Important Instruction to Examiners:-

1) The answers should be examined by key words & not as word to word as given in the model answers scheme.

2) The model answers & answers written by the candidate may vary but the examiner may try to access the understanding level of the candidate.

3) The language errors such as grammatical, spelling errors should not be given more importance.

4) While assessing figures, examiners, may give credit for principle components indicated in the figure.

5) The figures drawn by candidate & model answer may vary. The examiner may give credit for any equivalent figure drawn.

5) Credit may be given step wise for numerical problems. In some cases, the assumed contact 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 candidates understanding.

7) For programming language papers, credit may be given to any other programme based on equivalent concept.

Important notes to examiner

1) There is alternate solution is provided for Q-3(a). The examiner may give credit according to that.

SUMMER – 15 EXAMINATIONS Model Answer- Solid Waste Management

Page No- 02/15

Q.NO	SOLUTION	MARKS
Q1. a)	Attempt <u>ANY SIX</u> of following: (06 x 02)	12
(i)	State physical characteristics of solid waste. Explain any one.	02
	Physical characteristics of solid waste: 1. Specific weight or weight of waste per unit volume. 2. Particle size and size distribution	½ each
	 3. Field capacity/percentage of moisture in wet solid. <u>Field capacity:</u> It is defined as total amount of moisture held in a waste matter under gravity. It is important as it controls the rate of leachate generation and permeability. (Note: Student may Wright any appropriate explanation so credit may be given accordingly.) 	½ for explanation
(ii)	Explain solid waste management hierarchy.	02
	Prevention Minimisation Reuse Recycle Recovery Disposal Most favoured Least favoured	1 for neat labeled sketch
	 Solid waste management hierarchy The main aim of waste hierarchy is to generate minimum amount of waste and obtain maximum benefits from products. Following are the various stages in SWM Hierarchy: <u>Prevention:</u> preventing the use of such raw material in production which produces maximum solid waste and selecting the alternative raw materials. <u>Minimization:</u> if such alternative raw materials are less possible then minimize the use of raw materials producing more waste by implementing different techniques. <u>Reuse:</u> it is the next desirable option in which materials some materials are repeatedly used again and again for same purpose. Recycle: In this stage collection, sorting of recyclable products is done and then they are manufactured into new products. 	¼ for each (Any four)
	 5. <u>Recovery:</u> in this stage the recoverable materials are processed which includes activities like recycling and composting. 6. <u>Disposal:</u> It is the last option and should be considered after all other possible actions to recover that waste matter. It may includes incineration, dumping. 	

Page No- 03/15

Q.NO	SOLUTION	MARKS
(iii)	State factors affecting selection of site for transfer station.	02
	 Factors affecting selection of site for transfer station: <u>Waste scattering/ Pollution</u>: It should be selected such that it should not create nuisance to nearby areas. <u>Haul distance</u>: It should be constructed at suitable locations so as to minimize the haul distance. <u>Electricity</u>: Electricity should be available. It should be away from heritage place. 	1 marks each
(iv)	State organizational setup of Solid waste Management (SWM) administration for city having population between 5-10 lacs.	02
	Legislative body Ministry of environment and forest Central pollution control board State government State pollution control board State pollution control board Private formal sector Private formal sector Private informal sector	2 for neat labeled sketch
(v)	Define biomedical waste. State components of Biomedical Waste (BMW).	02
	<u>Biomedical waste:</u> "The waste generated by hospitals, nursing or maternity homes, clinics, dispensary, veterinary institutions, pathological laboratory, blood banks which is potentially infectious to human health and the environment is called as Biomedical waste."	1
	Components of Biomedical Waste:1. Sharps: needles, broken glass, blades, razors etc.2. Plastic waste: IV sets, tubing, blood & urine bags, syringes.3. Infectious waste: soiled bandages, dressings, pathological tissues.4. Cytotoxic waste5. Chemical waste	¼ each (Any four)

SUMMER – 15 EXAMINATIONS

Subject Co	ode: 17605 <u>Model Answer-</u> Solid Waste Management	Page No- 4/15
Q.NO	SOLUTION	MARKS
(vi)	Enlist sources of Biomedical waste	02
	Following are the sources of Biomedical waste:	
	1. Waste generated by Hospitals	
	2. Waste generated by nursing homes	
	3. Waste generated by clinics	½ marks
	4. Waste generated by pharmacies	each
	5. Waste generated by pathological laboratory	(Any four)
	6. Waste generated by blood banks	
	7. Waste generated by medical research laboratory.	

