



MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION
(Autonomous)
(ISO/IEC -270001 – 2005 certified)

WINTER -2016 EXAMINATION

Subject code: 17605

Model Answer

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Important Instructions to examiners:

- 1) The answer should be examined by keywords 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 error such as grammatical, spelling errors should not be given more importance. (Not applicable for subject English and communication skill).
- 4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figure 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 the some cases, the assumed constants values may vary and there may be some difference in the candidates answer and model answer.
- 6) In case of some questions credit may be given by judgment on part of examiner of relevant answer based on candidates understanding

Question and Model Answers	Marks
Q.1 Attempt any FIVE of the following:	20 M
a) Define Solid waste and list any four sources of solid waste.	04
Defn.- Solid waste means discarded material including solid, liquid and semi solid resulting from domestic, Industrial, commercial, Agriculture and Mining operation. Sources <ul style="list-style-type: none">➤ Residential:➤ Commercial:➤ Institutional:➤ Municipal:➤ Industrial:➤ Agricultural:➤ Open areas:	02M ½ M Each (Write any Four)
b) Enlist any four transport vehicles with their capacities for transporting municipal waste.	04
<ul style="list-style-type: none">➤ Handcart- Consist of 6 or 8 bins of 25 lit capacity.➤ Animal cart - 1.5 M³➤ Auto vehicle - 2 M³➤ Dumper - 12 M³➤ Compactor - 5 -10 M³➤ Tractor and Trailer- 6 M³➤ Truck - 10 M³	1M (1/2 for name and ½ for capacity) Each (Write any Four)

<p>c) State various factors affecting composting process.</p>	<p>04</p>
<p>➤ Temperature Microorganisms require a certain temperature range known as Mesophiles (20-45°C or 68-113°F) and thermophiles (45°C or 113°F) for optimal activity. Certain temperatures promote rapid composting and destroy pathogens and weed seeds. Thermopiles bacteria can turn waste to compost almost 6 months faster than the lower temperature bacteria.</p> <p>➤ Moisture Level Microorganisms living in a compost pile need an adequate amount of moisture to survive. Moisture is very important for a composting toilet. Without moisture, no bacteria can perform the processes necessary for composting.</p> <p>➤ Air Circulation or Oxygen Level Aerobic conditions are important for proper composting and odor control. If anaerobic (no air present) conditions are allowed to exist, then foul and offensive odors. Providing proper ventilation by designing the composting toilet with a vent pipe.</p> <p>➤ Particle size: Smaller particle size increases conversion rate during composting.</p> <p>➤ pH: During the composting process, the pH level will fluctuate according to the different reactions produced by the micro-organisms.</p> <p>➤ Carbon/Nitrogen Nutrient Ratio The proper balance of nutrients is vital to the composting process. A good carbon/nitrogen (C/N) ratio for a compost toilet is 20/1 to 35/1. This means far more carbon must be present in the vault to the nitrogen for good composting to proceed. Because of the composition of feces and urine, a lot of carbon in the form of hay, straw, wood chips, and sawdust have to be added to the compost toilet.</p>	<p>1mark for any Four</p>
<p>d) Define Biomedical Waste and enlist any four sources of generation of biomedical waste.</p>	<p>04</p>
<p>Defn.- Bio-medical waste means any solid and or liquid waste including its container and any intermediate product, which is generated during the diagnosis, treatment of human beings or animals or in research and testing.</p> <p>Sources</p> <ul style="list-style-type: none"> ➤ Hospital ➤ Health clinic ➤ Nursing home ➤ Research laboratories ➤ Offices of physicians ➤ Dentists ➤ Doctors offices ➤ Veterinary hospitals 	<p>02 M</p> <p>½ M Each (Write any Four)</p>
<p>e) State the purpose of recycling of solid waste.</p>	<p>04</p>
<ul style="list-style-type: none"> ➤ To Make Environment Clean ➤ Material volume reduction ➤ Toxicity reduction ➤ Conservation of Materials ➤ To Save Energy ➤ Reduce Garbage in Landfills ➤ Reduce the pollution ➤ Natural resources conservation 	<p>1mark for any Four</p>

