KATHMANDU UNIVERSITY
End Semester Examination
February, 2025

Marks Scored:

Level : B.Tech.
Year : III

14 FEB 2025

Course : ENVE 304
Semester : II

Exam Roll No. :

Time: 30 mins.

F. M. : 20

Registration No.:

Date 14 FEB 2025

SECTION "A"

[20 Q. × 1 = 20 marks]

Choose and encircle the most appropriate option from each set of choices

1. Sewerage is
   a. collection of sewage
   b. collection + conveyance of sewage
   c. collection + conveyance + treatment of sewage
   d. collection + conveyance + treatment + disposal of sewage

2. The quantity of sanitary sewage entering the sewer would _____the total quantity of water supplied.
   a. be equal to b. be greater than c. be less than d. have no relation with

3. If a sewer of diameter 0.6 m laid at a gradient of 1 in 400 runs half full. Then the discharge through sewer will be_____. Use Manning's formula taking N=0.012.
   a. 0.371 m^3/s b. 0.371 m^3/s c. 0.419 m^3/s d. 0.838 m^3/s

4. Which of the following sewer runs fully and under the pressure higher than the atmospheric pressure?
   a. lateral sewer b. depressed sewer c. trunk sewer d. outfall sewer

5. The flushing tank which holds and flushes the water to the sewer automatically for the purpose of cleaning the sewer functions mainly by _____ action.
   a. syphon b. spillway c. capillary d. inverted syphon

6. BOD represents
   a. pollution strength of a waste
   b. pollution strength of inorganic fraction of waste
   c. pollution strength of organic fraction of waste
   d. pollution strength of biodegradable organic fraction of waste

7. Low COD to BOD5 ratio indicates _____ in wastewater.
   a. high inert fraction
   b. low biodegradable and inert fraction
   c. high biodegradable fraction
   d. equal biodegradable and inert fraction

8. The technique of overland runoff for disposal of sewage by land treatment is applied when
   a. soil have good absorptivity
   b. sewage is from household
   c. sewage is from industries
   d. soil have poor absorptivity

9. The change in concentration of pollutant with time in natural stream is due to
   a. advection, dispersion and conversion
   b. dispersion and conversion
   c. advection and conversion
   d. advection and dispersion

10. Primary treatment of wastewater uses_____ tank.
a. sedimentation b. skimming c. aeration d. digestion

11. The end products produced during the secondary treatment of wastewater under aerobic condition are
a. CO_2 and biomass
b. CO_2
c. CH_4, CO_2 and biomass
d. CH_4 and CO_2

12. High rate trickling filter is the
a. suspended growth anaerobic process
b. attached growth anaerobic process
c. suspended growth aerobic process
d. attached growth aerobic process

13. The combination of WSP's suitable for the treatment of wastewater with higher strength of organic pollutant is
a. aerobic pond + facultative pond
b. anaerobic pond + maturation pond
c. anaerobic pond + facultative pond
d. aerobic pond + anaerobic pond

14. In which type of ASP all the steps of the activated sludge process occur in a single complete mixed reactor?
a. Extended Aeration ASP
b. Contact Stabilization ASP
c. Sequencing Batch Reactor
d. Oxidation Ditch

15. The major function of recirculation in high rate trickling filter is
a. maintaining F/M ratio
b. dilution
c. maintaining MLSS
d. maintaining MLVSS

16. Which of the following forms of nitrogen conversion happens during the denitrification process in wastewater treatment?
a. $NO_3^- \; converts \; to \; NO_2^-$
b. $NH_4^+ \; converts \; to \; NO_2^-$
c. $NO_3^- \; converts \; to \; N_2$
d. $NO_2^- \; converts \; to \; NO_3^-$

17. Septic tank involves
a. sedimentation alone
b. sludge digestion alone
c. sewage aeration
d. sedimentation as well as sludge digestion

18. How does a pit latrine works?
a. Separates sludge and scum from the liquid wastewater.
b. Holds faeces and urine in a pit until it can be removed for further treatment.
c. Mixes air to speed up the breakdown of waste.
d. Allows faeces and urine to flow directly to a drain field for bacteria to continue their work.

19. A wastewater treatment plant treats 35,000 m^3/day of wastewater with an influent suspended solids concentration of 500 mg/l and achieves a 85% removal efficiency in PST, the approximate daily production of primary sludge is
a. 17.500 tons/day b. 14.875 tons/day c. 4.375 tons/day d. 2.625 tons/day

20. Sludge conditioning is done to _____ sludge.
a. increase the solid content in
b. decrease the water content in
c. stabilize
d. improve dewater characteristics of

KATHMANDU UNIVERSITY
End Semester Examination
February, 2025

14 FEB 2025

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

Course : ENVE 304
Semester : II
F. M. : 55

Assume suitable data where necessary. Some useful information/formula are provided at the last.

