





KATHMANDU UNIVERSITY  
End Semester Examination  
February/March, 2018

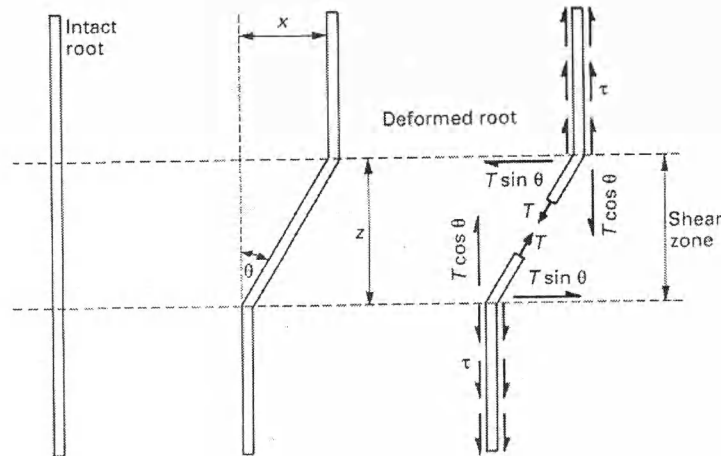
Level : B.Sc./B.Tech.  
Year : IV  
Time : 2 hrs. 30 mins.

Course : ENVS 431  
Semester: I  
F.M. : 55

**Assume necessary data with explanation. Formula sheet is provided to solve numerical. Attempt all questions. Please answer the questions in serial order. Use graph page to solve the Q.No 5.**

SECTION "C"

- Calculate the length (L), breath (B) and height (H) (if L:B = 3:1) of the rectangular shaped landfill of Ratnanagar Municipality if the per capita waste generation is 200gm and average projected population is 5,00,000 for one decade. Calculate the area required if 10% of the waste produced per capita is added for commercial and other wastes and 75% of the waste is expected to reach the landfill site. It is estimated that there will be 5 cells in 1 lift of 5 m including daily cover height of 15 cm and intermittent cover of 30 cm. The landfill allows maximum of 5 lifts. [7]
- A landfill site was closed six years ago and final capping was done with 50 cm soil. After 6 years of tree plantation, it was found that following root system was developed. Calculate amount of increase in shear strength, if angle of internal friction of slope material is 25 degree and root were observed in C/S of 2 m<sup>2</sup> in a closed landfill with the help of the following diagram. [7]



| No. of roots | Dia. of roots (cm) | Tensile strength of root fiber (MPa) | Angle of shear distortion in shear zone |
|--------------|--------------------|--------------------------------------|---|
| 10           | 8                  | 12                                   | 15                                      |
| 20           | 5                  | 20                                   | 18                                      |
| 18           | 9                  | 10                                   | 20                                      |
| 24           | 6                  | 18                                   | 22                                      |

3. What is the compactor size required to haul waste from a residential community with following details: [7]

- Container size (c) = 0.24 m<sup>3</sup>
- Container utilization factor = 0.75
- Avg. no. of container in each station = 2
- Collection vehicle compaction ratio = 2.5
- Container unloading time  $U_c = 5$  min/container
- Two-way haul distance  $x = 30$  km
- Speed limit = 40 km/hr
- Length of workday  $H = 8$  hr.
- Average driving time between the containers = 6 mins
- $t_1$  and  $t_2$  are 30 mins.

4. Permeability depends on pore size distribution, surface area, porosity and properties of the waste materials. To determine permeability we use,  $K = C d^2 (\gamma/\mu) = k (\gamma/\mu)$ . Define all the dimensions of the above equation. Calculate the heat value of ethanol in KJ/Kg. [3+4]

OR

Explain ISSWM. Identify and discuss briefly the issues that you feel will be important in the field of solid waste management in the 21<sup>st</sup> century. [2+5]

5. Determine landfill gas generation distribution over time for a landfill with a useful life of five years based on following data: [7]

- Landfill life = 5 years
- Assume complete decomposition takes place
- Readily biodegradable and slowly biodegradable wastes are 29.27% and 4.1% of total waste respectively
- The sum of gas generated from annual readily biodegradable and slowly biodegradable wastes are 0.95 m<sup>3</sup>/kg and 1.16 m<sup>3</sup>/kg within the period of 5 and 15 years respectively
- The gas production starts after one year of deposition
- Use triangular gas production model
- The amount of waste landfill is 100 ton everyday

OR

With a neat sketch draw a section of a landfill and explain its major parts. Explain the biological decomposition process of organic waste. [4+3]

6. Define leachate. Calculate the time required by the monsoon landfill leachate to contaminate the ground water in Goharai municipality? [1+6]

Given:

- Leachate discharge rate =  $3000\text{m}^3/\text{ha./day}$  ,
- $\text{BOD}_5$  at  $20^\circ\text{C}$  of leachate =  $1800\text{ mg/L}$  ,
- The ground water sample is collected 500 m away from LFS,
- $\text{BOD}_5$  at  $20^\circ\text{C}$  of GW =  $120\text{ mg/L}$  ,
- Depth of GWT = 7.5 m. and the average gradient of ground = 4%

7. Define proximate analysis of solid waste. Estimate the total MC, total dry mass, overall density and volume from the waste sample given below. [3+4]

| Components        | % by mass | MC % | Density $\text{kg/m}^3$ |
|-------------------|-----------|------|-------------------------|
| food waste        | 15        | 70   | 290                     |
| paper             | 45        | 6    | 85                      |
| cardboard         | 10        | 5    | 50                      |
| plastics          | 10        | 2    | 65                      |
| Agriculture waste | 10        | 60   | 105                     |
| wood              | 5         | 20   | 240                     |
| tin cans          | 5         | 3    | 90                      |

8. Write short notes on (any *TWO*): [3+3]
- i. Sanitary engineering
  - ii. Landfilling methods
  - iii. Characteristics of hazardous waste