	7. Waste generated by medical research laboratory.		
	8. Waste generated by funeral homes etc.		
(vii)	Define communicable and non-communicable diseases.	02	
	<u>Communicable diseases:</u> The diseases that spread from one person to another through	1	
	airborne bacteria or viruses or through direct contact with infected person.	T	
	Non-communicable diseases: The diseases that cannot transmitted from infected person	1	
	to other person through air, water or direct contact and hence are non infectious.		
(viii)	Explain sorting at source and (MSW) Municipal Solid Waste.	02	
	Sorting at Source: It is the most efficient technique that reduces the mixing of various		
	biodegradable and non biodegradable wastes together. In this process different types of		
	wastes are stored in different containers like plastic waste, biodegradable waste, E-	1	
	waste, Glass, Paper, etc. Based on the nature of waste collected appropriate treatment is	T	
	given, which automatically reduces the time and cost of treatment.		
	Municipal Solid Waste: It is the waste collected from various sources like household,	1	
	institutions, commercial centers, etc. and then taken to the nearest transfer stations,	1	
	which after transferred to Municipal Solid Waste Plants by hauling vehicles for further		
	treatment.		
b)	Attempt any TWO of the following: $(04 \times 02 = 08)$	08	
(i)	State the factors affecting generation of MSW	04	
	Factors affecting generation of MSW:		
	1. Living standard		
	2. Rate of generation of waste	1 each	
	3. Population growth	(Any four	
	4. Improper guidance	(Ally Iour	
	5. Lack of awareness		
	6. Industrialization growth etc.		
(ii)	Define transfer station. State necessity of transfer station.	04	
	Transfer station: 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	1	
	to these stations.		
	Necessity of transfer stations: Transfer stations are necessary due to following reasons		
	1. They prevent the scattering of MSW.	1 each	
	2. To have ease in proper storage and collection of MSW from different locations.	(Any 3)	
	3. To prevent nuisance due to scattered solid waste to nearby area.	(· ··· ; 3)	

4. To reduce the haul distance.

Page No- 5/15

Q.NO	SOLUTION	MARKS
(iii)	State biomedical waste rules having six schedules and their content	04
	Rules for BMW:	
	1. Rules for duty of occupier.	
	2. Rules for treatment and disposal.	
	3. Rules for segregation, packaging, transportation and storage.	
	4. Rules for prescribed authority.	½ each
	5. Rules for authorization.	(Any 8)
	6. Rules for advisory committee.	
	7. Rules for annual report.	
	8. Rules for maintenance of records.	
	9. Rules for accident reporting.	
	10. Rules for appeal.etc	
Q.02	Attempt <u>ANY FOUR</u> of the following: (04 x 04 = 16)	16
a)	State factors affecting composting process. Explain any one factor.	04
	Factors affecting composting process:	
	1. Particle size	
	2. Moisture content	½ for each
	3. pH	(Any Four)
	4. Temperature	
	5. Carbon Nitrogen ratio	
	6. Blending and seeding7. Air circulation	
	Blending and seeding: It is required to maintain the moisture content and to accelerate	
	biological decomposition of waste and hence affect the rate of composting.	2 for
	Proper timing should be followed for blending and seeding.	explanation
	(Note: Student may Wright any appropriate explanation for <u>Any factor</u> so credit	
	may be given accordingly.)	
b)	State the factors affecting selection of site for land filling of solid waste.	04
~,	Factors affecting selection of site for land filling of solid waste:	
	1. Site should be easily approachable.	
	2. It should be located away from community area.	
	3. Sufficient quantity of soil should be available nearby site.	
	4. Waterlogged and flood prone areas should be avoided.	1 each
	5. Local climate should be considered while selecting site for land filling.	(Any four)
	6. Ground water should be very deep; it should not be less than 5m.	
	(Note: Student may Wright any appropriate explanation for <u>Any factor</u> so	
	credit may be given accordingly.)	
c)	Explain use and byproduct of incineration method of solid waste (SW).	04
	Use and byproduct of incineration method of solid waste:	
	1. After the incineration process the left out products can be used as aggregate for	
	preparation of low grade concrete or even sometimes it can also be used as	
	road metal.	
	2. The incineration ash is used for making bricks or block manufacturing.	1 each
	3. Also the steam generated during incineration can be used for electricity	
	generation by running the turbines.	
	4. The products of incineration can also be used as filler material.	
	(Note: Student may Wright any appropriate explanation for <u>Any factor</u> so credit may be	
	given accordingly.)	