SECTION "B"
[7 Q. × 5= 35 marks]

Attempt ANY SEVEN questions.

1. How will you quantify the total wastewater flow through the combine sewer for its design? Explain the process in brief. [5]

2. Find the minimum velocity and gradient required to transport coarse sand through a sewer of 1 m diameter with sand particles of 1 mm diameter and specific gravity of 2.60. Assume $\beta = 0.05$ and $f = 0.02$. Assume the sewer runs at 0.6 of its depth. Take Manning's coefficient $N = 0.012$. [5]

3. List out the key differences between BOD and COD of wastewater. For a wastewater sample, BOD_5 for 30° C is 160 mg/l and is 80 % of the ultimate BOD. What fraction of ultimate BOD remain unoxidised after 16 day at 20° C. [2+3]

4. What do you understand by grit chambers? Why it is necessary to provide a grit chamber? Explain the configuration of a grit chamber with the help of neat figures. [5]

5. Explain how the biological treatment of wastewater functions in removing pollutant from the wastewater in brief. Describe in brief the various types of reactor used during the biological treatment of wastewater with the help of appropriate figures. [2+3]

6. Explain how trickling filter functions during the treatment of wastewater with the help of well labelled figures. [5]

7. Under what conditions will you recommend onsite sanitation for any settlement? Explain one the most appropriate suitable option of it in context of Nepalese community with the help of well labelled figures. [2+3]

8. Why is it necessary to treat the sludge before final disposal? Explain the possible reasons in brief. Draw the flow chart showing the various processes involved in the sludge treatment and disposal. [3+2]

9. Discuss briefly (***ANY TWO***): [2 × 2.5]
   a. Advantages and disadvantages of combined sewerage system
   b. Conditions when manhole are introduced in sewerage system
   c. Nitrification process

P.T.O.

SECTION "C"

[2 Q. × 10= 20 marks]

Attempt ANY TWO questions.

10. Draw a well labelled deoxygenation, reoxygenation and oxygen sag curves. Briefly explain the denitrification process in removal of nitrogen from wastewater. A stream with DO of 7. 4 mg/l has a flow of 1.75 m^3/s, BOD_5 of 8 mg/l and reoxygenation constant of 0.3 per day (base 10) at 20 °C. It receives wastewater with discharge of 0.55 m^3/s having BOD_5 35 mg/l, DO 4.5 mg/l and deoxygenation constant of 0.13 per day (base 10) at 20 °C. The temperature of stream is at 15 °C and that of wastewater is at 20 °C. The average velocity of flow of the stream is 0.20 m/s. Calculate the DO level at point 40 km downstream. The saturation DO at 16 °C is 10.0 mg/l and at 17 °C is 9.7 mg/l. [2+3+5]

11. Design a conventional activated sludge plant to treat settled domestic sewage for the following data: [10]

Population = 1,25,000, Per capita sewage contribution = 80 lpcd, Settled sewage BOD_5 = 210 mg/l, Effluent BOD_5 required = 20 mg/l. Determine the followings:

a. Influent flow and efficiency required
b. Volume of aeration tank
c. Hydraulic retention time
d. Volumetric loading
e. Return sludge ratio

Take F/M = 0.20, MLSS = 2,900 mg/l and SVI = 95.

12. Draw a well labelled cross-sections of vertical flow constructed wetland and sludge drying bed showing its essential components. Explain how facultative pond functions during the treatment of wastewater with the help of well labelled figures. [5+5]

14 FEB 2025

Useful information/formula

$$V_s = \sqrt{\frac{8\beta}{f}(G_S - 1)gd_s}$$

$$V = \frac{1}{N}R^{2/3}S^{1/2}$$

$$Y_t = L_0\,(1 - e^{-K_1 t}) = L_0\,(1 - 10^{-Kt})$$

$$K_T = K_{20}\theta^{(T-20°C)}$$

θ may be taken as 1.056 for temperature range of 20-30° C

$$L_t = L_0 e^{-K't}$$

$$D_t = \frac{K'L_0}{R'-K'}\left[e^{-K't} - e^{-R't}\right] + D_0 e^{-R't}$$

$$D_t = \frac{KL_0}{R-K}\left[10^{-Kt} - 10^{-Rt}\right] + D_0 10^{-Rt}$$

$$t_c = \frac{1}{R-K}\log_{10}\frac{R}{K}\left[1 - \frac{D_0(R-K)}{KL_0}\right]$$

$$R_T = R_{20}\,1.024^{T-20}$$

$$\frac{F}{M} = \frac{QL_a}{(V/1000)X_t}$$

$$\frac{Q_r}{Q} = \frac{X_t}{(10^6/SVI) - X_t}$$