

Damietta University
Faculty of Science
Environmental Sciences Department



Semester: May 2024 Date: Saturday 08/06/2024 Allowed Time: 2 hours

Final Exam of Water Quality (Course Code: 413 E) for 4th. Level Environmental Sciences and Chemistry Program

Answer All the Following Questions:

Total Mark: 90 Marks

Question [1]: (22 Marks)

- a) "Increasing the natural self-purification capacity of a river is one of the strategic options for wastewater management". Briefly demonstrate this concept, and mention some ways that could be used to achieve this concept.

 [8 Marks]
- b) Conventional potable water treatment systems remove some parameters from water and do not usually remove the others. Which of the following parameters could be removed and which could be not? and why?

1- E. coli

2- Suspended Solids

3- Organochlorine pesticides

4- SO42-

[8 Marks]

c) Oxidation ponds have diverse characteristics in waste water treatment. Comment on this statement. [6 Marks]

Question [2]: (28 Marks)

- a) Illustrate the concept of "the end of pipe measures" within the framework of wastewater management. [8 Marks]
- b) Compare between each of the following:
 - i. Activated sludge and membrane bioreactor processes for wastewater treatment, and use the drawing for clarification. [12 Marks]
 - ii. Primary Drinking Water Standards and Secondary Drinking Water Standards according to the U.S. EPA. [8 Marks]

Question [3]: (20 Marks)

a) i. State the different phases of anaerobic wastewater degradation, then infer at which phase the organic load starts to be actually treated, and give the reason for your answer.

[6 Marks]

- ii. Write *very shortly* about how to generate energy from the biodegradable organic matter of wastewater, using the idea of the anaerobic degradation. [1 Mark]
- b) Choose the most appropriate answer for each of the following: [13 Marks]
 - 1- In the stationary phase of the microbial growth patterns in batch cultures, there is a balance between the activated sludge amount and (effluent organic load dissolved oxygen influent organic load growth of bacteria adaptation of bacteria).
 - 2- Treatment of wastewater using activated sludge system followed by discharging into nearest surface water is the predominant type of wastewater treatment, however (reuse / recovery groundwater recharge discharge onto land area separation of wastewater) is a better option.
 - 3- The actual treatment stage in the activated sludge system for wastewater treatment is the (secondary settling tank primary settling tank thickener tertiary treatment disinfection secondary aeration tank).
 - 4- As an example of nutrient recovery from wastewater, ammonia can be recovered and reused after several conversions and up taking by some organisms as (heavy metals carbohydrates an organic fertilizer a protein).
 - 5- Trickling filter is an example of (suspended growth microbial growth attached growth activated sludge) biological wastewater treatment.
 - 6, 7- One of the drawbacks present in urban wastewater management system is the (option evolution pollution concentration population dilution), which cases wastage of resources such as (<u>liquid wastes</u> <u>water</u>, N, P & heavy metals <u>microorganisms</u> <u>suspended & dissolved solids</u> <u>solid wastes</u>).
 - 8- Priority pollutants are among the *(radiological microbiological physicochemical)* properties of liquid wastes.
 - 9- COD is used to measure the amount of (biological chemical organic inorganic oxidant TOC colloidal) content of a liquid waste.
 - 10- In the liquid waste management system, substitution of a chemical fertilizer with organic fertilizer and substitution of phosphorus in detergents with a biodegradable matter are considered as (reuse self-purification pollution prevention abuse) option.
 - 11- Activated sludge treatment system for the liquid wastes is considered as:

 (a recycling of the wastewater within the same process pollution prevention at source an end of pipe measures).
 - 12- Inorganic fertilizers, which discharged into waterways by the drainage of the agricultural wastewaters, cause organic pollution after a period of time due to the
 - i. degradation of pesticides and dump of animals that composed of organic matters
 - ii. degradation of sewage that composed mainly of organic matters
 - iii. degradation of aquatic plants that composed of organic matters
 - iv. degradation of the naturally occurring humic materials
 - v. none of the above
 - 13- The higher the organic matter content of water, the
 - i. lower the oxygen content.
- ii. higher the BOD results.
- iii. both of i and ii.
- iv. none of the previous.

Question [4]: (20 Marks)

- a) Calculate the TOC and COD of 7.6 millimoles of pentanoic acid solution in ppm, knowing that the oxidation of pentanoic acid occurs as follows:

 CH₃CH₂CH₂COOH + 6½O₂

 5CO₂ + 5H₂O
 [7 Marks]
- b) What are the organic loading rate and the sludge loading rate of an activated sludge plant treating sewage water, and working with a hydraulic retention time of 5.09 hours and has an influent biochemical oxygen demand of 399 ppm and a mixed liquor suspended solid of 3699 mg/l? then comment on the treatment rate of this treatment plant.

 [10 Marks]
- c) A sample of a medium strength industrial liquid waste was analyzed, and the results showed that 19% of its content of solids is coarse suspended solids, 13% is dissolved solids and 68% is colloidal solids. According to your knowledge, what will be the first choice for treating this investigated wastewater? Is it *chemical*, *biological* or *physical* treatment? and why?

 [3 Marks]

----- Best Wishes -----

Dr. Khaled H. El-Ezaby