Q.NO	SOLUTION	MARKS		
d)				
	 Following are the various methods of collection and segregation of BWM in colour coded bags or containers: Yellow bags: All the infectious wastes are collected into these bags. It may include soiled bandage, cotton or any other thing which is infected. The waste from these bags is treated by incineration only. Red bags: All the plastic wastes such as injections, syringes, I. V. tubing, Bottles are collected into these bags. They are treated by incineration only. Blue bags: It consists of all the types of glass bottles and broken glass articles. It is classified as hazardous waste and treated by incineration only. Black carboy: All sharps of metal are collected into these bags like blades, needles without syringes, etc. Purple container: It consists of Cytotoxic and cytostatic wastes, clinical waste. It is hazardous waste and has to be treated by incineration only. Yellow and Black containers: It consists of offensive but hygiene waste from health centers. It's non hazardous and can be treated by incineration, landfill. Black containers: It consists of domestic waste mixed with municipal waste which is classified as non hazardous waste. 			
	spent and expired capsules.	04		
e)	Discuss importance of public involvement and participation in SWMPublic involvement and participation in SWM is very important because of following			
	 To increase the awareness of solid waste management among the people. To increase the efficiency and effectiveness of planning process and implementation of solid waste management. To understand the planning importance and significance. To play an important role in the permitting process in case of hazardous waste as well as municipal waste facilities. To improve the waste management strategies, negotiations with municipal authorities for better involvement in decision making. To achieve the 3R principles. To encourage and assists the local composting and recycling initiatives. 	1 each (Any four)		
f)	State steps in recycling of solid waste. Explain <u>any one</u> method.			
	Steps in recycling of solid waste: 1. Collection of recyclables. 2. Sorting 3. Manufacturing 4. Purchasing the Recycled products.	2		
	<u>Collection of recyclables:</u> There are number of systems implemented to collect the recyclables from the genera waste stream. There are four methods of collecting the recyclables like 1. Drop out centers, 2.Buy back centers, 3. Curbside collection and 4. Single stream collection. In drop out centers, the producers are required to carry recyclables to the centers.	2		

Q.NO		SOLU	JTION	1	MARKS
-	In Buy back centers, the clean recyclables are purchased thus providing a clear incentive for use and creating a stable supply. In curbside collection method bins are placed at curbside for collection. In Single stream collection, all recyclable materials are placed in a single bin for collection and sorting which is handled later at a central facility.				
Q-3	Attempt <u>ANY TWO</u> of the following: $(08x 02 = 16)$				
a)	Comp materi (occur accur ii) Di	nciples of composting of Solid Was osting is the biological decompositio al by bacteria, fungi, worms and othe ring in the presence of oxygen) cond nulation of partially decayed organic fferentiate between Indore and Banga	n of o er orga itions matter alore r	anisms under controlled aerobic . The end result of composting is an called humus. nethod with sketch.	2 Marks
	No.	Bangalore method	No	Indore method	
	1	The Bangalore method functions aerobically for several days and then becomes anaerobic, because no turning occurs.	1	The Indore composting system relies on aerobic activity although portions of the pile or pit will likely become anaerobic between turnings.	1 Marks for Each Point (Any Six)
	2	Fly breeding and odor problems are often associated with this method	2	This method has better fly control.	
	3	Slow method	3	more rapid	
	4	Non-uniform decomposition	4	uniform decomposition	
	5	After 4 to 5 months the composting process is complete.	5	During the period of active composting the contents are turned from 1-5 times over a period of 16 months.	
	6	More labor intensive method.	6	Less labor intensive method.	
	7	moisture control problems	7	less moisture control problems	
a)	A A A	ore method Indore method layers of vegetable a trench, the depth of pile is 1.5-2m a ground form a mound called windro Normally windrows are conical in s The aeration is achieved by periodic	R and nig and wi bw. shape a cally t anical	ght soil is alternative piled into dths is about 3-8m or above the and about 50m in length. urning the piles. Manual turning is turning is adopted for larger plants.	4 Marks

