KATHMANDU UNIVERSITY
End Semester Examination [C]
May/June, 2019

Marks scored:

Level : B.Tech.
Year : III

Course : ENVE 309
Semester : I

Exam Roll No. :

Time: 30 mins.

F.M. : 20

Registration No.:

Date 30: MAY 2019

SECTION "A"
[20Q. × 1 = 20 marks]

Choose the best answer(s) among the given options and ***encircle*** *the letter of your choice or* ***fill*** *in the blanks.*

- ✓ *Note that there could be more than one correct answers.*
- ✓ *Make reasonable assumptions for any missing data or information.*

1. Percolation in unplanted drying beds removes the _____ water fraction:
   a. Intracellular b. Surface c. Free d. Interstitial

2. The term Lower specific sludge resistance for dewatering is relevant to:
   a. Longer sludge drying time b. Shorter sludge drying time
   c. Septic tank sludge d. Sludge from public toilets

3. Increasing hydraulic loading in sludge treatment results in:
   a. Increased drying time b. Increased efficiency for drying
   c. Reduction in usage time of beds c. Increase in usage time of beds

4. Splash plate is used to:
   a. Accommodate different loading b. Prevent erosion of the sand layer
   c. Even distribution of the sludge d. Remove sludge from the drying beds

5. The quantity (mass and volume) of faeces is higher for the one who consume ____ food:
   a. Processed b. Unprocessed c. high fiber content d. meat based

6. Time for rainfall to flow from the hydraulically remotest point to the nearest manhole is termed as:
   a. Inlet time b. Hydraulic Retention time
   c. Time of flow d. Time of concentration

7. Time of concentration is the sum of the Inlet time and _____.
   a. Hydraulic Retention Time b. Time of flow
   c. Rainfall duration d. Outlet time

(For Q.8, Q.9 & Q.10) A 1.5 acre residential area having runoff coefficient 0.7, 0.3, 0.5 for area of 40%, 10% and 50% respectively. Time of entry is 2 minutes and time of concentration is 15 minutes. The storm water runoff is given by Rational formula: $Q = \frac{CiA}{360}$; where, $i = \frac{1020}{t+20}$

8. The intensity of rainfall is _____.

9. The average runoff coefficient is _____.

10. The quantity of storm sewage is _____.

11. For Ferric Chloride, optimum range of pH is:
a. 4-6 b. 6-8 c. 8-10 d. < 4

12. Coagulant aid _____.
a. Decreases the amount of coagulant dosage
b. Is a coagulant
c. Increases the density of floc
d. Decreases the density of floc

(For Q.13 & Q.14) A source of average discharge 4 lps was identified for a village water supply scheme. Sedimentation tank of 29 m^3 for purification before distribution is designed.

13. The Hydraulic retention time (HRT) of the sedimentation tank is _____ h.

14. If the Surface overflow rate (SOR) of the sedimentation tank is 172.8 $m^3/m^2/day$, the depth of the tank is _____ m.

15. Baseline information for design of water supply project is collected in :
a. Design period b. Survey Year c. Design Year d. Base period

16. Which of the following represents the domestic water demand of the rural area in Nepal with a population of 1,000,000:
a. 5 MLD b. 50 MLD c. 100 MLD d. 150 MLD

17. A water column of 1 cm^2 and of 40 m high would exert a pressure of _____ at its base.
a. 4 .0 kg/cm^2 b. 40 kg/cm^2 c. 0.4 kg/cm^2 d. null

18. Which of the following term is relevant for conveyance of water from the treatment plant to households?
a. Collection chamber b. Transmission mains
c. Distribution mains d. Interruption Chamber

19. Run-off coefficient = 0.90 means:
a. 90% of the runoff will reach to the sewer
b. 10% of the precipitation is runoff
c. 90% of the precipitation is runoff
d. 10% of the runoff will reach to the sewer

20. In Hardy-Cross method the algebraic sum of _____ around a loop is zero.
a. Discharge (Q) b. head loss (h_L) c. h_L/Q d. $Q*h_L$

KATHMANDU UNIVERSITY
End Semester Examination [C]
May/June, 2019

30 MAY 2019

Level : B.Tech.
Year : III
Time : 2 hrs. 30 mins.

