KATHMANDU UNIVERSITY
End Semester Examination
February/March, 2019

Marks scored:

Level : B.Tech. Course : ENVE 309
Year : III Semester : I
Exam Roll No. : Time: 30 mins. F.M. : 20
Registration No.: Date FEB 2 0 2019

SECTION "A"
[10 Q. × 1 = 10 marks]

Make reasonable assumptions for any missing data or information. Circle the best answer(s).

1. Population of all the cities grow according to the:
   a. S-curve b. J-curve c. Straight line d. Parabolic curve

2. The population of a city recorded in 2011 was 74,100. The average increase in population per decade was found to be 10,350. The population of the city in 2031 is:
   a. 281,100 b. 74,308 c. 94,800 d. 96,246

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

4. Time required for survey, design and construction of water supply project is known as
   a. Design period b. Survey Year c. Design Year d. Base period

5. Which of the following represents the domestic water demand of the municipality in Nepal with a population of 1,000,000?
   a. 1 MLD b. 10 MLD c. 100 MLD d. 1000 MLD

6. A water column of 1 cm^2 and 60 m high would exert a pressure of ..... at its base.
   a. 6 .0 kg/cm^2 b. 60 kg/cm^2 c. 0.6 kg/cm^2 d. null

(For Q.7 & Q.8) A source of average discharge of 2 lps was identified for a village water supply scheme. Sedimentation tank of 14.5 m^3 for purification before distribution is designed.

7. What is the Hydraulic Retention Time(HRT) of the sedimentation tank?
   a. 2 hr b. 11.92 hr c. 0.08 hr d. 0.5 hr

8. If the Surface Overflow Rate (SOR) of the sedimentation tank is 172.8 $m^3/m^2/day$, the depth of the tank is:
   a. 10 m b. 0.7 m c. 17.28 m d. 1.45 m

9. For alum, optimum range of pH is:
   a. 4-6 b. 6-8 c. 8-10 d. < 4

10. If the pH value is more than the optimum:
    a. aluminium hydroxide floc disappears
    b. aluminium hydroxide floc becomes heavier
    c. aluminium hydroxide ionizes into an aluminate
    d. water becomes more turbid

SECTION "B"

[10 Q. × 1 = 10 marks]

Fill in the blanks with correct (or best possible) answer(s). Make reasonable assumptions for any missing data or information.

11. The cleaning of slow sand filter is done by _____
    and that of rapid sand filter by _____.

12. Separate sewerage system: _____
    _____
    _____.

13. The sewer that receives the discharge from one or more houses or buildings is _____
    _____.

(For Q.14, Q.15. & Q.16) A 1 km^2 residential area has runoff coefficient 0.5, 0.8, 0.2 for area of 20%, 30% and 50% respectively. Time of entry is 5 minutes and time of concentration is 25 minutes. The storm water runoff is given by Rational formula: $Q = \frac{CiA}{360}$; where, $i = \frac{1020}{t+20}$

14. The intensity of rainfall is _____.

15. The average runoff coefficient is _____.

16. The quantity of storm sewage is _____.

17. The hydraulic mean depth of circular sewers running full is given by the formula
    _____ and calculated as _____.

18. Weak links in the FSM service chain include many factors, such as :
    a. _____
    b. _____

19. The drying process in unplanted drying beds is based on two principles:
    a. _____
    b. _____

20. Define the two design parameters of unplanted drying bed:
    a. _____
    b. _____

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SECTION "C"

[5 Q. × 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 things to be considered before supplying water to the community? Draw a schematic diagram of a typical rural water supply system with the components (reservoir, sedimentation tank, spring source, distribution system, break pressure tank, interruption chamber). [2+2]

2. Central Bureau of Statistics (CBS) recorded the population of Banepa Municipality as:

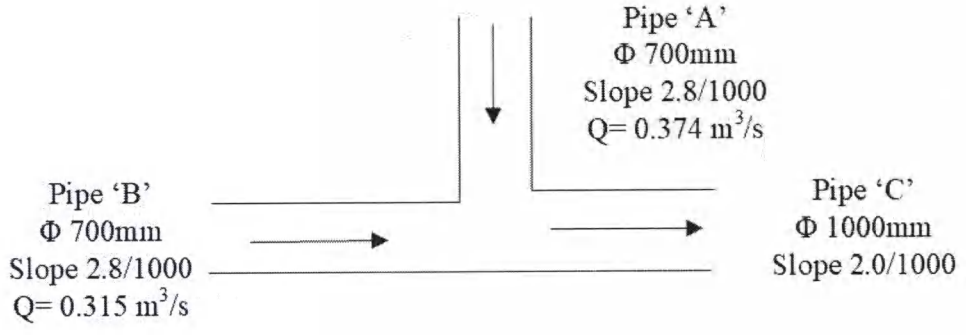
1971	50,000
1991	110,000
2011	160,000

Estimate: (a) the saturation population, and (b) expected population in 2031. [2+2]