f) Explain the health problem during time of segregation of solid waste.	04
<p>Health problem during the time of segregation</p> <ol style="list-style-type: none"> Workers and rag pickers can be infected during picking of biodegradable and Non biodegradable waste. If biodegradable and non biodegradables or wet and dry wastes are not put separately, it can creates bad odour. Possible health hazard include raised level of infant mortality, non communicable disease such as hand/leg injury by sharp edge material, respirational infections, eye infection,. Communicable diseases such as Diarrhoea & dysentery(due to flies), skin disease 	1M each
Q.2 Attempt any FOUR of the following:	16 M
a) State the various factor affecting on solid waste generation.	04
<ul style="list-style-type: none"> ➤ Living standard ➤ Awareness of people ➤ Source reduction/recycling ➤ Geographic location ➤ Collection Frequency ➤ Per person income ➤ Public attitudes ➤ Size of households ➤ Population density ➤ Population increase 	½ M Each (Write any Eight)
b) Give the physical characteristics of solid waste.	04
<ul style="list-style-type: none"> ➤ Density -50-290 Kg/m³ ➤ Moisture Content – 5-60% ➤ Particle Size of Waste Constituents -1cm-50cm ➤ Calorific Value 	1M each
c) Give the impact of solid waste on environment.	04
<ul style="list-style-type: none"> ➤ Ground water contamination by the leachate generated by the waste dump ➤ Surface water contamination by the run-off from the waste dump ➤ Bad odour, pests, rodents and wind-blown litter in and around the waste dump ➤ Generation of inflammable gas (e.g. methane) within the waste dump ➤ Bird menace above the waste dump which affects flight of aircraft ➤ Fires within the waste dump ➤ Erosion and stability problems relating to slopes of the waste dump ➤ Epidemics through stray animals ➤ Acidity to surrounding soil and Release of green house gas. 	1mark for any Four
d) Explain the principle of composting process.	04
<p>Decomposition and stabilization of organic waste matter is a natural phenomenon. Composting can be carried out in two ways i.e., aerobically and anaerobically.</p> <p>During aerobic composting aerobic micro-organisms oxidise organic compounds to Carbon dioxide, Nitrite and Nitrate. Carbon from organic compounds is used as a source of energy while nitrogen is recycled. Due to exothermic reaction, temperature of the mass rises.</p> <p>During anaerobic process, the anaerobic micro organisms, while metabolizing the nutrients, break down the organic compounds through a process of reduction. A very small amount of energy is released during the process and the temperature of composting mass does not rise much. The gases evolved are mainly Methane and Carbon dioxide. An anaerobic process is a reduction process and the final product is subjected to some minor oxidation when applied to land.</p>	2M 2M

<p>e) Enlist any four factors affecting site selection for landfilling.</p>	<p>04</p>
<ul style="list-style-type: none"> ➤ No Residential area should be located near the boundaries of landfill site. ➤ The site should be provided all facilities such as drinking water, Electricity, Roads for transportation. ➤ It should be free from Seismic Zone. ➤ Selection of landfill site should be based upon the examination of environmental issues. ➤ Land area and volume should be sufficient enough to provide landfill capacity. ➤ The landfill area having steep gradient (where stability of slope could be problematic) should not be selected. ➤ The water level in ground water table should be sufficient below the base of any excavation to enable landfill development. ➤ There should not be fault lines and significantly fractured geological structure. ➤ Landfill site should be away from airports. 	<p>1mark each for any Four</p>
<p>f) Give the meaning of following term</p>	<p>04</p>
<p>i. Hazardous waste Hazardous wastes may be defined as wastes of industrial, institutional or consumer origin which, because of their physical, chemical or biological characteristics are potentially dangerous to human and the environment. Typical examples are: solvents, paints and pesticides whose spent containers are frequently mixed with municipal wastes and become part of the urban waste stream.</p> <p>ii. Domestic waste The solid wastes that originate from single and multi-family household units. These wastes are generated from household activities such as cooking, cleaning, repairs, hobbies, redecoration, empty containers, packaging, clothing, old books, writing/new paper, and old furnishings.</p> <p>iii. Agriculture waste This mainly consists of spoiled food grains and vegetables, agricultural remains, litter, etc., generated from fields, orchards, vineyards, farms, etc.</p> <p>iv. Commercial waste Solid wastes that are originate in offices, wholesale and retail stores, restaurants, hotels, markets, warehouses and other commercial establishments.</p>	<p>1M</p> <p>1M</p> <p>1M</p> <p>1M</p>
<p>Q.3 Attempt any TWO of the following:</p>	<p>16 M</p>
<p>a) Enlist various methods of collection of municipal solid waste and explain any one of them.</p>	<p>08M</p>
<p>A) Classification of collection system Based on the availability of service</p> <ol style="list-style-type: none"> 1. Curb Service 2. Alley Service 3. Set out Set Back Service 4. Backyard Service <p>B) Collection Method Based on mode of operation:</p> <ol style="list-style-type: none"> 1. Hauled Container System 2. Stationary Container system 	<p>04 M For Classifi cations</p>

