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THE OPEN UNIVERSITY OF SRI LANKA
Department of Civil Engineering
Bachelor of Technology (Civil) - Level 6

CEX 6233 – ENVIRONMENTAL ENGINEERING

FINAL EXAMINATION - 2013/2014

Time Allowed: Three hours **Index No.** | | | | |

Date: 17th August, 2014 Time : 0930 - 1230

Answer any FIVE questions. All questions carry equal marks.

Question 1

(a) (i) What is meant by 'bioaccumulation' and 'biomagnification'? What is the difference between two terms? [02 marks]
(ii) (Poly Chloro Benzen) PCBs are a group of organic industrial chemicals that become very persistent contaminants when released into the environment. How this impacts to the human health if PCBs are released to a river. Explain briefly. [03 marks]

(b) (i) What is meant by biogeochemical cycles? Provide three examples and discuss some impacts resulting from the disruption of biogeochemical cycles. [03 marks]
(ii)Water pollution effects the reduction of dissolved oxygen level in the water. Explain briefly its impact on the ecological balance. [02 marks]
(iii)Discuss the impacts of global warming specially on ecosystems. [03 marks]

(c) (i)What is meant by communicable diseases? [01 mark]
(ii)List five common intestinal diseases coming under communicable diseases. What is the most common transmission mode of these diseases? [03 marks]
(iii)Controls of communicable diseases are a big challenge in Environmental Engineering. How do you overcome this task? Explain briefly. [03 marks]

Question 2

(a) (i) What are the dominant hardness producing ions and how hardness effects on potable water? [02 marks]
(ii) List the three reasons which cause for tastes and odours in water supply? Also describe the methods available for removing taste and odour. [04 marks]

(b) Groundwater from tube wells are not always a good solution for water scarcity. Arsenic (As) poisoning in Bangladesh in one of such issues in recent past.
(i)How As gets into this water. Explain briefly. [04 marks]
(ii)What are the consequences with As in human body. [02 marks]
(iii) How this As contamination spreads over a many part of the Country Explain Briefly. [04 marks]

(c) Nearly all water on earth contains naturally occurring fluoride. Investigations of the decay preventing effects of the naturally occurring fluoride in water led to the start of community water fluoridation in 1945.

(i) Why flurodizaton is important. What else may the fluorides added by drinking water? [02 marks]

(ii)Are there negative effects of fluoridation? [02 marks]

Question 3

(a) A small water treatment plant has a raw water inflow rate of 0.6 m^3/s. Laboratory studies have shown that the flocculated slurry can be expected have uniform particle size and it has been found through experimentation that all the particles settle at a rate of Vs = 0.004 m/s. A proposed rectangular settling tank has an effective settling zone of L= 20m, H=3m, and W=6m.

(i) Could 100% removal be expected? [04 marks]

(ii) What fraction of the particles is removed? [03 marks]

(b) (i)Why filtration in needed in water treatment systems? [01 mark]

(ii) A water treatment system consists of a filtration unit of 8m by 6m. What is the filtration rate if it receives 8 million L/d? [03 marks]

(iii) How much back wash water is required to clean the above filter unit if the back wash rate is 48 $m^3/hr/m^2$? [03 marks]

(c) DBPs (Disinfecion by products) are under concerns due to its carcinogenetic characteristics.

(i)How DBPs are formulated? [02 marks]

(ii)List compounds categorized under DBPs. [02 marks]

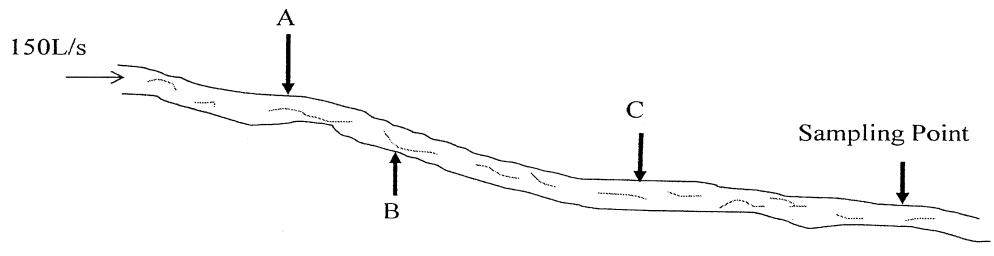
(iii) How do you eliminate DBPs. Explain briefly [02 marks]

