fuel than would be possible by direct combustion. This is mainly due to the separation of corrosive components (ash) from the converted fuel, thereby allowing higher combustion temperatures in e.g. boilers, gas turbines, internal combustion engines, fuel cells. Some are able to efficiently convert the energy into liquid or gaseous fuels: **Thermal technologies:** Gasification: produces combustible gas, hydrogen, synthetic fuels Thermal depolymerization: produces synthetic crude oil, which can be further refined Pyrolysis: produces combustible tar/biooil and chars Plasma arc gasification or plasma gasification process (PGP): produces rich syngas including hydrogen and carbon monoxide usable for fuel cells or generating electricity to drive the plasma arch, usable vitrified silicate and metal ingots, salt and sulphur Landfill Gas Collection **Non-thermal technologies:** Anaerobic digestion: Biogas rich in methane Fermentation production: examples are ethanol, lactic acid, hydrogen Mechanical biological treatment (MBT) MBT + Anaerobic digestion MBT to Refuse derived fuel **Anaerobic digestion** Anaerobic biogas digesters are airtight reactors in which organic waste is decomposed and transformed into biogas by a biological process called anaerobic digestion. Biogas is recovered and transformed into heat or any other form of energy. The remaining sludge contains many nutrients and can be used in agriculture (optionally after an aerobic post-composting). Mainly in industrialized countries, this technology has been evolved over the	4 marks for any one method

past centuries, resulting in various designs of different complexities. Facing the problem of municipal waste disposal and soaring fuel prices, low-tech set-ups, particularly adapted for developing countries have been developed today.

All biogas digesters are basically designed following the same process of anaerobic digestion. Anaerobic digestion is a four-stage process consisting of hydrolysis; fermentation (conversion of non-soluble organic biomass to soluble organic compounds); acidification (e conversion of soluble organic compounds to volatile fatty acids and CO2, followed by the conversion of volatile fatty acids to acetate and H2); and finally methane formation. The final product, biogas, is a mixture of methane (CH4), carbon dioxide (CO2) and other trace gases. There are many ways in which anaerobic digestion can occur. The simplest reactors are covered waste dumps, where anaerobic digestion can occur naturally in uncontrolled systems. As mentioned above, today there is a large range of different types and designs of anaerobic digester technologies for the treatment of organic waste available. Even though the process for all these technologies is always the same (i.e. anaerobic digestion), depending on the composition of the substrate and the volume of the waste stream, complexity of design, construction and operation vary strongly.

Energy recovery by thermal incineration

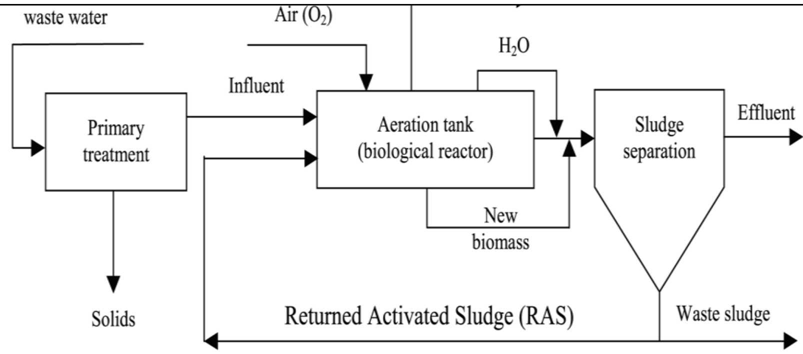
A waste-to-energy - or energy-from-waste - plant converts municipal and industrial solid waste into electricity and/or heat for industrial processing and for district heating systems – an ecologically sound, cost-effective means of energy recovery. The energy plant works by burning waste at high temperatures and using the heat to make steam. The steam then drives a turbine that creates electricity.