3. Following data gives the monthly inflows during the critical low flow period at the site of a proposed dam across a river. Determine analytically the storage capacity required of impounded reservoir to maintain a constant draft of 2500 million liters of water per month. [4]

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Inflow (m^3/s)	0.04	0.45	0.62	0.93	1.33	1.78	1.89	3.17	3.35	1.1	0.07	0.06

4. For a given sewer pipe network, direction of the flow, diameter of the pipes, slopes and discharges are provided in the figure below. What is the velocity and depth of sewage flowing through pipe 'C'? (Take manning's coefficient, n=0.014) [4]



5. Discuss on operational factors that impact the variability of faecal sludge. [4]

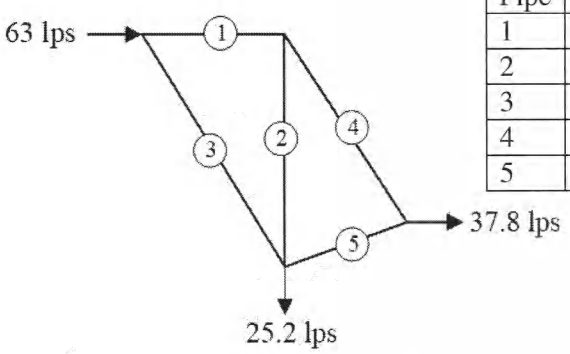
SECTION "D"

[5 Q. × 7 = 35 marks]

6. What are the different types of water demand? Discuss in brief about the various factors affecting the demand of water.
Summary of the survey carried out in the year 2017 of the village of Nepal is given as:
Population = 5000 nos. ; Annual Population growth rate = 1.5%; Annual growth rate for students = 1%; No. of cows = 50 nos.; No. of goats = 250 nos.; No. of chickens = 2000 nos.; No. of schools = 2 with overall 350 day scholars students; No. of VDC offices = 2; No. of tea shops = 3;
If the base year is taken as 2020 and the design period is 20 years, calculate the total water demand of the village for the service year. [1.5+1.5+4]

7. Differentiate between Rapid Sand Filter (RSF) and Slow Sand filter (SSF) with neat and clean diagram. What are coagulant aids? [5+2]

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. [7]



Pipe	Length (m)	Diameter (mm)
1	305	150
2	305	150
3	610	200
4	457	150
5	153	200

9. Design a sewer to serve a population of 120000. The daily per capita water supply allowance is 180 liters, of which 80% find its way into the sewer. The permissible sewer slope is 1 in 1000, peak factor = 2, and take Manning's coefficient (n) = 0.012. Check for self-cleansing velocity at maximum flow and at dry weather flow. Maximum permissible velocity = 3 m/s and minimum permissible velocity = 0.6 m/s. [7]

10. What is non-sewered sanitation? Design a settling-thickening tank and unplanted drying beds for a city generating 400 m^3/day of FS in average. A characterization study conducted before the design estimated average concentration of solids (organics, nutrients and pathogens) as: 26.4 kg TS/m^3. [1+4+2]

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+ table

For designing settling-thickening tank, assume:

Settling velocity as: 0.125 m/h

Solid-liquid separation efficiency as 80%

Peak factor= 1.5

Use operating hours of plant = 10 hrs/day

Loading period=30 days

50% of the sludge accumulated pumped once a week into unplanted sludge drying beds.

Scum Layer (0.8m) = 160 kg TS/m^3

Clear water layer (0.5m) = 5 kg TS/m^3

Separation layer (0.5m) = 60 kg TS/m^3

Thickening layer: 140 kg TS/m^3

For Unplanted drying beds:

Hydraulic loading rate = 0.3 m

Solid loading rate = 300 kg TS/m^2/year

Total solids in sludge from settling tanks = 80 kg TS/m^3

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 l / student	Without hostel
2	Hospital	500 l / bed	Equipped with bed and toilet facilities
3	Health Post	1000 l / day	No in-built toilet
4	Health Post	2500 l / day	With built in toilet
5	Health Center	500 l / bed	With an attached toilet in the rooms
6	Police Post and other offices	500 – 1000 l	Per office per day
7	Tea Shop	50 0 l / day	Per office per day
8	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.

