MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

SEMESTER B.TECH. END SEMESTER EXAMINATIONS NOVEMBER 2019

SUBJECT: SOLID WASTE MANAGEMENT [BIO4004]

Date of Exam: 28th November '19 Time of Exam: 2-5 pm. Max. Marks: **50**

Instructions to Candidates:

❖ Answer ALL the questions& missing data may be suitable assumed

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1A.	Illustrate the interrelationships between material flows and waste generation and point out the significance of knowing this interrelationship.	3
1B.	Discuss the factors that cause variability in waste sampling.	2
1C.	(table below) Determine the chemical composition of the organic fraction of the municipal solid waste (MSW) as per the table, with and without sulfur and with and without water.	5

Component	Wet weight, lb	%Moisture content	Typical data on ultimate analysis Percent by weight (dry basis)					
			C	H	O	N	S	Ash
Food wastes	10	80	48	6.4	37.6	2.6	0.4	5
Paper	28	6	43.5	6	44	0.3	0.2	6
Textiles	1	7	55	6.6	31.2	4.6	0.15	2.5
Leather	1	15	60	8	11.6	10	0.4	10
Wood	3	17	49.5	6	42.7	0.2	0.1	1.5

2A.	(table below) Assume the following values for a landfill having a compaction of 1200 lb/yd³. Estimate the percent volume reduction due to compaction.	4

Components	Percentage (by weight)	Uncompacted bulk density (lb/ft³)
A	45	4
B	20	4.5
C	20	19

2B.	Determine the intrinsic permeability of a landfill site, given that the coefficient of permeability, dynamic viscosity of water and specific weight of water are 2.43×10^{-4} m/s, 8.90×10^{-4} Pa.s and 62.4 lb/ft³ respectively.	2
2C.	Explain the parameters which are considered while estimating the chemical properties of MSW evaluating the alternate processing and recovery options.	4
3A.	Enlist the properties used to classify hazardous wastes.	2
3B.	Describe the different strategies employed to handle household hazardous wastes.	3
3C.	A 20 g of chemically treated waste from a hospital is combusted in a calorimeter, having a heat capacity of 8800 cal/°C. The temperature increase on combustion is 3°C. Calculate the heat value of the sample.	2
3D.	The first order removal constants for two industrial solvents are 0.07/hr and 3×10^{-5} /hr. Comment on the issues that will arise during the disposal of these two solvents and the significance of evaluating the half-life of hazardous wastes.	3
4A.	A waste disposal center receives 15 tons of harvest material, 4.5 tons of metal scrap, 1 ton of cardboard boxes, and 0.5 tons of miscellaneous materials, on any given day. For the 15 tons of harvest material, 12 tons become processed product, 2.2 tons end up as produce waste, which is fed to cattle, and the remainder is discharged with the wastewater from the plant. 3.5 tons of the metal scrap is stored for later use and the	5

	remainder is used for packaging. About 3 percent of the metal scrap used is damaged. Stored separately, the damaged metal scrap is recycled. The cardboard boxes are used for packaging the product, except for 3 percent that are damaged and subsequently separated for recycling. Of the miscellaneous materials, 25 percent is stored; 50 percent becomes waste paper, of which 35 percent is separated for recycling with the remainder being discharged as mixed waste; and 25 percent becomes a mixture of solid waste materials. Assume there is a daily collection for materials separated for recycling and disposal. Prepare a materials balance for the waste disposal center on this day and a materials flow diagram accounting for all of the materials.	3
4B.	Describe the factors that affect waste generation rates.	
4C.	Discuss the relationship between the type of collection vehicle and the container system employed in solid waste management (SWM) system.	2
5A.	Illustrate with proper labeling the elements involved in the construction of a sanitary landfill site.	4
5B.	Calculate the methane yield after anaerobic digestion of the following waste materials: a) $C_{106}H_{168}O_{34}N_{28}S$ b) $C_8H_{15}O$	3
5C.	Describe the different designs and configurations of anaerobic digestion systems.	3