<p>A) Classification of collection system Based on the availability of service</p> <p>1. Curb (Kerb-side)</p> <ul style="list-style-type: none"> • Kerb side collection, or curbside collection, is a service provided to households, typically in urban and suburban areas, of removing household waste. • House owner is responsible for placing solid waste containers at the curb on scheduled day. • The work man come, collect and empty the container and put back at the curb. • House owner is required to take back the empty containers from the curb to his house. • Quickest/ economical • Crew: 1 driver + 1 or 2 collectors • No need to enter property <p>2. Alley Service -</p> <p>The containers are placed at the alley line from where they are picked up by workmen from refuse vehicle who deposit back the empty container.</p> <p>3. Set out Set Back Service -</p> <p>Set out man go to the house collect containers and empty them in the refuse vehicle. Another group of persons return them to the house owner's yard.</p> <p>4. Backyard Service -</p> <p>The workers with the vehicles carry a bin, wheel-barrow or sack or cloth to the yard and empty the solid waste container in it. The wheel barrow or bin is then taken to solid waste vehicle where it is emptied.</p> <p>B) Collection Method Based on mode of operation:</p> <p>1. Hauled Container System</p> <p>An empty storage container (Known as a drop- off box) is hauled to the storage site to replace the container that is full of waste, which is then hauled to the processing point, transfer station or disposal site.</p> <p>2. Stationary Container System</p> <p>In this system, containers used for the storage of waste remain at the point of collection. The collection vehicles generally stop alongside the storage containers, and collection crews load the waste from the storage containers into the collection vehicles and then transport the waste to the processing, transfer or disposal site.</p>	<p>04 M</p> <p>For</p> <p>Any</p> <p>One</p> <p>Method</p> <p>Explain</p>
<p>b) Enlist Various Methods of land filling and explain any one of them. Give the advantages and disadvantages of land filling.</p>	<p>08 M</p>
<p>❖ Land filling methods</p> <ol style="list-style-type: none"> 1) Area method 2) Trench method 3) Slope method 4) Valley method 	<p>1/2 M</p> <p>each</p>

<p>1) Area method</p> <ul style="list-style-type: none"> The Area Method is used when the terrain is unsuitable for the excavation of trenches in which to place the solid wastes. The filling operation usually is started by building an earthen bund against which wastes are placed in thin layers and compacted as the fill progresses until the thickness of the compacted wastes reaches a height of 2 to 3 m at the end of day's operation a 150 mm to 300 mm layer of cover material is placed over the compacted fill. The cover material must be hauled in by truck or earth-moving equipment from adjacent land or from borrow-pit areas. A final layer of cover material is used when the fill reaches the final design height. <p>2) Trench method</p> <ul style="list-style-type: none"> The trench method is suited to areas where an adequate depth of cover material is available at the site. Where the water table is well below the surface. To start the process, a portion of the trench is dug with a bulldozer and the dirt is stockpiled to form an embankment behind the first trench. Wastes are then placed in the trench, spread into thin layers and compacted. The operation continues until the desired height is reached. Cover material is obtained by excavating an adjacent trench or continuing the trench that is being filled. <p>3) Slope Method- In hilly regions it is not possible to find flat ground for landfilling, in such situation waste is placed along the sides of existing hill slope. The wastes are spread on existing slope, compacted & covered. The cover materials usually come from just ahead of the working face.</p> <p>4) Valley Method-</p> <ul style="list-style-type: none"> At locations where natural or artificial depression exists, it is often possible to use them effectively for land filling operations. Canyons, ravines, fry borrow pits and quarries have all used for this purpose. The technique to place and compact solid waste in depression landfills vary with the geometry of the site, the characteristics of the cover material, the hydrology and geology of the site, and the access to the site. 	<p>2M FOR ANY ONE METHOD</p>
<p>❖ Advantages of Landfilling:</p> <ul style="list-style-type: none"> Volume can increase with little addition of equipment. Filled land can be reused for other community purposes. Low cost and ease of application, no high-tech. Absorb massive amounts of solid wastes. Replanting the area with trees is possible. Access to methane. <p>❖ Disadvantages of Landfilling:</p> <ul style="list-style-type: none"> Leakage of air pollutant gases: methane, carbon dioxide. Possibility of contamination of water sources by waste water resulting from landfill. Requires proper planning, design, and operation 	<p>2M</p> <p>2M</p>