Q .NO	SOLUTION	MARKS
	 Turning continued for about 4-5 weeks during which biodegradable organic are consumed. The solid waste is allowed to keep for 2-8 weeks with turning the composting in windrow may take 21-28 days for stabilization. The composted waste is removed from windrow and allowed to mature in maturing yards for 1-3 months, after which the compost becomes ready for being taken out for use. 	
	 II) Bangalore method Bangalore method is commonly used anaerobic method used for biological used anaerobic method used for biological conversion of organic component of municipal solid waste. In this method underground earthen trench is excavated and alternate layer of waste and soil is filled in trench or pit to control odour.final layer of soil is provide at top. The soil cover not only prevent odour but also prevents breeding of files. Within 2-3 days of burial intensive biological action starts taking place and organic matter beings to be destroyed. After 4-5 months complete stabilization of waste takes placed. During biological action head is evolved which rises temperature of decomposing mass. 	4 Marks
b)	 i) Definition Leachate is any liquid that in passing through matter, extracts solutes, suspended solids or any other component of the material through which it has passed. ii) Effect of Leachate Problems including clogging with mud or silt. growth of micro-organisms in the conduit The chemical composition of leachate can weaken pipe walls, which may then fail. The percolation of leachate will cause the soil pollution Lechate will also contaminate the shallow ground water source in rainy 	2 Marks 3 Marks (Any Three)
с)	 season. It affect the DO Content water which is harmful for aquatic life It will leads to the growth of waterborne diseases. iii)Control measures. Leachate is carefully collected and shall be treated before its release on ground if possible. Prevention of migration of leachate from landfill sides and landfill base to the sub-soil by a suitable liner system should be provided. used leachate treatment methods like Natural system, Biological treatment Physicochemical treatment i) Principles of Pyrolysis 	3 Marks (Any Three)
	Pyrolysis is the one of the most common methods in thermal conversion technology of biomass. In Pyrolysis, biomass is heated to moderate temperatures, 400-600°C, In the absence of oxygen to produce oil. In gasification, biomass is heated to high temperatures, >700°C, to produce a synthesis gas(H2 and CO), which can be converted in a catalytic step to liquid transportation fuels.	2 Marks

Q.NO	SOLUTION			MARKS		
-	ii) Merits of P			3 Marks		
	Reduces greenhouse gas emissions and waste going to landfill					
		uces a marketable product like gases, a b	io-oil, bio-chemicals,	for Each)		
	and charcoal.					
		risk of water pollution.				
	Low risk of odors.					
	High recovery rate of resources.					
		mal risk of health consequences.				
	iii) Demerits o	mercially proven technology.				
		capacity.				
		efficiency.		3 Marks		
		e expensive		(1 Mark		
		nology is still evolving		for Each)		
		tets are yet to be developed for char prod	uct and pyrolysis liquids			
		tets are yet to be developed for enal prod	act and pyrorysis inquitas			
Q.4 a)	Attempt ANY	TWO of the following: $(08x 02 = 16)$		1 Marks		
				each for		
	Classification	of biomedical waste in tabular for with	h their treatment and disposal.	any 8		
	Category	Waste Type	Treatment and Disposal	points		
	Category-1	Human Anatomical waste(Tissues,	Incineration/Deep Burial			
		Body Part, organs)				
	Category-2	Animal waste	Incineration/Deep Burial			
	Category-3	Microbiology and Biotechnology	Incineration/Microwave			
		waste	/Autoclaving			
		Waste				
	Category-4	Sharps	Disinfection/Microwaving			
			/Autoclaving/Shredding			
	Category-5	Discarded medicine and cytotoxic	Incineration/destruction and			
		Drugs	drugs disposal in land fill			
	Category-6	Contaminated solid waste	Incineration/Microwave			
		Containinated Solid Waste	/Autoclaving			
	Category-7	Solid waste (other items than sharps)	e			
	Category-/	Sond waste (other nems than sharps)	Disinfection/Microwaving			
			/Autoclaving/Shredding			
	Category-8	Liquid waste(generated from	Disinfection and discharge in			
		laboratory washing, cleaning and	to Drains.			
		housekeeping and disinfecting				
		activates				
	Category-9	Incineration Ash	Disposal in municipal landfill			
	Category-10	Chemical Waste	Disinfection and discharge in			
			C			
			to Drains and secured landfill for solid.			

