B. Tech.
(SEM. VI) THEORY EXAMINATION 2011-12
ENvironmental engineering—II

Time : 3 Hours  Total Marks : 100

Note : Attempt all questions and assume suitable value of parameters, if not given in questions.

1. Attempt any four of the following :  (4 \times 5 = 20)
   (a) How are the organic contents measured in waste water samples? Discuss any one method in detail.
   (b) Discuss advantages and disadvantages of BOD and COD test.
   (c) What is the maximum permissible limit of nitrate in drinking water? Also discuss the detrimental effects of excess nitrate.
   (d) What is M.P.N.? How it is measured?
   (e) What is Theoretical Oxygen Demand (ThOD)? Determine the ThOD for Glycine \((\text{CH}_2\text{(NH}_2\text{)}\text{COOH})\).
   (f) What size of sample expressed as a percent is required if the 5 day BOD is 400 mg/l and the total oxygen consumed in the BOD bottle is limited to 2 mg/l?

2. Attempt any two of the following :  (2 \times 10 = 20)
   (a) Define :
      (i) Discrete Particles
(ii) Flocculating Particles
(iii) Dilute Suspension
(iv) Concentrated Suspension.
(b) Describe the four functional zones of long-rectangular settling tank.
(c) Name and discuss the four mechanisms thought to occur during coagulation.

3. Attempt any two of the following: \(10 \times 2 = 20\)
(a) A rapid sand filter has a bed depth of 0.7 m. It is composed of sand grains that have a specific gravity of 2.65 and shape factor of 0.82. The porosity of the bed is 0.45 throughout. The sieve analysis of the sand is shown below:

<table>
<thead>
<tr>
<th>Sieve No.</th>
<th>Mass retained (%)</th>
<th>Average particle size (\text{mm})</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.87</td>
<td>1.0</td>
</tr>
<tr>
<td>2</td>
<td>8.63</td>
<td>0.71</td>
</tr>
<tr>
<td>3</td>
<td>21.30</td>
<td>0.54</td>
</tr>
<tr>
<td>4</td>
<td>28.10</td>
<td>0.46</td>
</tr>
<tr>
<td>5</td>
<td>23.64</td>
<td>0.38</td>
</tr>
<tr>
<td>6</td>
<td>7.09</td>
<td>0.32</td>
</tr>
<tr>
<td>7</td>
<td>3.19</td>
<td>0.27</td>
</tr>
<tr>
<td>8</td>
<td>2.16</td>
<td>0.23</td>
</tr>
<tr>
<td>9</td>
<td>1.02</td>
<td>0.18</td>
</tr>
</tbody>
</table>

Determine the head loss through the bed if the flow rate is 5.0 m/s and water temperature is 17°C.

(b) Design rapid gravity filter for producing a net filtered water flow of 250 m³/hr. The relevant data is:
(i) Quantity of back wash water used = 3% of output
(ii) Time lost during back washing = 30 minutes
(iii) Design rate of filtration = 5 m³/m²/hr
(iv) Length to width ratio = 1.25 – 1.33 : 1
(v) Under drainage system = central manifold
(vi) Size of drainage perforations = 9 mm
(c) Design a secondary circular sedimentation tank to remove alum floc with following data:
   (i) Average output from settling tank = 250 m³/hr
   (ii) Amount of water lost in desludging = 2%
   (iii) Average design flow = 255.1 m³/hr
   (iv) Minimum size of alum floc to be removed = 0.8 mm
   (v) Sp. gr. of alum floc = 1.002
   (vi) Expected removal efficiency = 80%
   (vii) Assumed performance of settling = very good
        (h = 1/8)
   (viii) Kinematic viscosity of water at 20 °C = 1.01 × 10⁻⁶ m²/s

4. Attempt any two of the following: \(2 \times 10 = 20\)
   (a) Design a facultative aerated lagoon to serve 40,000 people.
       For sewage flow @ 180 lpcd = 7200 cu.m/day. Raw
       BOD₅ = 277 mg/l and final BOD₅ is not to exceed
       30 mg/l in winter. Average ambient air temperature in
       January is 18°C and in summer 37°C.
   (b) Design a facultative stabilization pond to treat 5000 m³/d
       municipal wastewater, BOD₅ 230 mg/l, from a town
       (population 25,000 persons) located in Central India,
       latitude 22-N, elevation 100 m above sea level. The
       average temperature is 18°C. The effluent from the pond
       is to be used for irrigation.
   (c) (i) Discuss various modifications of activated sludge
        process (ASP). Also explain role of F/M ratios in
        ASP.
   (ii) Write and explain NRC’s and Eckenfelder’s equation
        for Trickling filter.
5. Answer any four of the following: (4×5=20)
   
   (a) Write various steps involved in Anaerobic process. At which step the alkalinity will be maximum?
   
   (b) What are low rate and high rate anaerobic digesters?
   
   (c) What is UASBR? Draw a schematic diagram of a UASBR reactor.
   
   (d) Write short notes on Duck weed pond.
   
   (e) Discuss nutrients removal in wastewater a tertiary treatment.
   
   (f) What is septic tank? Discuss advantages and disadvantages of centralized vs. decentralized wastewater treatment.