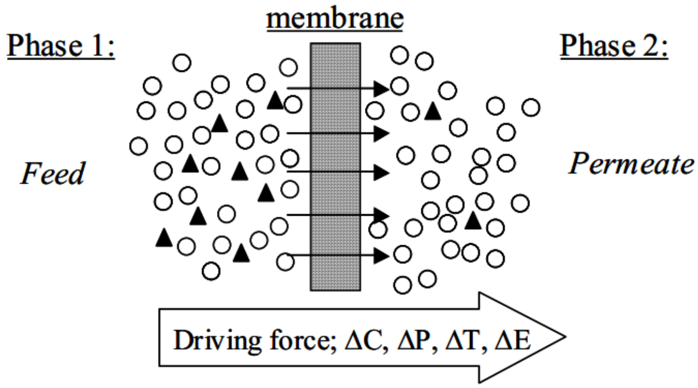
The typical incineration plant for municipal solid waste is a moving grate incinerator. The moving grate enables the movement of waste through the combustion chamber to be optimized to allow a more efficient and complete combustion. A single moving grate boiler can handle up to 35 metric tons (39 short tons) of waste per hour, and can operate 8,000 hours per year with only one scheduled stop for inspection and maintenance of about one month's duration. Moving grate incinerators are sometimes referred to as Municipal Solid

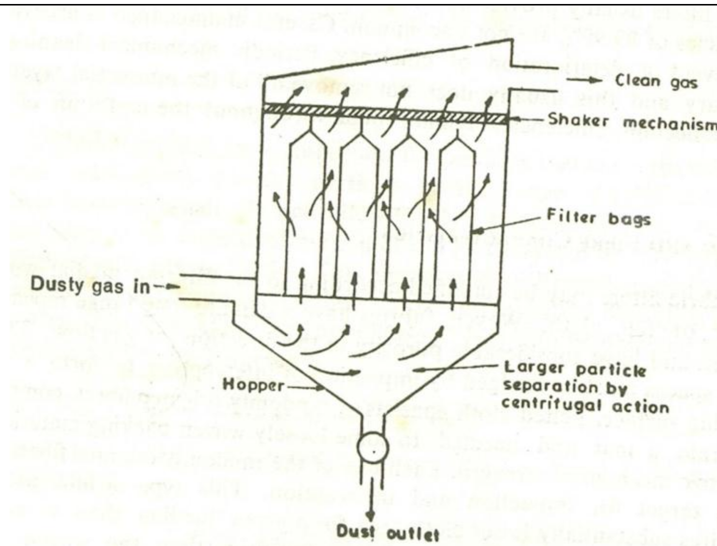
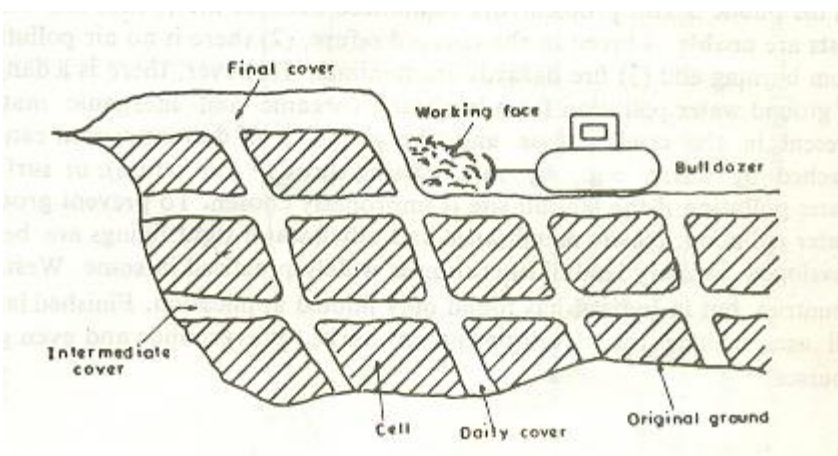
		Waste Incinerators (MSWIs). The waste is introduced by a waste crane through the "throat" at one end of the grate, from where it moves down over the descending grate to the ash pit in the other end. Here the ash is removed through a water lock. Municipal solid waste in the furnace of a moving grate incinerator capable of handling 15 metric tons (17 short tons) of waste per hour. The holes in the grate elements supplying the primary combustion air are visible. Part of the combustion air (primary combustion air) is supplied through the grate from below. This air flow also has the purpose of cooling the grate itself. Cooling is important for the mechanical strength of the grate, and many moving grates are also water-cooled internally. Secondary combustion air is supplied into the boiler at high speed through nozzles over the grate. It facilitates complete combustion of the flue gases by introducing turbulence for better mixing and by ensuring a surplus of oxygen. In multiple/stepped hearth incinerators, the secondary combustion air is introduced in a separate chamber downstream the primary combustion chamber. he flue gases are then cooled in the superheaters, where the heat is transferred to steam, heating the steam to typically 400 °C (752 °F) at a pressure of 40 bars (580 psi) for the electricity generation in the turbine. At this point, the flue gas has a temperature of around 200 °C (392 °F), and is passed to the flue gas cleaning system.	
	c)	**Love Canal tragedy** One of the most famous and important examples of groundwater pollution in the U.S. is the Love Canal tragedy in Niagara Falls, New York. Love Canal is a neighborhood in Niagara Falls named after a large ditch (approximately 15 m wide, 3–12 m deep, and 1600 m long) that was dug in the 1890s for hydroelectric power. The ditch was abandoned before it actually generated any power and went mostly unused for decades, except for swimming by local residents. In the 1920s Niagara Falls began dumping urban waste into Love Canal, and in the 1940s the U.S. Army dumped waste from World War II there, including waste from the frantic effort to build a nuclear bomb. Hooker Chemical purchased the land in 1942 and lined it with clay. Then, the company put into Love Canal an estimated 21,000	4