 a of e-waste on human health and environment b cts of e-waste on human health Beryllium causing human carcinogens Cadmium causing damage to kidney and bones. Lead Damage to nervous system Mercury Damage to central nervous system Polychlorinated biphenyls liver damage and cancer promotion and damage to reproductive system. etc b cts of e-waste on environment Pollution of ground water Air Pollution Acidification of soil E-Waste account for 40% lead and 75% metal in land fills etc Optimization of resources : waste reduction at individual and institutional level	4 Marks (1 Mark for Each) 2 Marks each (for
Beryllium causing human carcinogens Cadmium causing damage to kidney and bones. Lead Damage to nervous system Mercury Damage to central nervous system Polychlorinated biphenyls liver damage and cancer promotion and damage to reproductive system. etc ects of e-waste on environment Pollution of ground water Air Pollution Acidification of soil E-Waste account for 40% lead and 75% metal in land fills etc minimization approach for treating industrial solid waste. Optimization of resources: waste reduction at individual and institutional level	for Each) 4 Marks (1 Mark for Each) 2 Marks each (for
Beryllium causing human carcinogens Cadmium causing damage to kidney and bones. Lead Damage to nervous system Mercury Damage to central nervous system Polychlorinated biphenyls liver damage and cancer promotion and damage to reproductive system. etc ects of e-waste on environment Pollution of ground water Air Pollution Acidification of soil E-Waste account for 40% lead and 75% metal in land fills etc minimization approach for treating industrial solid waste. Optimization of resources: waste reduction at individual and institutional level	4 Marks (1 Mark for Each) 2 Marks each (for
Cadmium causing damage to kidney and bones. Lead Damage to nervous system Mercury Damage to central nervous system Polychlorinated biphenyls liver damage and cancer promotion and damage to reproductive system. etc ects of e-waste on environment Pollution of ground water Air Pollution Acidification of soil E-Waste account for 40% lead and 75% metal in land fills etc minimization approach for treating industrial solid waste. Optimization of resources: waste reduction at individual and institutional level	4 Marks (1 Mark for Each) 2 Marks each (for
Lead Damage to nervous system Mercury Damage to central nervous system Polychlorinated biphenyls liver damage and cancer promotion and damage to reproductive system. etc ects of e-waste on environment Pollution of ground water Air Pollution Acidification of soil E-Waste account for 40% lead and 75% metal in land fills etc minimization approach for treating industrial solid waste. Optimization of resources: waste reduction at individual and institutional level	4 Marks (1 Mark for Each) 2 Marks each (for
Mercury Damage to central nervous system Polychlorinated biphenyls liver damage and cancer promotion and damage to reproductive system. etc ects of e-waste on environment Pollution of ground water Air Pollution Acidification of soil E-Waste account for 40% lead and 75% metal in land fills etc minimization approach for treating industrial solid waste. Optimization of resources: waste reduction at individual and institutional level	4 Marks (1 Mark for Each) 2 Marks each (for
Polychlorinated biphenyls liver damage and cancer promotion and damage to reproductive system. etc ects of e-waste on environment Pollution of ground water Air Pollution Acidification of soil E-Waste account for 40% lead and 75% metal in land fills etc minimization approach for treating industrial solid waste. Optimization of resources: waste reduction at individual and institutional level	4 Marks (1 Mark for Each) 2 Marks each (for
reproductive system. etc ects of e-waste on environment Pollution of ground water Air Pollution Acidification of soil E-Waste account for 40% lead and 75% metal in land fills etc minimization approach for treating industrial solid waste. Optimization of resources: waste reduction at individual and institutional level	4 Marks (1 Mark for Each) 2 Marks each (for
Acts of e-waste on environmentPollution of ground waterAir PollutionAcidification of soilE-Waste account for 40% lead and 75% metal in land fills etcminimization approach for treating industrial solid waste.Optimization of resources: waste reduction at individual and institutional level	(1 Mark for Each) 2 Marks each (for
Pollution of ground water Air Pollution Acidification of soil E-Waste account for 40% lead and 75% metal in land fills etc minimization approach for treating industrial solid waste. Optimization of resources : waste reduction at individual and institutional level	(1 Mark for Each) 2 Marks each (for
Air Pollution Acidification of soil E-Waste account for 40% lead and 75% metal in land fills etc minimization approach for treating industrial solid waste. Optimization of resources: waste reduction at individual and institutional level	for Each) 2 Marks each (for
Acidification of soil E-Waste account for 40% lead and 75% metal in land fills etc minimization approach for treating industrial solid waste. Optimization of resources: waste reduction at individual and institutional level	2 Marks each (for
E-Waste account for 40% lead and 75% metal in land fills etc minimization approach for treating industrial solid waste. Optimization of resources: waste reduction at individual and institutional level	each (for
minimization approach for treating industrial solid waste. Optimization of resources: waste reduction at individual and institutional level	each (for
Optimization of resources : waste reduction at individual and institutional level	each (for
Optimization of resources : waste reduction at individual and institutional level	each (for
•	
•	
	-
goes side by side with the utilization of raw materials.	points)
Using again the Scrap Material: this is the process in which individual and	
industry reuse the waste material as soon as it is produced. This keeps it from	L
becoming a waste material.	
Quality control improvement and process monitoring: this technique is to	
ensure that products produced are kept from rejection and this is increased by the	:
inspection of frequency and monitoring point's inspection.	
Exchanging Waste: this is the technique in which the waste product, which	
comes out of a process, becomes a raw material for another process. This is	1
another way for reducing waste.	
Point of use from ship: to maintain and making deliveries for the raw materials	•
to be used with the manufacturing process, at the point of assembly with fewer	•
packages and wrappings can save from the waste production.	
Zero waste: this is a whole systems approach that aims to eliminate waste at the	;
source and at all points down the supply chain, with the intention of producing	
no waste. It is a design philosophy which emphasizes waste prevention as	i e
opposed to end of pipe waste management.	
ot <u>ANY FOUR</u> of the following: (04 x 04 = 16)	
ources of solid waste and types of solid waste	2 Marks
	(1/2 mark)
es of solid waste:	for each
Residential	write any
Residential Commercial	four
Residential Commercial Institutional	points
Residential Commercial Institutional Construction and Demolition	
Residential Commercial Institutional Construction and Demolition Municipal Services	
Residential Commercial Institutional Construction and Demolition	
Residential Commercial Institutional Construction and Demolition Municipal Services	
	Institutional Construction and Demolition Municipal Services