Course : ENVE 309
Semester : I
F.M. : 55

SECTION "B"
[5Q. × 4 = 20 marks]

(Refer last page for useful information/equations/formula. Make logical assumption for any missing data or information. Make neat and clean sketch wherever required.)

1. What are the factors to be considered before selecting a source of water supply for a particular town or city? Define Impounding Reservoir. What are the conditions for the construction of the impounding reservoir? [2+0.5+1.5]

2. The present population of Kumveshwor city is 74,850 which was 68,000 ten years ago, 57,500 twenty years ago, 42,800 thirty years ago, 25,800 forty years ago, 17,500 fifty years ago. Estimate the population of the city after the next 28 years by geometrical increase method. [4]

3. The water demand of a city is 320 MLD. The water demand is to meet through pumping from a tube well. The pumping period is 4:00 to 10:00 hours in the morning and 16:00 to 22:00 hours in the evening. The water is supplied to the consumers from the reservoir by continuous system. Calculate the capacity of balancing reservoir for the consumption pattern as shown below. [4]

Time	5:00-7:00	7:00-12:00	12:00-17:00	17:00-19:00	19:00-5:00
Water Consumption	25%	30%	15%	20%	10%

4. Obtain the relation: $\frac{q}{Q} = \left[\frac{\theta}{360} - \frac{Sin\theta}{2\pi}\right]\left[1 - \frac{360\,Sin\theta}{2\pi\theta}\right]^{\frac{2}{3}}$; where q=discharge in the sewer running partially full, and Q=discharge in the sewer running full, and θ is the angle made by flow with the center. [4]

5. The mayor of Kakarbhitta Municipality is interested to construct a Faecal Sludge Treatment Plant in his town. Based on the preliminary characterization study of Faecal Sludge done, it is found that Mass of Total Solids (TS) = 100 tonnes/30 days and concentration of TS = 60 kg TS/m^3. Design an Unplanted drying bed assuming 30 days of one drying cycle, Hydraulic loading rate = 0.2 m and Solid loading rate = 280 kg TS/m^2/year. [4]

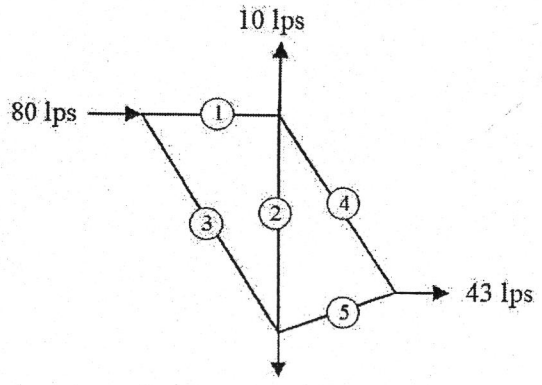
SECTION "C"
[5Q. × 7 = 35 marks]

6.
   a. Explain the logistic method of population growth with a plot between population *P* and the time *T* for a developing city. [2.5]
   b. In rural village, the survey is carried out on the year 2072 B.S. and the following data is obtained. [4.5]
   Population= 5320 nos., Annual population growth rate = 1.7%, No. of cows = 4030, No. of goats = 1520, No. of chickens = 5500 nos., No. of students = 200 boarders and 1020 day scholars, No. of VDC offices = 5, No. of Tea shops = 3. If the base year is taken as 2075 B.S and the design period is 20 years, calculate the total water demand of the village for the service year.

7.

a. Define Backwashing of Rapid Sand Filter (RSF). [1]
b. Explain the working mechanism of Rapid Sand Filter (RSF) with a schematic diagram. [3]
c. Explain the process of backwashing. Support your answer with the timing of opening and closing of different valves during the operations. [3]

8. Calculate the head losses and primary corrected flows in the various pipes of a given distribution network using Hardy Cross method. Compute the corrected flows after two corrections. [3+4]



Pipe	Length (m)	Diameter (mm)
1	310	150
2	400	150
3	550	200
4	600	150
5	200	200

9. Explain the different types of sewer system with a schematic diagram. How do you calculate dry and wet weather flow? Calculate the diameter of a sewer to serve catchment area of 4942 acres with a population density of 250 persons per hectare. The average rate of sewage flow is 350 lpcd. The maximum flow is 60% in excess of average, together with the rainfall equivalent of 15mm/day, all of which are runoff. Take the V_{max} as 3m/s. [3+1+3]

