

KATHMANDU UNIVERSITY
End Semester Examination [C]
November/December, 2023

Marks Scored:

Level : B.E.

Year : III

Course : CHEG 322

Semester : II

Exam Roll No. :

Time: 30 mins.

F. M. : 10

Registration No.:

Date

0:7 DEC 2023

SECTION "A"

[20Q. × 0.5 = 10 marks]

Choose and encircle the most appropriate answer.

1. What does RDF mean?
a. Residual derived fuel
b. Refuse derived fuel
c. Reuse derived fuel
d. Recycle derived fuel
2. Facultative bacteria are able to work in
a. Presence of oxygen only
b. Absence of oxygen only
c. Presence as well as in absence of oxygen
d. Presence of water
3. The correct relation between theoretical oxygen demand (TOD), Biochemical oxygen demand (BOD) and Chemical oxygen demand (COD) is given by
a. TOD > BOD > COD
b. TOD > COD > BOD
c. BOD > COD > TOD
d. COD > BOD > TOD
4. Why is peak heating phase in composting is important?
a. Recover heat for other use
b. Kill pathogens and weed seeds
c. Improve bacterial activities
d. Keep birds away from the pile
5. What is the best way to maintain CN ratio in composting?
a. Co-composting
b. Dilution
c. Increase water content
d. Increasing temperature
6. If the sewage contains grease and fatty oils, these are removed in?
a. Grit chamber
b. Detritus tanks
c. Skimming tanks
d. Sedimentation tanks
7. Composting and lagooning are the methods of
a. Sludge digestion
b. Sludge disposal
c. Sedimentation
d. Filtration
8. What happens in preliminary wastewater treatment?
a. Grit removal
b. Sedimentation
c. Equalization of flow
d. BOD removal
9. What is the recommended moisture content of finished compost?
a. 15%
b. 30%
c. 50%
d. 70%
10. What is limiting nutrient for eutrophication in the sea?
a. Nitrogen
b. Phosphorus
c. Sulphur
d. Calcium

11. What is the chemical formula of cell mass?
a. $C_5H_7O_2N$ b. $C_7H_5O_2N$ c. $C_5H_7N_2O$ d. $C_7H_5N_2O$
12. Blue baby disease found in infants is due to excessive _____ in drinking water.
a. Color b. Sulphates c. Carbonates d. Nitrates
13. The dissolved oxygen level in natural unpolluted waters at normal temperature is found to be of the order of (in mg/L)
a. 1 b. 10 c. 100 d. 1000
14. What does Tanner's triangle assess?
a. Compactness of waste b. Permeability of waste
c. Voidness of waste d. Combustibility of waste
15. What are key variables in characterizing as fuel?
a. Moisture, inorganic, organic b. Moisture, ignitability, organic
c. Moisture, ignitability, inorganic d. Ignitability, organic, inorganic
16. Activated carbon is used for
a. Disinfection b. Removing hardness
c. Removing odors d. Removing corrosiveness
17. What is limiting nutrient for eutrophication in the freshwater?
a. Nitrogen b. Phosphorus c. Sulphur d. Calcium
18. What is ThCOD of $C_3H_6O_2$ in g O_2 /g $C_3H_6O_2$?
a. 0.5 b. 1.5 c. 2.5 d. 3
19. Nitrification is performed by
a. Anaerobic autotrophic chemolithotrophs
b. Aerobic autotrophic chemolithotrophs
c. Anaerobic heterotroph chemolithotrophs
d. Aerobic heterotroph chemolithotrophs
20. Activated sludge process is an example of
a. Anaerobic suspended growth process
b. Anaerobic attached growth process
c. Aerobic attached growth process
d. Aerobic suspended growth process

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07 DEC 2023

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

Course : CHEG 322
Semester : II
F. M. : 40

SECTION "B"
[5Q. × 8 = 40 marks]

Attempt *ALL* questions.

1.
 - a. Describe how you determine the following parameters: Total solids, Total suspended solids, Total volatile solids. [6]
 - b. Why should we remove nutrients (nitrogen and phosphorus) and organic carbon from wastewater? [2]

2.
 - a. List four different parameters you should monitor for smooth functioning of an AD reactor? [4]
 - b. Describe what happens to these five parameters during instability. [4]

3.
 - a. Draw a typical activated sludge wastewater-treatment plant (only COD removal) flow diagram incorporating flow equalization tank. [3]
 - b. What is leachate? What should be considered while choosing a location for a landfill? List at least 10. [3]
 - c. Determine the area required for a new landfill site with a projected life of 30 years for a population of 250,000 generating $2.02 \text{ kg} \cdot (\text{capita})^{-1} \cdot \text{day}^{-1}$. The density of the compacted waste is $470 \text{ kg} \cdot \text{m}^{-3}$. The height of the landfill cannot exceed 15 m. [2]

4.
 - a. Different samples of waste collected in a city have been taken and analyzed. It has been found that it can be divided into four categories which are Food Waste, Paper, Cardboard and Plastic. Amount of potentially critical elements against each category can be found in the table below.

Component	Wet mass in kg	Dry mass in kg	Moisture in kg	Composition in kg					
				C	H	O	N	S	Ash
Food Waste	16	5	11	2.40	0.32	1.88	0.13	0.02	0.26
Paper	46	43	3	18.70	2.58	18.92	0.13	0.08	2.58
Cardboard	11	10	1	4.40	0.59	4.46	0.03	0.02	0.51
Plastic	11	10	1	6.00	0.72	2.38	0.00	0.00	1.00

Find

- i. Approximate formula of solid waste [4]
 - ii. Energy contents of solid waste per Kg. (Assume that Ash is already removed before incineration) $(\text{BTU/lb} = 145\text{C} + 610(\text{H} - 1/8 \text{O}) + 40\text{S} + 10\text{N})$ [2]
- b. What is a logical priority in managing hazardous waste? Be creative. [2]

5. A city of 200000 people deposits $1.05 \text{ m}^3/\text{s}$ of sewage having an ultimate BOD of 28.0 mg/L and 1.8 mg/L of DO into a river that has a flow rate of $7.08 \text{ m}^3/\text{s}$ and a flow of 0.37 m/s . Just upstream of the release point, the river has an ultimate BOD of 3.6 mg/L and a DO of 7.6 mg/L . The saturation value of DO is 8.5 mg/L . The deoxygenation coefficient $k_d = 0.61$ per day and the reaeration coefficient k_r is 0.76 per day. Assume complete and instantaneous mixing of the sewage and river.
- Find the initial oxygen deficit and ultimate BOD just downstream of the outfall. [2]
 - Find the time and distance to reach the minimum DO. [3]
 - Find the minimum DO. [3]

Formulas:

$$D = \frac{k_d L_a}{k_r - k_d} (e^{-k_d t} - e^{-k_r t}) + D_0 e^{-k_r t}$$

$$t_c = \frac{1}{k_r - k_d} \ln \left[\frac{k_r}{k_d} \left(1 - \frac{D_0 (k_r - k_d)}{k_d L_a} \right) \right]$$

$$D = S - C$$