<p>c) Enlist types of incinerators. Explain any one of them. Give the advantages and disadvantages of incineration process.</p>	<p>08 M</p>
<p>❖ Types of Incinerators -</p> <ol style="list-style-type: none"> 1) Mass burner Incinerator 2) RDF (Refuse-Derived fuel) based incinerator 3) Modular Incinerators 4) Fluidized bed incineration <p>i) Mass burner Incinerator:</p> <ul style="list-style-type: none"> • This incinerator consists of two or three incineration unit ranging from 50 to 1000 tons per day. These are design to incinerate the municipal solid waste as collected without prior processing. It is flexible and convenient. • It is continuously fed to a grate system the waste intake are usually includes tipping floor a pit, a crane and sometimes a conveyors. Truck dumps solid waste on floor or directly into a pit. • When waste is dumped on floor bulldozer is used to push them into a pit or conveyor and then it is fed to grate system which moves waste through combustion chamber <p>ii) RDF based incinerator:</p> <ul style="list-style-type: none"> • RDF is homogeneous system and better control on combustion and can recover more energy. • Various components like metal, glass and non-combustible material can be removed to produce RDF. • The combustible waste is shredded into uniform particle size, then pelletisation is done to get RDF pellets. • In this system process solid waste refuse derived fuel is burnt. <p>iii) Modular Incinerators:</p> <ul style="list-style-type: none"> • These are prefabricated units with relatively small capacities. • The capacity range is in between 5 to 120 tones solid day. • The capital cost per ton of capacity is lower than other MSW incineration option. • Modular incinerator includes two combustion chambers, which ensures complete combustion. It has better control of pollution. <p>iv) Fluidized bed incineration:</p> <ul style="list-style-type: none"> • This type of combustion system includes steel vertical cylinder lined from inside with bricks and sand is placed as bed. • Air nozzles are provided to inject air at high pressure. • Solid fuel is injected into chamber along with natural gas or oil initially to increase temperature of incinerator. • This system is suitable for burning sewage sludge and other chemical waste. 	<p>½M for Four Types</p> <p>02 M For Any One Explanation</p>

<p>❖ Advantages of Incineration:</p> <ol style="list-style-type: none"> i) This is most hygienic method, since it ensures the complete destructions of pathogens. ii) There is no odour trouble or dust nuisance. iii) The heat generated can be used for raising the steam power. iv) Clinkers produce can be used for the road purpose. <p>❖ Disadvantages of Incineration:</p> <ol style="list-style-type: none"> i) Large initial expenditure. ii) Improper operation results air pollution problems and incomplete reduction of waste materials. iii) Disposal of remaining residue is required, iv) High stacks are needed for the natural draft chimneys present safety problems. 	<p>02 M For Any Two Points</p> <p>02 M For Any Two Points</p>
<p>Q. 4 Attempt any FOUR of the following:</p>	<p>16 M</p>
<p>a) Explain the term waste prevention and waste reduction.</p>	<p>04</p>
<p>❖ Waste prevention-:</p> <ul style="list-style-type: none"> • Waste prevention is often called source reduction which means reducing waste by not producing it. • Waste prevention actually avoids waste generation, it is the preferred waste management activity • Overall, waste prevention conserves resources, protects the environment, and prevents the formation of greenhouse gases. <p>❖ Waste Reduction:</p> <p>Waste reduction can be achieved in three ways:</p> <ol style="list-style-type: none"> i) Reducing the amount of material used per product without sacrificing the utility of that product. ii) Increase lifetime of a product. iii) Eliminating the need of the product. <ul style="list-style-type: none"> • To reduce waste we usually have to make significant lifestyle changes. Reduce office paper waste by implementing a formal policy to duplex all draft reports and by making training manuals and personnel information available electronically. • Improve product design to use less material. • Switch to reusable transport containers 	<p>02 M</p> <p>02 M</p>