10. Explain the significance of sewered and non-sewered sanitation for proper management of faecal sludge in unplanned agglomeration like Kathmandu. What are the approaches and challenges for the estimation of the quantity of faecal sludge in Kathmandu? [2+2.5+2.5]

List of useful Equations/Formula:

$P = \frac{P_s}{1+e^{a+bt}}$; t is any period beyond the base year.

$$P_s = \frac{2P_0P_1P_2 - P_1^2(P_0 + P_2)}{P_0P_2 - P_1^2}$$

$$a = \log_e \frac{P_S - P_0}{P_0}$$

$b = \frac{1}{n}\log_e \frac{P_0(P_s-P_1)}{P_1(P_s-P_0)}$; n is the time interval between successive census.

$P_n = P + nI$

$P_n = P_0(1+r_g)^n$

$P_n = P + nI + \{n(n+1)r/2\}$

Table1: Water required for domestic purpose

SNo	Population of the community	Estimated amount	Remarks
1	< 20,000	45	Distributed from public taps
2	<20,000	70 – 100	Distributed from private and public taps
3	20,000 - 100,000	100 – 150	Distributed from private tap
4	>100, 000	150 - 200	Distributed from private taps

Table 2 : Institutional requirement

S. No.	Type	Estimated amount	Remarks
1	School	10 lpcd	Without hostel
2	School	65 lpcd	With hostel
3	Hospital	500 l / bed	Equipped with bed and toilet facilities
4	Health Post	1000 l / day	No in-built toilet
5	Health Post	2500 l / day	With built in toilet
6	Health Center	500 l / bed	With an attached toilet in the rooms
7	Police Post and other offices	500 – 1000 l	Per office per day
8	Tea Shop	50 0 l / day	Per office per day
9	Hotel with some accommodation	200 l / bed	With accommodation facilities and attached toilets

Table 3 : Livestock demand

S. No.	Type	Estimated amount	Remarks
1	For big animals	45 l/animal/day	Cow, buffalo, horse, etc.
2	Medium animals	20 l/animal/day	Goat, Dog, Rabbit, etc.
3	Small animals	20 l/100 bird/ day	Birds, Chicken, Duck, etc.

