Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

VII SEMESTER B.TECH. (CHEMICAL ENGINEERING)
END SEMESTER EXAMINATIONS, DEC 2020/JAN 2021

SUBJECT: PE - VI : INDUSTRIAL WASTEWATER ENGINEERING

[CHE 4006]
REVISED CREDIT SYSTEM

Date : 01/01/2021 **Time: 2 – 5 PM** **MAX. MARKS: 50**

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.

1A	The wastewater has a BOD_5 equal to 180 mg/l and a reaction rate k equal to 0.22/day. It also has a Total Kjeldahl Nitrogen content (TKN) of 30 mg/l. (i)Find the ultimate carbonaceous oxygen demand (CBOD) (ii)Find the ultimate nitrogenous oxygen demand (NBOD) (iii)Find the remaining BOD after 5 days have elapsed	**(3 marks)**
1B.	Describe the levels of wastewater treatment and classify the treatment process according to the level of advancement?	**(3 marks)**
1C.	Design a facultative aerated lagoon to serve 20000 persons with 50 gm/capita/day of BOD, Effluent BOD = 30 mg/l. Assume k_a at 20°C as 1 day^{-1} and design temperature of 25°C. Calculate number of aerators at a capacity of 1.75 kg of O_2/hr/HP with an efficiency of 75%.	**(4 marks)**
2A.	Explain the following terminologies: (i)Hydraulic retention time (ii)Flow through velocity (iii)Solid retention time (iv)Settling velocity	**(2 marks)**
2B.	Derive an expression for mean cell residence time, Sludge production rate and mass balance with biomass and with substrate using suitable mass balance equations for the sludge wastage from aeration tank.	**(8 marks)**

<table>
<tr><td>3A.</td><td>A conventional activated sludge process plant is in operation with a θ_c of 10 days. Reactor volume = 8000 m^3, MLSS = 3000 mg/l.
Determine
(i)Sludge production rate
(ii)Sludge wastage flow rate when wasting from the reactor
(iii)Sludge wastage flow rate when wasting from the recycle line.
Assume concentration of suspended solids in the recycle line as 10000 mg/l</td><td>(4 marks)</td></tr>
<tr><td>3B.</td><td>Estimate the dispersion number D/uL for a small tertiary pond for 2.2 days theoretical detention time for which the tracer test results are given below for a period of 9 hrs.
<table>
<tr><td>Time (hr)</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></tr>
<tr><td>Conc (mg/l)</td><td>43</td><td>43.5</td><td>45</td><td>46.5</td><td>48</td><td>51</td><td>47</td><td>46</td><td>45.4</td></tr>
</table>
Use both variance method and peak time technique.</td><td>(6 marks)</td></tr>
<tr><td>4A.</td><td>Explain the major problems in ASP treatment systems.</td><td>(3 marks)</td></tr>
<tr><td>4B.</td><td>Design a Trickling filter using an empirical method of US Tenstate standards for the following data. Calculate the corresponding value of k_f' in Eckenfelder equation.
Data given are Sewage flow = 5000 m^3/day, Raw BOD_5 = 200 mg/l, Efficiency = 85%, n = 0.5, Depth = 1.8 m.
Assume FLR as 1.2 kg BOD/m^3.day</td><td>(5 marks)</td></tr>
<tr><td>4C.</td><td>Draw the flow diagram of the following treatment systems:
(i)Secondary treatment with contact filtration and carbon adsorption
(ii)Extended aeration process</td><td>(2 marks)</td></tr>
<tr><td>5A.</td><td>Explain any two types of high rate anaerobic reactors with a neat flow diagram?</td><td>(3 marks)</td></tr>
<tr><td>5B.</td><td>What is sludge digestion? Explain the principal methods of processing and disposal of sludge?</td><td>(3 marks)</td></tr>
<tr><td>5C.</td><td>Explain the disinfection process for wastewater treatment and compare the usage of chlorine, ozone and UV for wastewater disinfection.</td><td>(4 marks)</td></tr>
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