



UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 7 Examination in Engineering: July 2016

Module Number: CE7304

Module Name: Environmental Management

[Three Hours]

[Answer all questions, each question carries twelve marks]

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- Q1. a) "The environment can no longer be viewed as a technical subject to be addressed independently from overall municipal and industrial strategic decision making." Rationalize this statement. [2.0 Marks]
- b) (i) "'Life Cycle Assessment' is a pro-active environmental management strategy." Rationalize this statement giving emphasis to the definition of 'Life Cycle Assessment'. [2.0 Marks]
- (ii) Discuss briefly how 'Life Cycle Assessment' can effectively be utilized as a tool for environmental management (a) during constructional activities; (b) in an industry. [2.0 Marks]
- c) (i) Identify the critical parameters to be included in the Environmental Monitoring Program of an Environmental Impact Assessment (EIA) report for one project out of the following list: a sea port construction project; a project for constructing a wastewater collection, treatment and disposal system; a project for constructing a cane sugar manufacturing industry. [2.0 Marks]
- (ii) Develop a viable Environmental Monitoring Program for the identified parameters above (Note: It should be presented in the tabular format). [4.0 Marks]
- Q2. a) (i) The characteristics of a wastewater out-fall having a varying flow rate is to be investigated. The flow variations exceed $\pm 15\%$. What is the most suitable sampling technique to be used to collect a sample from above waste stream, justify your selection? [1.0 Marks]
- (ii) The hourly flow rates of the above wastewater out-fall for a period from 6.00 a.m. to 12.00 noon are 200, 210, 190, 180, 220 and 205 m^3 . Two samples will be collected using 'fixed volume - fixed time interval composite sampling' and 'flow proportionate composite sampling' techniques. The total volume of each composite sample will be 1500 mL. Estimate the volume of the sample that should be collected every hour for each sampling technique. [3.0 Marks]

- b) In an industrial park, a cane sugar manufacturing industry, a chrome tanning industry, a dairy and a food processing industry are located. All the industries plan to discharge their effluent in to a municipal sewer after giving some pre-treatment if necessary.
- (i) Discuss how each of above industries would arrange the pre-treatment facilities so that the partially treated effluent is able to be discharged into a municipal sewer (i.e. Draw a flow diagram to illustrate all pre-treatment unit processes). [2.0 Marks]
- (ii) In order to convert this into an eco-industrial park, discuss **three** possible path-ways to minimize the pollution arising from wastewater, air and solid waste, except methods associated with the end-of-pipe treatment. [2.0 Marks]
- c) Table Q2 shows the hourly average flow rates of the wastewater discharged by an industry. Design the size of an equalization tank to balance the flow rates. Assume a safety factor of 1.75.

Table Q2 Wastewater flow rates

Time (h)	Average flow rate (m ³ /s)
0-1	0.13
1-2	0.14
2-3	0.17
3-4	0.15
4-5	0.11
5-6	0.09
6-7	0.1
7-8	0.15
8-9	0.15
9-10	0.21
10-11	0.22
11-12	0.15

[4.0 Marks]

- Q3. An industrial effluent is released into a tributary which flows into a larger stream at a distance of 0.25 km from the point of industrial effluent discharge. Table Q3 (i) gives the details of the industrial effluent, tributary conditions just upstream to the industrial discharge, and the stream conditions just upstream to the connection point of the tributary with the stream. Table Q3 (ii) gives the saturated DO concentrations at different temperatures. Following equations are applicable:

$$D_c = \frac{k}{k_2} L_i e^{-k\theta_H^*}; \theta_H^* = \frac{1}{(k_2 - k)} \ln \frac{k_2}{k} \left\{ 1 - \frac{D_i(k_2 - k)}{kL_i} \right\}; L = L_i e^{-k\theta_H};$$

$$D_{O_2} = \frac{kL_i}{(k_2 - k)} (e^{-k\theta_H} - e^{-k_2\theta_H}) + D_i e^{-k_2\theta_H}; k_T = k_{20} \times \theta^{(T-20)}; x = \theta_H u$$

D_i = Initial dissolved oxygen deficit at the point of waste discharge, mg/L

- D_c = Critical dissolved oxygen deficit, mg/L
 θ_H = Hydraulic retention time, d
 θ_H^* = Critical hydraulic retention time, d
 k_2 = Re-aeration constant, d^{-1}
 k = Carbonaceous organic matter degradation rate constant, d^{-1}
 k_T = Reaction rate constant at T °C, d^{-1}
 k_{20} = Reaction rate constant at 20°C, d^{-1}
 L_t = Ultimate BOD (BOD_u) at the point of waste discharge, mg/L
 x = Distance from the mixing point, m
 u = Velocity, md^{-1}

Table Q3 (i) Measurements of the industrial effluents A and B, and the stream.