Manning's equation: $v = \frac{1}{n} R^{2/3} I^{0.5}$

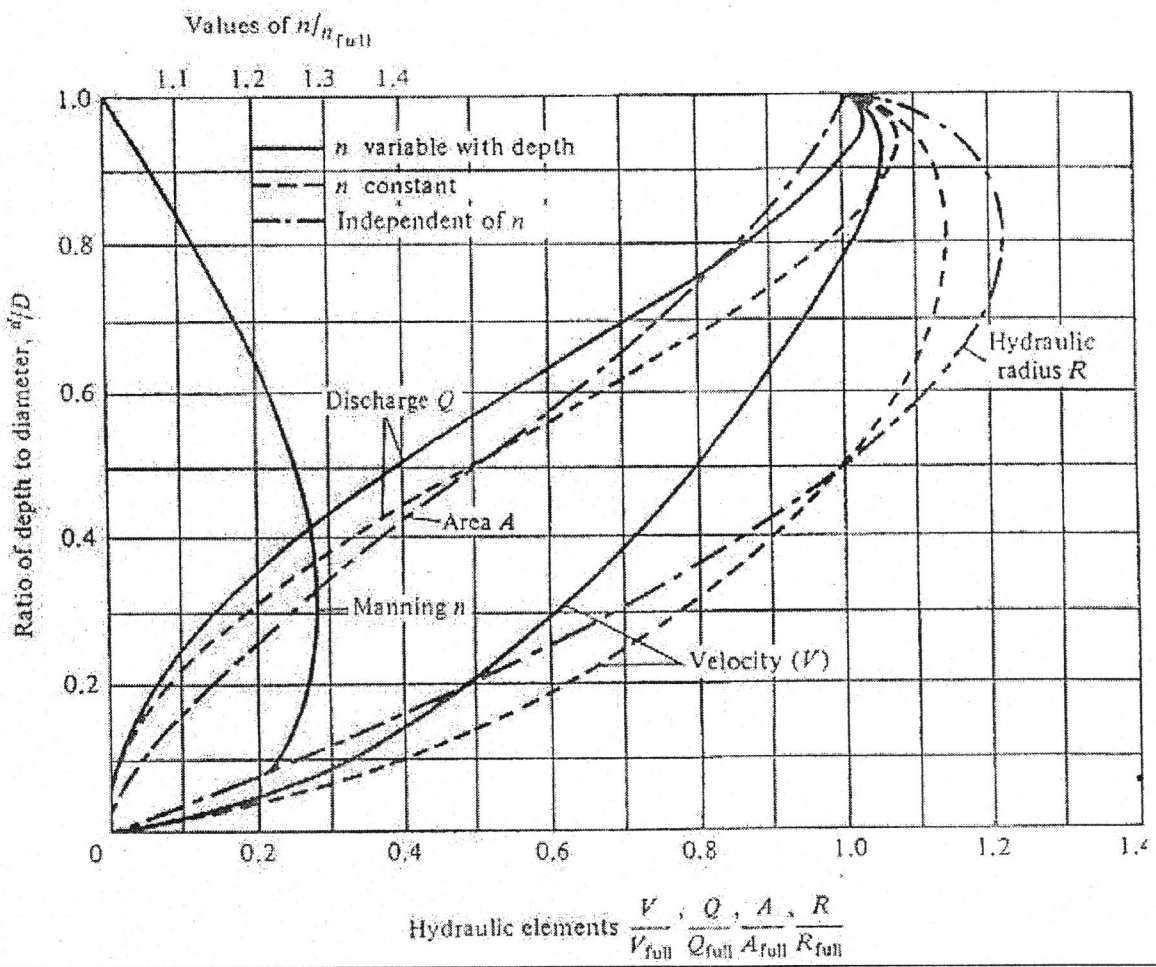


Figure 1: Partial flow diagram

For Hardy Cross method,

$$\Delta Q = -\frac{\sum h_L}{1.85 \sum \frac{h_L}{Q_0}}$$

Table 4: Computations for the Hardy Cross Analysis of the Pipe Network

Closed Circuit	Pipe	Dia. (mm)	Length (m)	Assumed flow (Q_0)	Head loss (m/1000m)	Total h_L	h_L/Q_0	ΔQ	Primary corrected flow
I									
II									

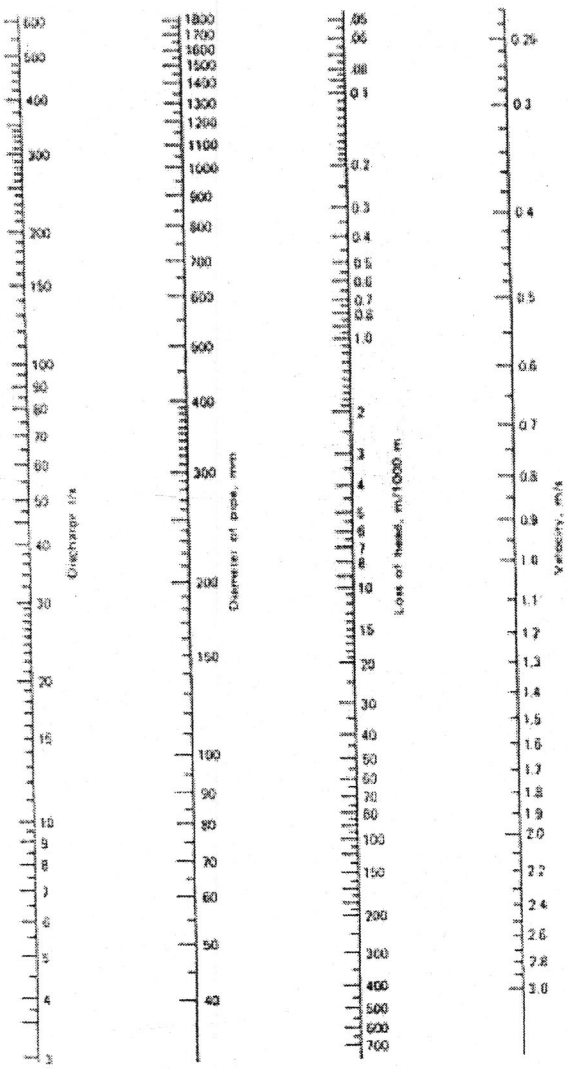


Figure 2: Head loss nomogram, based on Hazen William Formula