Ref. No.: **Ex/CE/PE/B/T/422G/2023**

# B.E. CIVIL ENGINEERING FOURTH YEAR SECOND SEMESTER EXAM 2023

## SUBJECT: INDUSTRIAL WATER POLLUTION AND CONTROL

**Time: 3 hours** **Full Marks: 100**

**Instructions: Use Separate Answer scripts for each part.**

## Part - I (Marks: 50)

<table>
<tr><th>Sl. No.</th><th>Question</th><th>CO</th><th>Marks</th></tr>
<tr><td>1</td><td>The hourly flow pattern of an industrial process is given below. Determine the volume of the equalization basin by Mass balance.
<table>
<tr><td>Time</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>Noon</td></tr>
<tr><td>Inflow rate ($m^3/h$)</td><td>2250</td><td>2235</td><td>2100</td><td>1920</td><td>1680</td><td>1380</td><td>1230</td><td>1350</td><td>1574</td><td>1574</td><td>1383</td><td>1174</td></tr>
<tr><td>Time</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>Midnight</td></tr>
<tr><td>Inflow rate ($m^3/h$)</td><td>1050</td><td>960</td><td>930</td><td>930</td><td>975</td><td>1080</td><td>1170</td><td>1350</td><td>1570</td><td>1800</td><td>2100</td><td>2235</td></tr>
</table></td><td>[CO2]</td><td>[15]</td></tr>
<tr><td>2</td><td>An industrial effluent discharges 0.35 $m^3$/min of wastewater with $H_2SO_4$ (0.15N) requires neutralization to a pH of 7.0 using a limestone bed. Assume limestone is 60% reactive. Hydraulic loading with depth of limestone bed to get pH of 7.0 are estimated from laboratory studies and results are furnished in the table below.
<table>
<tr><td>Depth, m</td><td>0.154</td><td>0.3</td><td>0.65</td><td>0.96</td><td>1.23</td></tr>
<tr><td>Hydraulic Loading, $m^3/m^2.hr$</td><td>1.8</td><td>6.3</td><td>35.5</td><td>55.6</td><td>66.3</td></tr>
</table>
Design neutralization system specifying<br>
a) Most economic limestone bed depth. Plot the flow rate per unit limestone volume vs. limestone bed depth.<br>
b) Weight of acid per day to be neutralized.<br>
c) Limestone requirements on a weekly basis.</td><td>[CO2]</td><td>[15]</td></tr>
<tr><td>3</td><td>Write short notes on grab sample and composite sample.</td><td>[CO1]</td><td>[5]</td></tr>
<tr><td>4</td><td>Discuss the importance of segregation in tanneries wrt salt recovery, Cr recovery and Sulphide oxidation.</td><td>[C04]</td><td>[5]</td></tr>
<tr><td>5</td><td>Neatly draw a flowchart of the treatment process for tannery effluent.</td><td>[C04]</td><td>[5]</td></tr>
<tr><td>6</td><td>Describe the steps for a Chromium recovery system.</td><td>[C03]</td><td>[5]</td></tr>
</table>

[ Turn over

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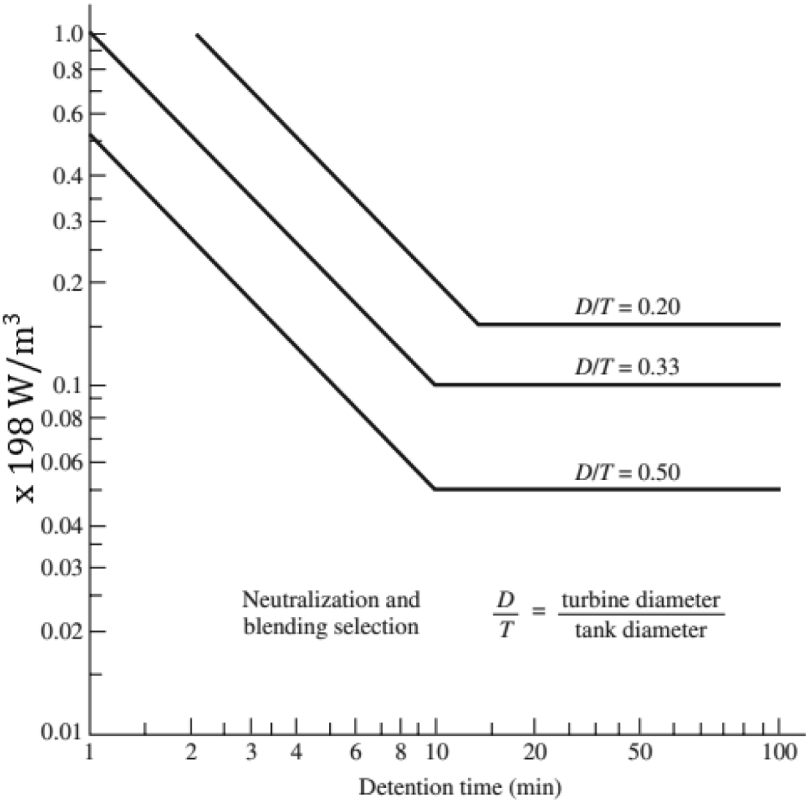
# B.E. CIVIL ENGINEERING FOURTH YEAR SECOND SEMESTER – 2023

