

University of Asia Pacific
Department of Civil Engineering
Final Examination Spring 2012
Program: B. Sc. Engineering (Civil)

Course Title: Environmental Engineering III
 Time: 2 hour

Course Code: CE 431
 Full marks: 100

Answer any FOUR out of FIVE.
(Note: Assume any missing data)

1. (a) Briefly explain the stages of decomposition in a typical landfill. (7)
- (b) Write explanatory notes on the following: (9)
 - i) Incineration ii) Significance of Source Reduction iii) Street cleansing
- (c) Estimating the methane potential of discards. (9)
 Suppose "as delivered" MSW discards include 67.3 percent decomposable materials such as paper, yard trimmings, food waste and wood. Of that 32.3 percent is moisture. An elemental analysis of the dried decomposable components yields the following mass percentages:

Element	C	H	O	N	Other	Total
Dry mass (%)	44.17	5.91	42.50	0.73	6.69	100%

Find the chemical formula for the C, H, O, N portion of the decomposables. Also find the energy content of the methane that would be generated per kg of discards. The HHV (high heating value) of methane is 890 kJ/mol.

2. (a) Describe briefly the risks associated with poor management of solid waste. (7)
- (b) Explain the collection methods on the basis of mode of operation. (5)
- (c) Define the after-use of landfill sites. How do the migration of landfill gas can be controlled? (7)
- (d) Estimate the landfill area needed to handle one year's MSW for a town of 100,000 people. Assume per capita national average discards of 3 lbs per day, no combustion, a landfill density of 1,000 lb/yd³ and one 10-foot lift per year. Assume 20 % of the cell volume is soil used for cover. (6)
3. (a) Do you suggest ocean can be a place for dumping hazardous waste? Justify your answer. (5)
- (b) Explain the following terms. (any four) (14)
 - i) Health care waste management ii) Biogas aspect in Bangladesh iii) Material Recovery Facilities (MRF)
 - iv) Waste-to-energy v) Hazardous waste landfill

(c) A recent study on recycling at the Los Angeles International Airport(LAX) generates about 19,000 tons of solid waste per year (1.3 pounds per passenger). On the annual basis , LAX recycles 12 tons of aluminum; 2,021 tons of cardboard ; 527 tons of office paper, 89 tons of newspaper, 17 tons of glass and 921 tons of plastic. In addition, they compost 271 tons of food waste. (6)

- i. Find the equivalent greenhouse gas savings associated with these recycled and composted materials assuming they would have all gone to a landfill if they hadn't been recycled.
- ii. If the landfill charges \$80/ton (called the tipping fee), how much money is saved in tipping fees by recycling and composting ?
- iii. If, in the future, there is a carbon tax \$10 per metric ton of carbon dioxide, how much would LAX save in carbon taxes at the current recycling rate ?

(a) Explain the human exposure pathways for hazardous wastes. (7)

(b) Is there any landfill site in Bangladesh ? If yes ; where and what type of landfill system is adopted ? Which countries assist the Bangladesh Govt. technically ? (3)

(c) Define "EPA "or sometimes "USEPA". Why regulations for New landfill is so important ? (6)

(d) Write down the objectives of thermal treatment processes. (3)

(e) The United States discards roughly 167 million tons of MSW. The High Heating Value of those discards is about 6,000 Btu/lb. A mass-burn waste-to-energy facility can convert those wastes to electricity with a heat rate of 17,000 Btu of thermal input per KWh of electrical output (roughly 20% efficiency). Estimate the electrical energy that could be produced per year if all our discards were used in this type of WTE system. Compare it with the total that is now generated which is about $4,000 \times 10^9$ KWh/yr. (6)

(a) Explain transfer station including its advantages and disadvantages. (10)

(b) Write down the problems associated in hazardous wastes treatment and disposal system in developing countries. (5)

(c) A transfer station handling 300 tons/day, 5 days per week, costs \$5 million to build and \$150,000 per year to operate. An individual tractor-trailer costs \$140,000 and carries 15 tons per trip. Operations costs and maintenance costs (including fuel) of the trucks are \$50,000/yr; the drivers make \$40,000/yr (including benefits). The capital costs of the building and transfer trucks are to be amortized over a 10-year period using a 12 percent discount factor. (10)

Suppose it takes 30 minutes to make a one-way trip from the transfer station to the disposal site and 7 round trips per day are made. Find the transfer station and hauling cost in dollars per ton.

Note: The necessary chart is given below:

TABLE 9.8

Materials	Source Reduction		Recycling or Composting versus Landfilling	Combustion versus Landfilling
	Current Mix of Inputs	100% Virgin Inputs		
Aluminum cans	2.28	4.28	3.71	-0.01
Corrugated cardboard	1.63	2.32	0.96	0.29
Fly ash	0.01	0.01	0.25	0.01
Food waste composted	NA	NA	0.25	0.25
Glass	0.88	1.02	0.50	0.43
HDPE	0.50	0.55	0.39	-0.24
Magazines	2.28	2.36	0.76	0.05
Mixed metals	NA	NA	1.44	0.30
Mixed MSW	NA	NA	NA	0.15
Mixed paper	NA	NA	1.06	0.27
Mixed plastics	NA	NA	0.42	-0.26
Mixed recyclables	NA	NA	0.83	0.20
Newspapers	1.09	1.39	0.52	-0.03
Office paper	2.71	2.79	1.31	0.70
Personal computers	15.14	15.14	0.63	0.06
PET	0.58	0.60	0.43	-0.28
Steel cans	0.88	1.02	0.50	0.43
Textbooks	3.03	3.11	1.38	0.70
Tires	1.10	1.10	0.51	-0.04
Yard trimmings	NA	NA	-0.01	0.00

Source: U.S. EPA, 2006b.