<p>b) Draw the organization pattern of solid waste management.</p>	<p>04 M</p>
<div style="text-align: center;"> <pre> graph TD LB[Legislative Body] <--> ME[Ministry of Environment and forest] ME <--> SG[State Government] ME <--> CPCB[Central pollution control board] SG <--> CC[City Corporation] CPCB <--> SPCB[State pollution control board] SPCB <--> CC CC <--> PFS[Private formal sector] CC <--> PIS[Private informal sector] PFS <--> PIS </pre> </div>	<p>04 M For Neat labeled sketch</p>
<p>c) Explain in brief transfer station.</p>	<p>04 M</p>
<p>❖ Transfer station: Defn.- These are the open or closed structures built by competent authority at various locations in city and waste collected by hauling vehicles is initially transferred to these stations prior to loading into large vehicles.</p> <p>❖ Location-: A transfer station is a building or processing site for the temporary deposition of waste. Transfer stations are often used as places where local waste collection vehicles will deposit their waste cargo prior to loading into larger vehicles. These larger vehicles will transport the waste to the end point of disposal in an incinerator, landfill, or hazardous waste facility, or for recycling.</p> <p>❖ Necessity of transfer stations: Transfer stations are necessary due to following reasons</p> <ol style="list-style-type: none"> 1. They prevent the scattering of MSW. 2. To have ease in proper storage and collection of MSW from different locations. 3. To prevent nuisance due to scattered solid waste to nearby area. 4. To reduce the haul distance. 	<p>01 M</p> <p>01 M</p> <p>02 M</p>

<p>d) State the methods of storage of solid municipal waste.</p>	<p>04 M</p>
<p>1) Large numbers of open communal storage sites and unofficial dumps. 2) Plastic buckets (with lids), with capacities between 7 and 10 L, 3) Plastic bins (with lids), with capacities between 30 and 60 L and equipped with handles 4) Galvanized steel or plastic bins (with lids), with a capacity between 50 and 70 L, 5) Disposable plastic bags have a number of advantages. 6) Other items commonly used for the storage of wastes include cardboard boxes, kerosene cans, and containers made out of truck tires. 7) DEPOTS a depot typically consists of a single-story building about the size of a large garage. 8) ENCLOSURES an enclosure is probably the most common communal storage method in Asia. Enclosures can have capacities from 1 to 10 m³ 9) FIXED storage bins this type of container usually is built from concrete blocks.</p>	<p>½ M Each (Write any Eight)</p>
<p>e) What do you understand by Vermi-composting?</p>	<p>04 M</p>
<p>❖ Vermicompost is the product or process of composting using various worms, usually red wigglers, white worms, and other earthworms to create a heterogeneous mixture of decomposing vegetable or food waste, bedding materials, and vermicast.</p> <p>❖ Vermicomposting- Concept</p> <ul style="list-style-type: none"> • Take a small wooden box or dig a small pit. • Spread a net on box. • Also spread 1 or 2 cm thick layer of sand. • Put some cow dung and kitchen wastes such as peels of fruits etc., to cover the sand. • Use green leaves to cover over the sand. • Sprinkle some water to make this layer wet. • Get some red worms and put them on the upper layer of bed. • Feed vegetable and fruit wastes as food. • After 3 to 4 weeks we get loose, soil like material in the pit. • Remove the material from the box, dry it in the sun. • Use this as manure. 	<p>02 M</p> <p>02M</p>
<p>f) Explain pyrolysis of waste.</p>	<p>04 M</p>
<p>Pyrolysis can be defined as the thermal decomposition of organic material through the application of heat without the addition of extra air or oxygen. In this process thermal decomposition of organic matter at high temperature take place. Pyrolysis is an endothermic process which requires heat for an external source. In this method solid waste material is heated in specially designed chamber which is called as pyrolysis reactor. In pyrolysis reactor, heating is carried out in closed environment which is almost oxygen free at an average temperature above 650^oC which may rise to 1000^oC. The end products are Hydrogen, methane, carbon mono-oxide, tar or oil, char, inert material.</p>	<p>02 M</p>