## SUBJECT: INDUSTRIAL WATER POLLUTION AND CONTROL (CE/PE/B/T/422G)

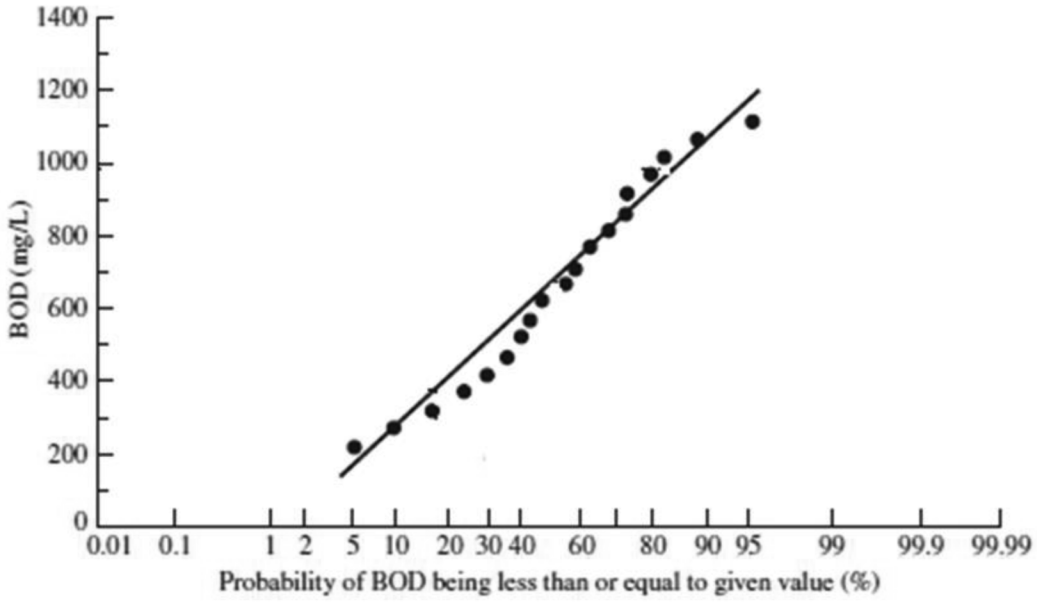
**Instructions: Use Separate Answer scripts for each part.**

