# MASTER OF CIVIL ENGINEERING EXAMINATION, 2019

First year , 2nd Semester

## SUBJECT: PROCESS DESIGN IN ENVIRONMENTAL ENGINEERING

Full Marks ~~30~~/100

Time: ~~Two hours~~/Three hours/~~Four hours/ Six hours~~

**Use a separate Answer-Script for each part**

| No. of Questions | Part I (Marks:60) | Marks |
|---|---|---|
| | Answer All the questions<br><br>Assume relevant Data wherever is necessary | |
| Q1. a) | A city requires to supply for a population of 10, 75,000 with 180 lpcd potable water for which rapid gravity filter is to be installed. The backwash water is 2% of the total requirement. The operation time is 20 hrs a day out of which 30 minutes are kept for service time. Determine the following components of the filtration unit.<br>a) No.of filter bed including 25% extra as stand bye.<br>b) Size and No. of Laterals.<br>c) Nos and spacing of orifices ( use 15mm dia)<br>d) Spacing of Laterals.<br>e) Size of Manifold.<br>f) Size of Back washwater troughs.<br>Assume other relevant data. | 12 |
| b) | Design a suitable septic tank for 50 users. Assume simultaneous equivalent fixture units to be operative as 30. Draw also a suitable sketch of the septic tank. | 8 |
| Q 2. | | |
| a) | Discuss the hydraulic configuration with reference to contact period of the following units.<br>a) Batch fed reactor.<br>b) Continuous reactor | 4+4=8 |
| b) | Derive an expression to calculate the reactor volume to obtain a desired concentration of any pollutant undergoes ' n' nos of CMBR. | 4 |
| c) | Determine the reaction order and the reaction rate constant using the following data obtained from a laboratory experiment.<br><br>Time in hrs:- 0 0.25 0.50 0.60 0.70 0.75 1.0 1.5 2 3 4<br><br>Concentration in mg/L :-40 38 26 20 18 16 10 8 6 5 2.0 | 8 |

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| No. of Questions | Part I (Marks:60) | Marks |
|---|---|---|
| Q3 . | | |
| a) | Following information are available for designing of a mixing and flocculation unit.<br>Flow rate = 10MLD<br>Rapid mixing time = 60sec<br>Viscosity of water = $1.08 \times 10^{-3}$ N-sec/m$^2$<br>The depth of rapid mixing unit = 3.6 m<br>The depth of flocculation basin = 4.2 m<br>Flocculation time = 20 min<br><br>Determine<br>1) the power input in the above two units in KW<br>2) dimension of mixing and flocculation unit<br>Assume G for fresh mixing unit 700 sec$^{-1}$<br>G for flocculation unit 35 sec | 13 |
| b) | Explain with examples, the principle of preparation of filter bed from river run off available sand | 7 |

Ref No. –Ex/PG/CE/T/128E/2019

M.E. CIVIL ENGINEERING 1ST YEAR EXAMINATION, 2019
(2nd Semester)
SUBJECT: Process Design in Environmental Engineering

Time: Three hours

Full Marks 100

Use separate Answer-Scripts for each part

| No. of Questions | Part I (40 marks for this part) | Marks |
|---|---|---|
| | **Answer any two questions. Answer should be brief and to the point. All the notations have their usual meaning. Assume relevant data if not provided** | |
| Q1. a) | Explain what do you mean by plug flow, complete mix flow and dispersal flow condition. | 2×3 |
| b) | Define dispersion number with its expression. What is its unit? | 2+1+1 |
| | For a waste stabilization ponds following data are applicable: | |
| c) | Population= 4000; Waste water flow = 165 litres/capitad$^{-1}$; $BOD_5$ contribution = 50g/persond$^{-1}$; Final $BOD_5$ in the effluent < 50 mg/l; $SO_4^{2-}$=115 mg/L, latitude of the place = 23°N; Average radiation in January = 125 cal/cm$^2$-d; conversion efficiency=6%; Kp reactor temperature = 0.09/d | |
| | **Determine:** | |
| | a. Oxygen production | 2+2 |
| | b. Detention time for mixed flow condition | +4+2 |
| | c. Pond size: volume, area and depth | |
| | d. Sulphide concentration in pond at 25°C | |
| Q2. a) | What do you mean by rotating biological contractor (RBC)? Draw a neat labeled process flow sheet for a RBC. | 2+3 |
| b) | With a neat sketch explain staging of a RBC. | 5 |
| c) | Determine the oxygenation capacity in kg per day of a cage rotor and power requirement in KW for an aerated lagoon with the following information: | 10 |
| | I. Waste water flow = 5000 m$^3$ per day | |
| | II. Influent soluble $BOD_5$ contribution = 200 g/m$^3$ | |
| | III. Desired effluent soluble $BOD_5$ = 30 g/m$^3$ | |
| | IV. Kinetic coefficient at reactor temperature: Y=0.6 g/g; $k_s$=80g/m$^3$; k= 5g/gd; $k_d$=0.07g/gd | |
| | V. Lagoon depth =2.5m | |
| | VI. Design hydraulic retention time = 5 days | |
| | VII. Power requirement for mixing = 8KW/1000m$^3$ | |
| | VIII. Aerator $O_2$ transfer rate 1.8 kg$O_2$/KWh | |

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(2nd Semester)

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| No. of Questions | Part I (40 marks for this part) | Marks |
|---|---|---|
| | IX. Summer ambient temperature = 30°C | |
| | X. Wastewater temperature during summer = 20°C | |
| | XI. For aerated lagoon, f=0.5 | |
| | XII. Elevation of the area = 1000m | |
| | XIII. $\alpha = 0.85$; $\beta = 1$ | |
| | XIV. $C_s$ = 9.17mg/L at 20°C | |
| | XV. $C_w$ at 25°C = 8.38mg/L | |
| | XVI. Altitude correction factor for 1000m elevation = 0.95 | |
| | XVII. O2 concentration to be maintained in liquid =1.5 mg/L | |
| Q3 a) | With a complete flow sheet of oxidation ditch explain the advantages of oxidation ditch for treating wastewater. | 6 |
| b) | Write a short note on flow through aerobic lagoons | 4 |
| c) | Determine the liquid volume and total oxygen requirement for an oxidation ditch for the following conditions: | |
| | i)Population to be served=60000 @ 150lpercapitaperday waste water, BOD5 at 20°C 40gpercapita perday and TKN 8g percapitaperday | 10 |
| | ii)Desired effluent BOD5 at 20°C=20mg/l | |
| | iii) Suspended solid in the wastewater = 20 mg/l and 65% of this solid is biodegradable | |
| | iv)Organic loading=0.25kgBOD5/day/kgMLVSS | |
| | v)MLSS concentration=3500mg/l | |
| | vi)Volatile fraction of MLSS=0.6 | |
| | vii)Sludge yield coefficient=0.6 | |
| | viii) Sludge decay coefficient=0.12$d^{-1}$ | |

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**No. of Questions**

**Part I (40 marks for this part)**

**Marks**