<p>Methods of Pyrolysis:</p> <p>1. Dry pyrolysis</p> <ul style="list-style-type: none"> • Process of thermal decomposition without access of oxygen (O₂) • Products of dry pyrolysis are gas with high heat of combustion, liquid and solid carbon residue. • Type of dry pyrolysis depend on the temperature of the process i.e. Low Temperature Analysis, Medium Temperature Analysis, High Temperature Analysis. <p>2. Oxidizing pyrolysis</p> <ul style="list-style-type: none"> • It's impossible to achieve a completely oxygen-free atmosphere. • Thus, a small amount of oxidation occurs. If volatile or semi-volatile materials are present in the waste, thermal desorption will also occur. • Thermal decomposition of industrial waste by its partial burning or direct contact with end product of fuel combustion • This method is used for neutralization of most wastes including "inconvenient" ones for burning are present in the waste, thermal desorption will also occur. • Thermal decomposition of industrial waste by its partial burning or direct contact with end product of fuel combustion • This method is used for neutralization of most wastes including "inconvenient" ones for burning 	<p>02M For Methods.</p>
<p>Q.5 Attempt any TWO of the following:</p>	<p>16M</p>
<p>a) Define E-Waste. State various types of E-Wastes. Explain the methods of disposal of E-waste.</p>	<p>8M</p>
<ul style="list-style-type: none"> • Defⁿ.- E-waste is any refuse created by discarded electronic devices and components as well as substances involved in their manufacture or use. • Types of E-Wastes are <ol style="list-style-type: none"> 1. Computers, 2. Office electronic equipment, 3. Entertainment device electronics, 4. Mobile phones, 5. Television sets, 6. Refrigerators etc. • Methods of Disposal of E-waste : <p>1) Land filling: In land filling, trenches are made on the flat surfaces. Soil is excavated from the trenches and waste material is buried in it, which is covered by thick layer of soil. Now a day's secure land filling are provided with some facilities like impervious liner made up of plastic or clay, leachate collection basin that collect and transfer the leachate to wastewater treatment plant. Environmental risk from land filling of e-waste cannot be neglected because the condition of land filling site are different from a native soil, particularly concerning the leaching behavior of metals.</p>	<p>2M</p> <p>2M</p> <p>1M each</p>

<p>2) Incineration: It is controlled and complete combustion process, in which the waste material is burned in specially designed incinerators at a high temperature. Advantage of incineration of e-waste is the reduction of waste volume and utilization of the energy content of combustible materials. Disadvantages of incineration are the emission to air of substances escaping flue gas cleaning and the large amount of residue from gas cleaning and combustion.</p> <p>3) Recycling of e-waste: Monitors and CRT, keyboards, laptops, modems, telephone bards, hard drives, floppy drives, compact disk, mobiles, fax machines, printers, CPUs, memory chips, connecting wires and cables can be recycled. Recycling involves dismantling and recovery of valuable materials. Recycling is the best possible option for the management of e- waste because the existing dumping grounds in India are full and overflowing beyond capacity and it is difficult to get new dumping sites due to Scarcity of land.</p> <p>4) Re-use: It is commonly used for electronic equipments like computers, cell phones etc. It constitutes direct second hand use or use after slight modification to the original functioning equipment. This method also reduces the volume of e-waste generation.</p>			1M each
b) Describe method of collection and disposal of industrial waste.			8M
Sr No.	Industry	Disposal Method	2M each any four
1)	Thermal Power Station Industry	Fly ash waste can be recycled for- <ul style="list-style-type: none"> ➤ Cement ➤ Raw material in ordinary Portland cement ➤ Cellular concrete bricks and blocks lime and cement fly ash concrete. ➤ Precast fly ash concrete building units. ➤ As a plasticizers. 	
2)	Sugar Industry	Converting waste into manure by composting treatment. And the bagasse is used as fuel for boiler.	
3)	Blast Furnace Slags from Metal Industry	<ul style="list-style-type: none"> ➤ As a aggregate in concrete ➤ Non- Portland cement ➤ Manufacture of slag cement, super sulphated cement, metallurgical cement ➤ As a structural fill (air- cooled slag) 	
4)	Paper and Pulp Industry	Paper cutting Waste is recycled for either same industry or it is send to cardboard industry as raw material.	
5)	Food Industry	Waste is treated either by Vermi-composting (For small quantity) and Bio-methenation process (For large quantity)	
<p>The collection of industrial solid waste is mainly done by industry itself and differ with each industrial unit. (Note: Student may write any appropriate industrial solid waste so credit may be given accordingly)</p>			
c)			8M
i) Explain Recycling of industrial waste.			4M
Following are the Industrial Waste and Area of Recycle: 1 Fly ash <input type="checkbox"/> Cement <input type="checkbox"/> Raw material in ordinary Portland cement <input type="checkbox"/> Cellular concrete bricks and blocks lime and cement fly ash concrete.			