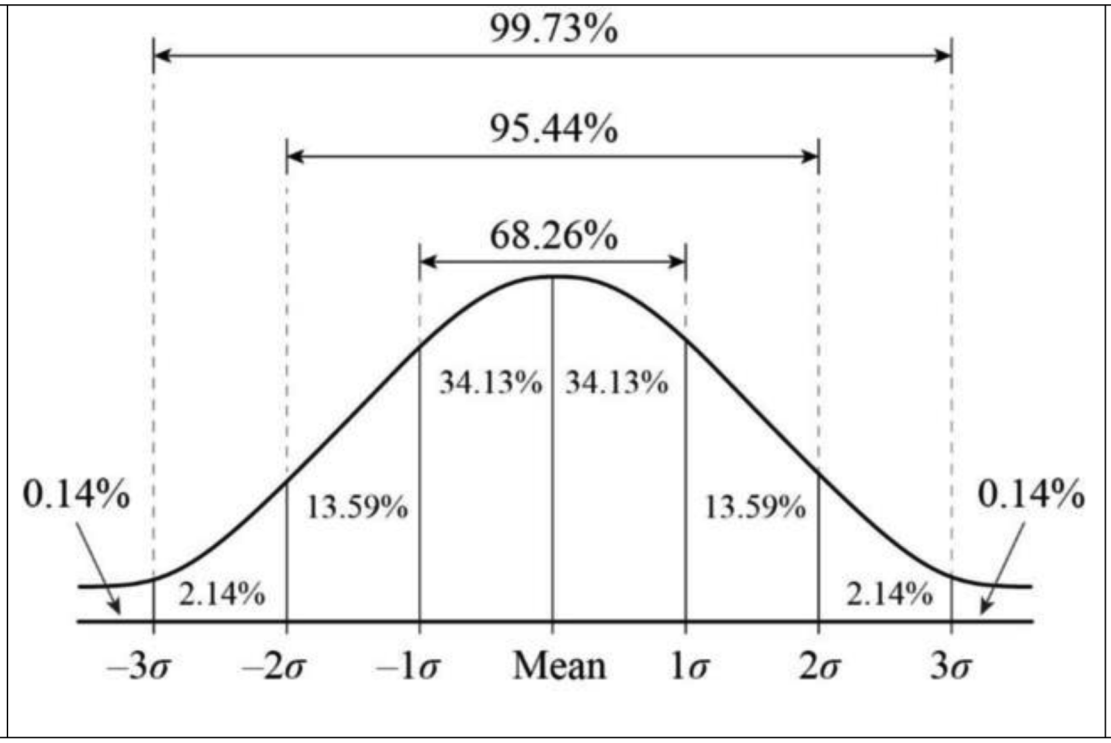
**Part - II ( Marks: 50 )**

| Sl. No. | Question | CO | Marks |
|---|---|---|---|
| **1** | Write down the basic equations for different types of precipitation process for removing heavy metal. | [C03] | [3] |
| **2** | What is the range of average waste water generation from different type of slaughter houses?<br>What is the composition of the wastewater?<br>Suggest a suitable treatment methodology for wastewater from slaughter houses. | [CO4] | [3+3+4] |
| **3** | Design an API separator for Indian oil refineries with an average flow rate of 300 $m^3$/hr. [Assume any necessary data within the range] | [CO2] | [8] |
| **4** | Design a flotation thickener without and with pressurized recycle to thicken the solids in activated sludge mixed liquor from 0.3 to 4%. Assume the following conditions:<br>i. $\frac{A}{S} = 0.008\ ml/mg$<br>ii. Air solubility: 18.7 ml/ltr<br>iii. Recycled system pressure: 275 kPa<br>iv. Fraction of saturation = 0.5<br>v. Surface loading rate: 8 ltr/$m^2$-min<br>vi. Sludge flow rate : 350 $m^3$/day | [CO2] | [8] |
| **5** | Waste water from a galvenizing shock industry is found to be highly acidic and requires neutralization prior to secondary treatment. The flow rate of waste water is 0.4 $m^3$/min, pH is 1.5. This flow is to be required to rise a pH of 7 by using lime. From titration curve it is observed that 1st stage requires 2000 mg/ltr and second stage requires 300 mg/ltr. Retention time is 5 – 10 min. Lime slurry consistency is 6-8 %. Assume depth of the tank in the range of 1.2 to 2 meter. Determine:<br>i) Quantity of lime to be used.<br>ii) Lime slurry storage tank volume.<br>iii) Find out the power requirement of the mixture | [CO2] | [8] |




| | | | |
|---|---|---|---|
| **6** | A waste with a total flow of 10,000 $m^3$/d was characterized as shown in Fig. Extensive data were collected every 4 h for 17 d. The average BOD was 690 mg/L and the maximum value was 1185 mg/L. Design calculations with activated sludge systems have indicated that the effluent from the equalization basin must not exceed 850 mg/L (confidence limit = 97.72%) in order to meet the effluent quality criteria of an average BOD of 15 mg/L and a maximum concentration of 25 mg/L from the activated sludge system. Design an equalization basin to meet the desired effluent requirements. | [CO2] | [13] |

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95.44%
68.26%
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Mean
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