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

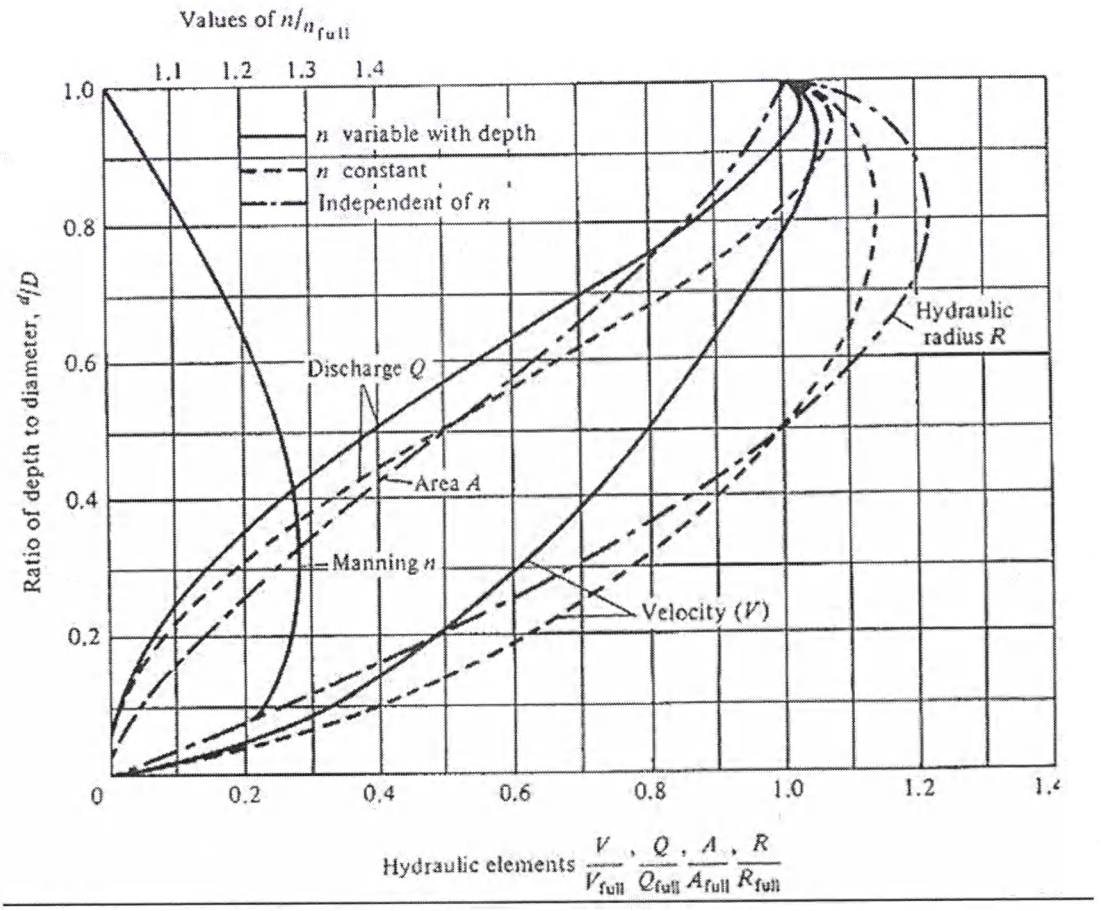

Figure 1: Partial flow diagram

For Hardy Cross method,

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

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									

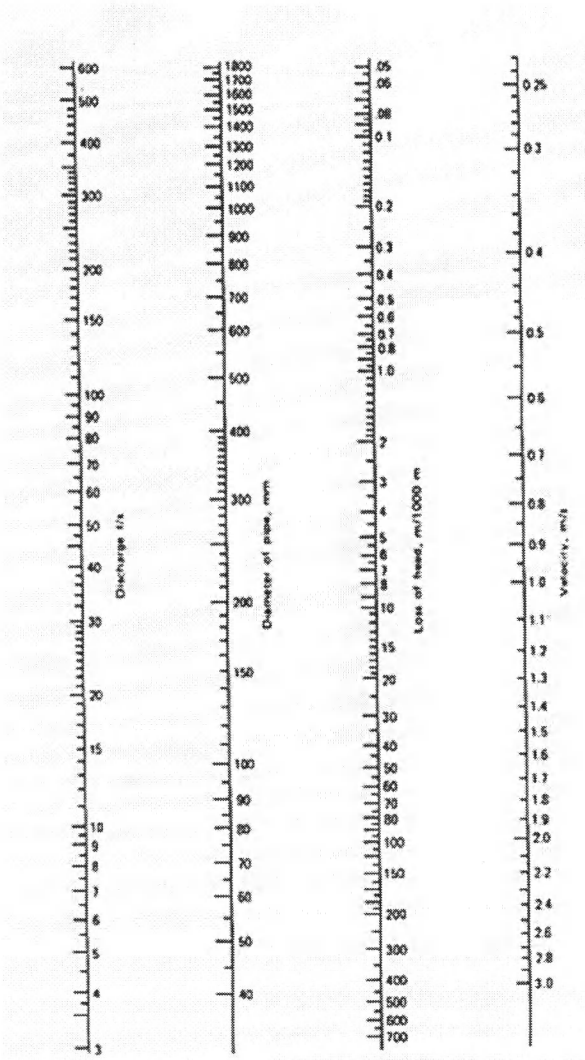

Figure 2: Head loss nomogram, based on Hazen William Formula