<input type="checkbox"/> <input type="checkbox"/> Precast fly ash concrete building units. <input type="checkbox"/> <input type="checkbox"/> As a plasticizers. 2 Blast Furnace Slags <input type="checkbox"/> <input type="checkbox"/> As a aggregate in concrete <input type="checkbox"/> <input type="checkbox"/> Non- Portland cement <input type="checkbox"/> <input type="checkbox"/> Manufacture of slag cement, super sulphated cement, metallurgical cement <input type="checkbox"/> <input type="checkbox"/> As a structural fill (air- cooled slag) 3 Red Mud <input type="checkbox"/> <input type="checkbox"/> As a binder <input type="checkbox"/> <input type="checkbox"/> Making construction blocks <input type="checkbox"/> <input type="checkbox"/> Colored composition for concrete <input type="checkbox"/> <input type="checkbox"/> Making heavy clay product and red mud bricks. 4 Lime Sludge <input type="checkbox"/> <input type="checkbox"/> For recycling in parent industry <input type="checkbox"/> <input type="checkbox"/> Manufacture of building lime <input type="checkbox"/> <input type="checkbox"/> Manufactured of masonry cement <input type="checkbox"/> <input type="checkbox"/> Manufacture of lime pozzolana bricks/ binders	1M each any four
ii) Explain Biomedical waste management and handling Rule 1998.	4M
<p>The ministry of environment and forests notified the bio medical waste rules, 1998 in July 1998. In accordance with these rules following provisions are made</p> <ul style="list-style-type: none"> ➤ It is the duty of every occupier i.e. a person who has the control over the institution or its premises, to take all steps to ensure that waste generated is handled without any adverse effect to human health and environment. ➤ The hospitals, nursing homes, clinics, dispensaries, pathological laboratories etc. are therefore required to set in places the biomedical waste disposal & treatment facilities as per schedule V & VI respectively. ➤ Segregation, packaging, transportation and storage of BMW according to schedule 1, Schedule 2 & 3, Schedule 4 respectively. ➤ For the effective BMW management the state government shall establish prescribed authority for granting authorization to concern occupier/operator; who are required to maintain the annual & accident records of the facility. 	1M each
Q.6. Attempt any FOUR of the following:	16M
a) Write short note on health aspect during handling and processing of solid waste.	4M
<p>Health aspects involved in handling and processing of solid waste:</p> <input type="checkbox"/> <input type="checkbox"/> There is potential risk to environment and health from improper handling of solid wastes. Direct health risks concern mainly the workers in this field, who need to be protected, as far as possible, from contact with waste. <input type="checkbox"/> <input type="checkbox"/> Traffic accidents can result from toxic spilled wastes. <input type="checkbox"/> <input type="checkbox"/> Air pollution can be caused from the inefficient burning of wastes, either in open air, or in plants that lack effective treatment facilities from the gaseous effluents. <input type="checkbox"/> <input type="checkbox"/> Uncontrolled hazardous wastes from industries mixing up with municipal wastes create potential risk to human health. <input type="checkbox"/> <input type="checkbox"/> The most obvious environmental damage caused by municipal solid wastes is aesthetic, the ugliness of street litter and degradation of urban environment and beauty of city. <input type="checkbox"/> <input type="checkbox"/> There is specific danger of concentration of heavy metals in the food chain, a problem that illustrates the relationship between municipal solid wastes and liquid industrial effluents containing heavy metals discharged to a drainage/ sewerage system and/ or open dumping sites of municipal solid wastes and the wastes discharged thereby maintains a vicious cycle.	1M for each

