Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

II SEMESTER M.TECH. EXTERNAL EXAMINATIONS REGULAR APRIL 2019

SUBJECT: DESIGN AND DEVELOPMENT OF BIOLOGICAL TREATMENT PROCESSES [BIO 5247]

Date of Exam: **04/05/2019** Time of Exam: **9.00 AM – 12.00 PM** Max. Marks: **50**

Instructions to Candidates:

- Answer ALL the questions & missing data may be suitable assumed

1A.	Write on the following parameters that are used in the design of activated sludge process i. Mixed liquor suspended solids (MLSS) ii. Mixed liquor volatile suspended solids (MLVSS) iii. Food to microorganisms (F/M) ratio	**3**
1B.	Explain the ORBAL process that is used for BOD removal, Nitrification and denitrification	**3**
1C.	Explain the following parameters that are used in the design of secondary clarifier i. The over flow rate ii. The weir loading rate iii. The solid loading rate	**4**
2A.	Design an aerated lagoon to treat domestic wastewater with a total BOD of 400 mg/l, a TSS of 130 mg/l and daily flow of 8000 m^3/d. Data for heterotrophic bacteria: μ_m=2.8d^{-1}, Kd=0.03 d^{-1}, Y=0.5 mgVSS/mg BOD, Ks=60 mg BOD/l, θ=2.5 d, BOD/TSS=0.63 and MLVSS=0.8 MLSS i. Calculate the required surface area of the Lagoon ii. Calculate power requirement for oxygen transfer and mixing	**4**
2B.	You are asked to design the separate stage for denitrification process with completely mixed reactor behavior. The denitrifying bacteria has the following growth constants. Data for Denitrifying bacteria: μ_m=0.4 d^{-1}, K_{Dn}=0.16 mg/l, Y=0.9, K_d=0.04 d^{-1} Influent substrate concentration (NO_3^- N)=39 mg/l, Effluent Substrate concentration (NO_3^- N)=1 mg/l, Influent flow rate=12918 m^3/d	**6**

<table>
<tr><td></td><td>Calculate (i) Cell Residence time (θ_C) (ii) Hydraulic Residence time (θ)
(iii) Amount of sludge discarded.</td><td></td></tr>
<tr><td>3A</td><td>Design an oxidation ditch for BOD removal only with the following data:
Influent BOD=300 mg BOD/L (soluble), Effluent BOD=15 mg BOD/L (soluble), Q=20,000 m^3/d, Y=0.5 mg VSS/mg BOD, Kd=0.03 d^{-1}, Ks=30 mg BOD/L, μ_m=2.5 d^{-1}. Assume that we want to allow for some sludge discard by using a sludge age (θ_c) 30 days and hydraulic residence time (θ) 15 h. Calculate
i. Substrate and biomass concentrations
ii. Amount of sludge discard
iii. Amount of air required.</td><td>5</td></tr>
<tr><td>3B.</td><td>Determine the rise in temperature for the aerobic stabilization of raw sewage sludge, if the initial dry matter content is around 32 g/L (average organic dry matter content of sewage sludge) and the biodegradability of 60% within the residence time in the sludge reactor. Specific energy requirement for heating 1 L of H_2O from 14.5–15.5 °C is 4.185 kJ.</td><td>2</td></tr>
<tr><td>3C.</td><td>Determine theoretically the gas composition (% carbon dioxide and % methane) of biomolecule $C_5H_{11}NO_2S$ and the volume of methane produced from 1 kg of biomolecule (NTP).
$C_cH_hO_oN_nS_s + \{(4c - h - 2o + 3n + 2s)/4\}\ H_2O \rightarrow$
$\{(4c - h + 2o + 3n + 2s)/8\}\ CO_2 + \{(4c + h - 2o - 3n - 2s)/8\}\ CH_4 + nNH_3 + sH_2S$</td><td>3</td></tr>
<tr><td>4A</td><td>Explain the removal of nitrogen from wastewater in order to avoid eutrophication.</td><td>4</td></tr>
<tr><td>4B</td><td>The following data were obtained from an experiment to determine the BOD rate constant k and ultimate BOD (L) for an untreated wastewater by daily difference method and Fujimoto method:
<table>
<tr><td>Time (d)</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>BOD (mg/L)</td><td>65</td><td>109</td><td>138</td><td>158</td><td>178</td><td>190</td><td>200</td><td>205</td><td>210</td></tr>
</table></td><td>6</td></tr>
<tr><td>5A</td><td>Describe the anaerobic treatment of wastewater by UASB reactor.</td><td>4</td></tr>
<tr><td>5B</td><td>What are the different methods available for disinfection of wastewater? Explain each one of them.</td><td>6</td></tr>
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