Q.NO	SOLUTION	MARKS
	Types of solid waste:	2 Marks
	Municipal Waste	(1/2
	Hazardous Waste	marks for
	Biomedical Waste	each
	Electronic Waste	write any
		four
		points
b	Explain four characteristics of hazardous waste.	4 Marks
	1.Ignitability - Ignitable wastes create fires under certain conditions or are	(1 Marks
	Spontaneously combustible, or have a flash point less than 60 °C (140 °F).	each)
	2. Corrosivity - Corrosive wastes are acids or bases (pH less than or equal to 2 or	
	greater than or equal to 12.5) that are capable of corroding metal containers, such as	
	storage tanks, drums, and barrels.	
	3. Reactivity - Reactive wastes are unstable under "normal" conditions. They can	
	cause explosions, toxic fumes, gases, or vapors when mixed with water.	
	4. Toxicity - Toxic wastes are harmful or fatal when ingested or absorbed (e.g.,	
	containing mercury, lead, etc.). When toxic wastes are disposed of on land, contaminated liquid may drain (leach) from the waste and pollute ground water.	
	Toxicity is defined through a laboratory procedure called the Toxicity Characteristic	
	Leaching Procedure.	
	Leaching Trocedure.	
с	Explain issues regarding transportation of solid waste.	4 Marks
	 Compactors and properly covered dump trucks were to be utilized to transport the waster 	
	to the landfill site.	
	Separate vehicles were to be employed for transportation of biodegradable waste and	
	mixed recyclable waste.	
	Compactor loaders directly lift the bin, unload the waste and replace it in the original position.	
	 Choice of vehicle depends on the access roads to individual sites. 	
	Dump trucks are fitted with hydraulic equipments which enable them to unload waste without	
	the help of manual labour.	
	(Note: Student may Wright any appropriate explanation so credit	
	may be given accordingly.)	
d	Enlist tools and equipment for collection and transportation of a solid waste.	1/2
	1. Litter bin	Marks
	2. Broom	For Each
	3. Shovels	write any
	4. Handcarts	8 point
	5. Animal carts	
	6. Tractors and Trailers	
	7. Auto vehicle	
	8. Trucks.	
	9. Dumper	
	10. Compactors vehicles.	