<p><input type="checkbox"/> <input type="checkbox"/> Municipal Solid Wastes Management Systems involves various activities like storage, collection, transportation, disposal etc. These activities even if properly controlled and with proper precautionary measures adopted, may have adverse impact on land, water and air environment, human and environmental health aesthetics and quality of life.</p> <p><input type="checkbox"/> <input type="checkbox"/> The main risk to health is indirect and arises from the breeding of disease vectors, primarily flies and rats.</p>	
<p>b) Describe health problems during time of segregation of solid waste.</p>	<p>4M</p>
<p>Health problem during the time of segregation</p> <ol style="list-style-type: none"> 1. Workers and rag pickers can be infected during picking of biodegradable and Non biodegradable waste. 2. If biodegradable and non biodegradables or wet and dry wastes are not put separately, it can creates bad odour. 3. Possible health hazard include raised level of infant mortality, non communicable disease such as hand/leg injury by sharp edge material, respirational infections, eye infection,. 4. Comunicable diseases such as Diarrhoea & dysentery(due to flies), skin disease 	<p>1M each</p>
<p>c) State any four benefits of recycling of solid waste.</p>	<p>4M</p>
<p><input type="checkbox"/> <input type="checkbox"/> Reduces the amount of waste sent to landfills and incinerators.</p> <p><input type="checkbox"/> <input type="checkbox"/> Conserves natural resources such as timber, water and minerals.</p> <p><input type="checkbox"/> <input type="checkbox"/> Saves energy.</p> <p><input type="checkbox"/> <input type="checkbox"/> Prevents pollution by reducing the need to collect new raw materials.</p> <p><input type="checkbox"/> <input type="checkbox"/> Reduces the environmental degradation.</p> <p><input type="checkbox"/> <input type="checkbox"/> Reduce greenhouse gas emissions that contribute to global climate change.</p>	<p>1M each any four</p>
<p>d) Describe the process of recycling.</p>	<p>4M</p>
<p>➤ Recycling is the process of recovering and reusing waste product from household use, manufacturing, agriculture and business and thereby reducing their burden on the environment.</p> <p>➤ Recycling is the process of collecting used materials, commonly known as waste and creating new products to prevent the waste of potentially useful materials.</p> <p>➤ Recycling is the process of collecting and processing materials that would otherwise be thrown away as trash and turning them into new products. Recycling can benefit your community and the environment.</p> <p style="text-align: center;">Collection ⇌ Sorting ⇌ Processing ⇌ New Product</p> <p>(Note: Student may write any appropriate explanation so credit may be given accordingly)</p>	<p>4M</p>

e) State the purpose of recycling of solid waste.	4M
<ul style="list-style-type: none"> ➤ To Make Environment Clean ➤ Conservation of Materials ➤ To Save Energy ➤ Reduce Garbage in Landfills ➤ Reduce the pollution. 	1M each any four
f) State the importance of mass education in solid waste management.	4M
<p>The mass education in SWM is very important because of following points:</p> <ol style="list-style-type: none"> 1. To increase the awareness of solid waste management among the people. 2. To increase the efficiency and effectiveness of planning process and implementation of solid waste management. 3. To understand the planning, importance and significance. 4. To play an important role in the permitting process in case of hazardous waste as well as municipal waste facilities. 5. To improve the waste management strategies, negotiations with municipal authorities for better involvement in decision making. 6. To achieve the 3R principles. 7. To reduce littering of waste on streets and into drains, open spaces, etc. 8. To encourage and assists the local composting and recycling initiatives. 	1M each any four