		tons of hazardous chemical waste, including the carcinogens benzene, dioxin, and PCBs in large metal barrels and covered them with more clay. In 1953, Hooker sold the land to the Niagara Falls school board for $1, and included a clause in the sales contract that both described the land use (filled with chemical waste) and absolved them from any future damage claims from the buried waste. The school board promptly built a public school on the site and sold the surrounding land for a housing project that built 200 or so homes along the canal banks and another 1,000 in the neighborhood (Figure 1). During construction, the canal's clay cap and walls were breached, damaging some of the metal barrels. Eventually, the chemical waste seeped into people's basements, and the metal barrels worked their way to the surface. Trees and gardens began to die; bicycle tires and the rubber soles of children's shoes disintegrated in noxious puddles. Public awareness of the disaster unfolded in the late 1970s when investigative newspaper coverage and grassroots door-to-door health surveys began to reveal a series of inexplicable illnesses—epilepsy, asthma, migraines, and nephrosis—and abnormally high rates of birth defects and miscarriages in the Love Canal neighborhood. As it turns out, consecutive wet winters in the late 1970s raised the water table and caused the chemicals to leach (via underground swales and a sewer system that drained into nearby creeks) into the basements and yards of neighborhood residents, as well as into the playground of the elementary school built directly over the canal. President Jimmy Carter declared a state of emergency in 1978 and had the federal government relocate 239 families. This left 700 families who federal officials viewed as being at insufficient risk to warrant relocation, even though tests conducted by the NYS Department of Health revealed that toxic substances were leaching into their homes. After another hard battle, activists forced Carter to declare a second state of emergency in 1981, during which the remaining families were relocated. The total cost for relocation of all the families was $17 million.	
	d)	**Benefits of ISO14000 (any 4)** 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	1 mark each for any four

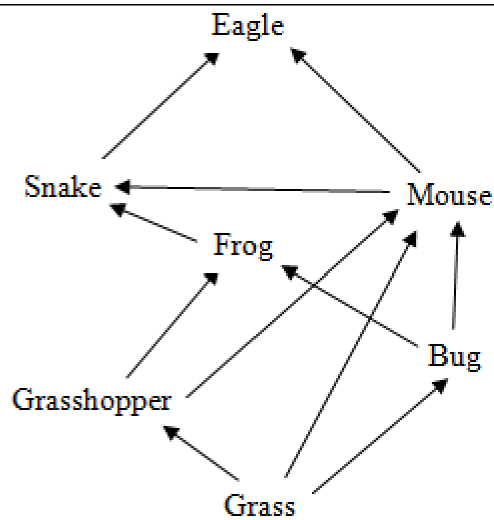
		4. Assists in developing and transferring technology within the company 5. Helps reduce pollution 6. Fewer operating costs 7. Savings from safer workplace conditions 8. Reduction of costs associated with emissions, discharges, waste handling, transport & disposal 9. Improvements in the product as a result 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	
	e)	**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 oftime, the activated sludge is allowed to settle out by sedimentation and is disposed of (wasted) or reused (returned to the aeration tank) **Working** 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 Aerobic bacteria thrive as they travel through the aera- tion 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	2