Q.NO	SOLUTION	MARKS
е	As a civil engineer how will you promote four R (4R) principle of SWM.	4 Marks
	1. Reduction: Waste reduction can be achieved in three ways: i) reducing the	(1 Mark
	amount of material used per product without sacrificing the utility of that	each
	product. ii) Increase lifetime of a product. iii) Eliminating the need of the	point)
	product.	
	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	
	2. Reuse: Reuse corrugated moving boxes internally.	
	Encourage employees to reuse office materials rather than purchase new ones.	
	3. Recycle: Recycling turns the material that would otherwise become waste into	
	valuable resources and generates a combination of environmental, financial and social benefits.	
	After collection of these materials (eg. Glass, metal, plastics, paper etc.) are	
	separated and sent to facilitates that can process them into new products and	
	materials.	
	4. Recovery: Recovery of solid waste means recovering material from solid waste	
	to useful purposes. Composting is a way to return nutrient back into the environment by	
	allowing micro organisms to turn the waste into manure.	
f	Explain resource recovery through solid waste processing.	4 Marks
	Biological and thermal treatment of waste can result in recovery of useful product such	
	as energy or compost.	
	Biological Processes: In this treatment involves using micro-organisms to decompose	
	the biodegradable components of waste.	
	Two types of process are use:	
	i) Aerobic processes: Windrow composting, aerated static pile composting and	
	in vessel composting, vermiculture etc. Utilizable product is compost.	
	ii) Anaerobic processes: Low solids anaerobic digestion, high solids anaerobic	
	digestion. Utilizable product is methane gas.	
	In India, aerobic composting plants have been used to process up to 500 tons per day of	
	waste.	
	Thermal processes: Thermal treatment involves conversion of waste into gaseous, solids	
	and liquid conversion products with subsequent release of heat energy.	
	Three types of systems are as follows:	
	i) Combustion systems: Thermal processing with excess amounts of air.	
	ii) Pyrolysis systems: Thermal processing in complete absences of oxygen.	
	iii) Gasification systems: Thermal processing with less amounts of air.	
	Note-: (Resource recovering is nothing but recycling practice so if student	
	write about recycling appropriate credit may be given accordingly.)	

Q.NO	SOLUTION	MARKS
Q.6 a)	Attempt <u>ANY FOUR</u> of the following: (04 x 04 = 16)	4 Marks
		(1 Mark
		for each)
	Explain proximate analysis of solid waste.	
	Determination of fixed carbon, volatile combustible matter, moisture and ash content of	
	the Waste in order to estimate its capability as a fuel.	
	-The fixed carbon, volatile combustible matter can be burnt while moisture and ash not.	
	The Vaporization of the moisture consumes heat.	
	Method of analysis (tests):	
	1. Moisture: Determination from the loss of weight by heating at 105 °C for one hour.	
	2. Volatile combustible matter: the additional loss of weight after ignition at 950 °C in a	
	Covered crucible (O2 is excluded).	
	3. Fixed carbon: combustible residue after the volatile combustible matter is removed;	
	ignition At 600 to 900 °C.	
	4. Ash: the weight of residue after combustion in an open crucible.	
	% fixed carbon=100 %-% moisture -% ash-% volatile matter	
	It does not provide any information of possible pollutants emitted during combustion.	
	These data are determined by ultimate analysis.	
b	Described impact of solid waste on human health and environment	2 Marks
	Impacts of solid waste on health	(1/2
	Low birth weight	marks for
	> Cancer	each
	Neurological disease	write any
	Increase in mercury level in fish due to disposal of mercury in the rivers. This is	four
	Harmful for human health.	points
	 Chemical poisoning through chemical inhalation. 	2 M 1
	Nausea and vomiting In arrange in homitalization of dishetic resident living near wests site	2 Marks $(1/2)$
	Increase in hospitalization of diabetic resident living near waste site	(1/2 marks for
	 Impacts of solid waste on Environment. ➤ Waste breaks down in landfills to form methane, which causes greenhouse gas. 	each
	 Change in climate and destruction of ozone layer due to waste biodegradable 	
	Due to waste pollutions, illegal dumping, Leaching: is a process by which solid waste	write any four
	enter soil and ground water and contaminating them	points
	enter son and ground water and containinating them	points
С	Explain present scenario of collection of MSW.	4 Marks
	 No bins for storage of domestic, trade or institutional waste are kept at source. 	i i i i i i i i i i i i i i i i i i i
	Very few people keep personal bins for storage of waste. The percentage of	
	these people is very insignificant.	
	 Most of the situations domestic waste as well as waste from shops, offices and 	
	establishment including hospitals, nursing homes, hotels, restaurants, garden etc.	
	come on the street or is disposed of open plot or even discharge in the drains. Its	
	result is clogging of drains, pollution of water resources and increasing	
	insanitary condition in urban areas.	
	> Hence there is no practice of storing the waste at sources in scientifically	
	segrated way.	
	 Citizens have not been educated to keep domestic, trade and institutional bins for 	
	storage of waste at source.	
	(Note: Student may Wright any appropriate explanation so credit may be given accordingly.)	