Question 4

(a) A stream [Figure Q(a)] flowing at 150 L/S and 20 mg/L suspended solids, receives wastewater from three square sources:

Source	Quantity (L/s)	Solid Concentration (mg/L)
A	100	200
B	300	50
C	50	200

What are the flow and suspended solid concentration downstream at the sampling point? [05 marks]



(b) An activated sludge system has a flow of 4000 m3/day with X= 4000 mg/L and S_0 = 300 mg/L. From pilot plant work the kinetic constants are Y =0.5, K = 3 d^{-1}, Ks = 200 mg/L. We need to design an aeration system that will remove 90% of the BOD_5. Estimate
(i) the volume of the aeration tank [03 marks]
(ii) the sludge age [02 marks]
(iii) the amount of waste activated sludge [03 marks]

(c) Metal concentrations in wastewater sludge are often expressed in terms of grams of metal per kilogram of total dry solids. A wet sludge has a solid concentration of 200,000 mg/L, and 8000 mg/L of these solids are zinc.
(II) What is the concentration of zinc as g Zn/g dry solids? [03 marks]
(ii) If this sludge is to be applied to farmland and spread on pastures used by cows, explain how would you monitor the project with regard to the potential environmental or health effects caused by the presence of the zinc. [04 marks]

Question 5

(a) A channel type grit chamber is to be installed in a wastewater treatment plant processing 0.01 m^3/s. The flow through velocity is to be controlled at 0.33m/s by a downstream proportioning weir. Determine the channel dimensions for a depth to width ratio of 1:1.5. [05 marks]

(b) (i)Describe the waste removal process of tricking filter or Rotating biological contractors with help of the neat figures. [02 marks]
(ii) Determine the surface area of a primary settling tank sized to handle a maximum hourly flow of 0.570 m^3/s at an overflow rate 60.0 m/d. If the effective tank depth is 3.0 m what is the effective theoretical detention time? [05 marks]
(iii) If an equalization tank is installed ahead of the primary tank in above problem , the average flow to the tank is reduced to 0.4 m3/s. What is the new overflow rate and detention time? [04 marks]

(c) (i)What are the principal mechanisms to remove and transform pollutants in subsurface water flow wetlands?
(ii)Explain 'sludge conditioning' giving examples. [02 marks]
(iii)Describe the locations for ultimate sludge disposal and treatment steps prior to ultimate disposal. [02 marks]

Question 6

(a) (i) What are the natural sources might the following pollutants arise: CO_2, H_2S, CH_4 and particulate matter (dust and smoke) [04 marks]
(ii)The primary ambient air quality standard for NO_2 is 100 $\mu g/m^3$. What is this in ppm. Assume 298 K and 1 atm) [03 marks]
(iii)In Colombo, Sri Lanka the ambient NO_2 levels are higher that the stipulated levels by the Central Environmental Authority. What is main contributor? Also explain two mitigatory measures to reduce ambient NO_2 in Colombo city. [03 marks]

(b) (i) What specific air pollution control devices are available for control the particulate emissions at their source? [02 marks]
(i)Vehicles were the largest air pollution source in some cities in the world. Name and describe three control devices developed for control of automotive emissions. [03 marks]
(iii) What is 'opacity' and how it is measured? [02 marks]

(c) Noise effects on existing urban residences and institutions in an area are being studied. Describe three different methods to reduce the noise from increased traffic for the people living and working in the area. [03 marks]

Question 7

The Open University uses an incinerator to dispose of some of the solid waste generated on its premises. Materials incinerated include garden waste, paper and some plastics.

Answer the following questions related to this practice. Please answer briefly and to the point. Use tables and lists where possible. Marks will be reduced if irrelevant or incorrect material is included in the answer.

(a) Do you think that the incinerator is a suitable method of disposal for these types of waste? Justify your answer including a discussion of alternatives. [04 marks]

(b) Identify and describe an alternative method of disposal for garden waste. Use neat figures if necessary. [04 marks]

(c) Identify three pollutants can be reduced by maintaining a proper operating temperature in the incinerator. Explain your answer. [04 marks]

(d) Why is it necessary to install a chimney (also known as a smokestack) on the incinerator? [02 marks]

(e) List and discuss the factors you would consider in order to determine the height and diameter of the chimney of the incinerator. [04 marks]

(f) Identify any other steps you would take to reduce the air pollution caused by the incinerator. [02 marks]

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