Parameter	Industrial Effluent	Tributary	Stream
Flow rate, m^3/d	4,000	10,000	30,000
Velocity, m/d	-	50	80
Ultimate BOD , mg/L	30	20	-
Ultimate BOD load, kg/d	-	-	225
DO (Dissolved Oxygen) load, kg/d	12	50	250
Temperature, °C	30	25	25
k at 20 °C, d^{-1}	0.36	0.36	-
k_2 at 20 °C, d^{-1}	-	-	0.60
Temperature coefficient (θ)	1.06		

Table Q3 (ii) Saturated DO concentrations at different temperatures.

Temperature(°C)	21	22	23	24	25	26	27	28	29	30
Saturated DO concentration (mg/L)	8.9	8.73	8.56	8.4	8.24	8.09	7.95	7.81	7.67	7.54

- Find the conditions in terms of BOD_u , DO and Temperature just downstream to the industrial effluent discharge point at the tributary. [4.0 Marks]
- Find the conditions in terms of BOD_u , DO and Temperature just downstream to the connecting point of the tributary with the stream. [4.0 Marks]
- Determine the oxygen sag at the critical point of the stream. [2.0 Marks]
- Estimate the BOD_5 (25°C) of a sample taken at the critical point of the stream. Consider the temperature at the critical point as the temperature at which the above BOD_5 value should be determined. [2.0 Marks]

Q4. a) Read the following case and answer the questions.

A large-scale acid mining company has been operating for about 5 years in a coastal region. Mining activity of this company is very intense. This company has effectively implemented its Environmental Management Plan with great success, mitigating the environmental impacts caused by this activity. Up to

date, the results of the environmental auditory show that this company completely fulfill all legal requirements, laws and environmental standards established by the authorities. Since last year, this company is part of a trial against the community, which argues that after the company has started its mining activity in the zone, the quality of the water has been significantly deteriorated and that this company is operating in an environmentally sensitive area. The Company argues that it has relevant proofs in order to demonstrate that they have not polluted the environment. The mining company emphasizes that when they began the activities, the environment was already polluted especially the quality of water was very poor.

(i) What document the mining company must present in the trial in order to demonstrate its argument that the environmental quality was already deteriorate before their activities began in the zone. Why is this document so important?

[2.0 Marks]

(ii) Mention **five** environmental impacts this company might cause to the environment.

[2.5 Marks]

(iii) Explain briefly how to bring the above company into an environmentally sustainable state.

[2.5 Marks]

b) Construct an outline of a weighting-scaling checklist that could be used to compare alternative sites in developing an Environmental Impact Assessment (EIA) report for the project described in the following case. The checklist should include at least 10 decision factors, an imaginary weight for each decision factor and an imaginary scale for each alternative site. A composite index for each alternative has to be obtained based on the imaginary weights and scales.

Case :

There is a proposal to construct a dam and divert water from a river to a new reservoir through a 20-km long canal. Main objectives of this proposal are to prevent downstream flooding and supplying irrigation water and safe drinking water to surrounding townships. The average population affected is 25,000. About 20 % of the affected community is engaged in illegal sand mining in the reaches close to the proposed dam. These sand mining reaches are highly polluted due to the illegal disposal of urban waste, and possess eroded banks. Majority of the population is engaged in small scale agriculture like paddy and other crop cultivation and small scale businesses. People are poor. The percentage of people without access to safe drinking water and sanitation are 40% and 50%, respectively. The project area will inundate a few paddy fields.

[5.0 Marks]

Q5. a) What are Environmental standards and why are they important in the context of EIA?

[3.0 Marks]

b) Discuss briefly 3 objectives of public participation and stakeholder involvement in environmental management?

[3.0 Marks]

c) What are the responsibilities of an Engineer-in-charge of an Industry with

respect to the environmental management?

[3.0 Marks]

- d) Explain briefly how the quantity of solid waste generated in an industry could be reduced.

[3.0 Marks]