			2
5.		**Attempt any TWO of the following**	**12**
	a)	**Membrane Separation Technology** Membrane technology covers a number of different processes for the transport of substances between two fractions with the help of permeable membranes. Membranes used in membrane technology may be regarded as selective barriers separating two fluids and allowing the passage of certain components and the retention of others from a given mixture, implying the concentration of one or more components. The driving force for the transport is generally a gradient of some potential such as pressure, temperature, concentration or electric potential. There are basically four pressure driven membrane processes allowing separation in the liquid phase: microfiltration (MF), ultrafiltration (UF), nanofiltration (NF) and reverse osmosis (RO). These processes are distinguished by the application of hydraulic pressure as the driving force for mass transport. Nevertheless the nature of the membrane controls which components will permeate and which will be retained, since they are selectively separated according to their molar masses, particle size, chemical affinity, interaction with the membrane.	6

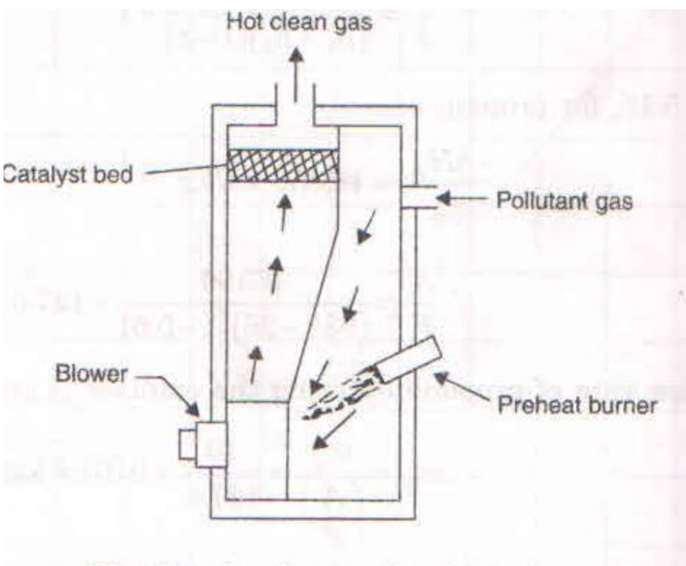
		 **Ultrafiltration** (UF) utilizes a **semi-permeable membrane** to physically remove suspended particles from water based on particle size and the pore size rating of the UF membrane. Among membrane technologies commonly used, UF is typically one step "tighter" (meaning it has smaller pore size) than microfiltration**.** **Nanofiltration** is sometimes used to recycle wastewater, as it offers higher flux rates and uses less energy than a reverse osmosis system.The design and operation of **nanofiltration** is very similar to that of reverse osmosis, with some differences. The major difference is that the nano membrane is not as "tight" as the reverse osmosis membrane. It operates at a lower feedwater pressure and it does not remove monovalent (i.e., those with a single charge or valence of one) ions from the water as effectively as the RO membrane	
	b)	**Working of bag(fabric) filter** Dust-laden gas or air enters the fabric filter through hoppers (large funnel-shaped containers used for storing and dispensing particulate) and is directed into the fabric filter compartment. 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. When sufficient pressure drop (delta P) occurs, the cleaning process of bag begins. Cleaning can take place while the fabric filter is online (filtering) or is offline (in isolation).When the compartment is clean, normal filtering resumes.	4

			2
	c)	**Sanitary landfill method**  In sanitary landfill operation, refuse is spread and compacted in this layers within a small area. This layered structure is usually referred to as a cell. To allow for proper compaction, the cell depth should not exceed about 2 meters. The cell is then covered with a layer of soil which is spread uniformly and then compacted. To provide as adequate seal the 'cover' should normally be at least 20 cm thick. If the refuse includes large irregular objects it may be necessary to increase the thickness of the cover. On the other hand , a cover thickness of less than 15 cm may be satisfactory if the refuse has been pulverized. When a number of cells reach the final desired elevation, a final cover of about one meters of earth is placed and it is again compacted. This final cover is necessary to prevent rodents from burrowing	2 4