Q.NO	SOLUTION	MARKS
d	 State role of mass education in SWM. Advertisement may be given in a planned manner to educate the masses and local newspapers can also be requested to insert the given messages on SWM at regular intervals. Slides in cinema theaters can be displayed to inform and motivate the public. Use of TV/ Cable TV/ Radio/ Websites this is very powerful medium and can be used through local programs to inform the citizen about new waste collection arrangement by local bodies. Attractive posters with good photographs and messages with a very few words, should be prepared and displayed in various parts of the city. Newspapers may be especially encouraged to give coverage to successful initiatives that have overcome SWM problems. (Note: Student may Wright any appropriate explanation so credit may be given accordingly.) 	4 Marks
e	 Explain storage methods of Garden waste and construction Demolition waste. I) Storage methods of Garden waste Private garden should as far as possible compost all plant on site. Where it is not possible to dispose of garden waste within the premises and the waste is required to be disposed of outside the premises, it shall be stored in large bags or bins on site and transferred into a municipal waste. Waste should be stored in the premises and kept ready for handling over to the municipal authority. Garden waste and fallen leaves from avenue trees within large public parks and gardens should be composted to the extent possible. If such waste has disposed of, large containers may be kept, which match with the municipal transportation system for transportation of such waste. II) Construction demolition waste: Construction waste shall be stored only within the premises of building or in container. If storage facility is not available on premises, such waste producers shall take prior permission of local authority as may be applicable for temporary storage of such waste, may stored such waste in such a way that it does not hamper the traffic, the waste does not get spread on the road and does not block the surface drains or water drains. Provide container on rent for storage and transportation of construction and demolition waste. 	2 Marks
f	 Described present status of recycling of solid waste in India. ➢ In India, there is no formal recycling system but informal recyclers are there and play an important role in SWM. Recycling by means of repair, reprocessing, and reuse of waste materials is a common practice in India. ➢ These comprise of unorganized and unrecognized establishments which are difficult to be monitored by governmental agencies. However resource recovery through material recycling is taking place in India in a big way, through unorganized ways. 	4 Marks

Q.NO	SOLUTION	MARKS
	Material recycling is done through sorting of waste into different streams at	
	source or at a centralized facility. At present recycling of dry recyclables does	
	take place at the household level in India.	
	Waste is accessible to waste pickers; they segregate it into saleable materials such as paper, plastics, glasses, metal pieces, textile, etc.	
	Pickers segregate the wastes directly from the dumps and bins with no precautions and they are exposed directly to harmful wastes.	
	The separated waste is sold to a small waste dealer, from where the waste is transferred to a medium sized dealer or wholesaler.	
	All these activities are not regulated or monitored by any governmental organisation. Due to this informal segregation, volume reduction is achieved, while it ignores social, economic, environmental, and health aspects.	
	(Note: Student may Wright any appropriate explanation so credit may be given accordingly.)	