KATHMANDU UNIVERSITY
End Semester Examination
January/February 2024

Marks Scored:

Level : B.Sc.
Year : II

05 FEB 2024

Course : ESEE 221
Semester : II

Exam Roll No. :

Time: 30 mins.

F. M. : 20

Registration No.:

Date :

SECTION "A"
[20Q. × 1 = 10 marks]

Choose and mark [X] the most appropriate answer.

1. Environmental monitoring is done in order to gain information about the ____ levels of harmful or potentially harmful pollutants in discharges to the environment.
[ ] present [ ] maximum [ ] minimum [ ] all of the above

2. Top soil loss from the slopes upstream in the watershed can be easily assessed with a ____ downstream.
[ ] counting number of trees
[ ] measuring ground water level
[ ] visual turbidity monitor
[ ] increased flow rate

3. In a river, a pollutant released from an industrial discharge point spread downstream. The process primarily responsible for the downstream movement of the pollutant due to the bulk movement of the water is___.
[ ] Advection
[ ] Turbulent dispersion
[ ] Gravitational settling
[ ] Centrifugal settling

4. If the velocity of the fluid increases in the advection process while the concentration remains constant, the advection flux _____.
[ ] decreases
[ ] remains constant
[ ] increases
[ ] becomes zero

5. Which of the following is designed to regulate the distribution system and ensure a steady supply of water?
[ ] Aqueducts
[ ] Break pressure chamber
[ ] Service reservoir
[ ] Distribution chamber

6. When does the peak per capita demand typically occur in a water supply system?
[ ] During the day when most people are at work
[ ] During the evening when people return home
[ ] During the night when water usage is minimal
[ ] Peak demand remains constant throughout the day

7. In the condition where Total Hardness (TH) > Total Alkalinity (TA), what is the formula for Non-Carbonate Hardness (NCH)?
[ ] NCH = CH
[ ] NCH = TH - CH
[ ] NCH = Alkalinity
[ ] NCH = 0

8. What is the primary purpose of double layer compression in the destabilization of colloids using coagulants?
[ ] Increase colloidal stability [ ] Enhance particle dispersion
[ ] Reduce aggregation potential [ ] Promote particle aggregation and settling

9. When activated silica is typically added in the water treatment process?
[ ] before alum [ ] at the same point as alum
[ ] never added [ ] only after filtration

10. Which of the following is **NOT** true for an ideal sedimentation tank having Length (L) and Breadth (B) and Height (H) is receiving a discharge of Q m^3/s?
[ ] Sediments are uniformly distributed
[ ] equal velocity at all points lying in the each vertical
[ ] All particles having settling velocity < Q/BL will escape from the tank
[ ] the settling path is the resultant of horizontal velocity and settling velocity

11. Plain sedimentation is expected to remove particles of specific gravity ____.
[ ] <1 [ ] >1.2 [ ] = 2.65 [ ] < 2

12. Which of the following is not related with slow sand filter?
[ ] Backwashing [ ] Manually scrapping the top layer of sand
[ ] Cleaning every 1-3 months [ ] Schmutzdecke layer or dirty skin layer

13. Which of the following best describes the ultimate first stage BOD?
[ ] The amount of oxygen required for microbial decomposition of nitrogenous matter
[ ] The initial oxygen equivalent of the organic matter undergoing microbial decomposition
[ ] The total oxygen demand of the wastewater over an infinite time period
[ ] The demand for oxygen in the last stage of biochemical oxidation

14. In a flash mixer, using coagulant in _____ form will relatively increase the Hydraulic Retention Time (HRT) during water treatment?
[ ] solid [ ] liquid [ ] granular [ ] powdered

15. The phenomenon 'Lysis' occurs in ____ phase.
[ ] lag [ ] log-growth [ ] stationary [ ] Endogenous

16. Which of the following is **NOT** suspended growth process?
[ ] Activated sludge [ ] Aerated lagoons
[ ] Trickling filters [ ] Oxidation ditch

17. In isokinetic sampling, the sample flow rate is adjusted to match
[ ] The velocity of the gas stream being sampled
[ ] The concentration of gaseous pollutants in the air
[ ] The temperature of the sampling equipment
[ ] The pressure inside the sampling chamber

18. In order to remove the gaseous pollutant, H_2S, which of the following adsorbent can be used in adsorption towers?
[ ] Iron oxide [ ] Silica gel
[ ] Pulverized limestone [ ] Alkalized alumnia

19. Which of the following is **NOT** the cleaning mechanism of Fabric filter?
[ ] Shaking [ ] Back wash [ ] Ultra Violet [ ] Pulse jet

20. Which pollution control technology is often preferred for removing fine particulate matter and is suitable for high-temperature applications?
[ ] Wet collector (scrubber) [ ] Electrostatic precipitator
[ ] Fabric filter (baghouse) [ ] Gravity settler

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F.M. : 55

SECTION "B"
[3 Q. × 7 = 21 marks]

Attempt *ANY THREE* questions.

1. Given an electrostatic precipitator with a collector plate area of 6000 m^2 is 97% efficient in treating 200m^3/s of flue gas from a 250-MW coal-fired power plant. Determine the required collector plate area for efficiencies of 70%, 80%, 90%, 95%, 98%, and 99%. Also, plot a graph with collector plate area on the Y-axis and efficiency on the X-axis to visualize the relationship for the specified efficiencies and discuss the results. [4+3]

2. Explain the working mechanism of cyclone separator with its schematic diagram. How can you increase its efficiency? [4+3]

3. Discuss the operation of trickling filter in treating the municipal wastewater with diagram. Discuss in brief about unloading of the filter. [4+3]

4. Define coagulation, flocculation and coagulation aids. Discuss the double layer compression theory in destabilization of colloidal particles. [3+4]

SECTION "C"
[5Q × 5 = 25 marks]

Attempt *ANY FIVE* questions.

5. Draw a schematic diagram of typical wastewater treatment plant. State the function and mechanism of pollutant removal of each unit operation and process.

6. How can the impact of air pollutants from stationary sources in Kathmandu valley be minimized or mitigated? Discuss on implementation of different strategies.

7. Determine ultimate BOD for a sewage having 5-day BOD at 20°C as 160ppm. Assume the deoxygenation constant as 0.12 day^{-1}. Also, determine the 3-day BOD of the above sample at 27°C.

8. Explain the working mechanism and cleaning of slow sand filter with neat and clean diagram.

9. What are the different types of settling? Discuss each type providing examples of unit operations.

10. Explain the factors affecting the demand of water.

11. Differentiate on suspended, colloidal and dissolved impurities.

SECTION "D"

[3Q × 3 = 9 marks]

Attempt *ANY THREE* questions.

12. Why losses and wastage due to theft, leaks, etc. is considered in calculating the total water demand?

13. What are the types of natural transport phenomena for pollutant transport? Provide examples for each.

14. Write short notes on objectives of environmental monitoring.

15. In what ways do constructed wetlands contribute to the treatment of wastewater?

Useful formulas:

$K_T = K_{20}\theta^{(T-20°)}$

$\eta = 1 - e^{-\frac{\omega A}{Q}}$