		into the refuse. The following figure is shows the cross-sectional area of a typical sanitary landfill.	
6.		**Attempt any TWO of the following**	**12**
	a)	**Food Chain** In scientific terms, a food chain is a chronological pathway or an order that shows the flow of energy from one organism to the other. In a community which has producers, consumers, and decomposers, the energy flows in a specific pathway. Energy is not created or destroyed. But it flows from one level to the other, through different organisms. A food chain shows a single pathway from the producers to the consumers and how the energy flows in this pathway. In the animal kingdom, food travels around different levels. To understand a food chain better, let us take a look at the terrestrial ecosystem. The sun is the source of energy, which is the initial energy source. This is used by the producers or plants to create their own food, through photosynthesis and grow. Next in this chain is another organism, which is the consumer that eats this food, taking up that energy. The primary consumers are the organisms that consume the primary producers. In a terrestrial ecosystem, it could be a herbivore like a cow or a goat or it could even be a man. When a goat is consumed by man, he becomes the secondary consumer. Example of food chain **Grass (Producer) ——Goat (Primary Consumer) —— Man (Secondary consumer)** When dead organic matter becomes the starting of a food chain, then it is called the detritus food chain (DFC). The decomposers, which are the fungi and bacteria, feed on the organic matter to meet the energy requirements. The digestive enzymes secreted by the decomposers help in the breakdown of the organic matter into inorganic materials. **Food Web** Food webs consist of a number of food chains meshed together. An organism may be the pray for many other organisms. E.g. an bug feeds upon leaves of various plants but the same insect is pray for different animals like frog, mouse etc. If this is to be shown in a figure it will form an intricate web instead of linear food chain such an intricate network is called as food web.	3 3



b) **Catalytic Convertor (Incinerator)**



2

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 proceeded by a preheat section, if necessary.

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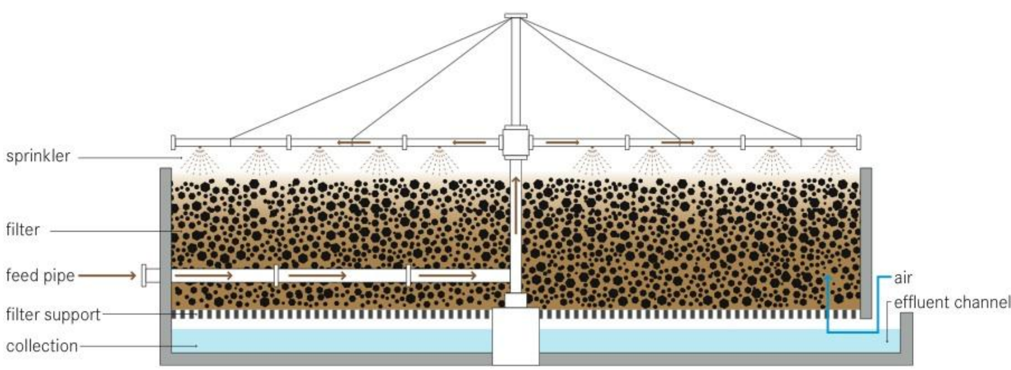
		In the preheat section, only the pollutant gas stream is heated to the temperature required to support catalytic combustion. The preheated gas is then passed through the catalyst bed where the combustion occurs. To maintain the catalyst in an active state and to achieve complete combustion about 1% excess oxygen is required**.** Product gases are simple compounds like carbon dioxide and water.	
	c)	**Trickling Filter** A trickling filter is a type of water pollution treatment system. It consists of a fixed bed of rocks, lava, coke, gravel, slag, polyurethane foam, sphagnum peat moss, ceramic, or plastic media over which sewage or other wastewater flows downward and causes a layer of microbial slime (biofilm) to grow, covering the bed of media. Aerobic conditions are maintained by splashing, diffusion, and either by forced air flowing through the bed or natural convection of air if the filter medium is porous. The terms trickle filter, trickling biofilter, biofilter, biological filter and biological trickling filter are often used to refer to a trickling filter. These systems have also been described as roughing filters, intermittent filters, packed media bed filters, alternative septic systems, percolating filters, attached growth processes, and fixed film processes. **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 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.	4

		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. 	2