

BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE
II SEMESTER 2017-2018

CE F342

Water and Wastewater Treatment
Comprehensive Examination (Closed Book)

Dated: 11.5.2018

Max. Marks: 120

Duration: 180 minutes

Answer all questions.

Answer all parts of a question together.

1. Explain the following with appropriate sketches wherever necessary:
 - a) Oxidation ditch
 - b) Sludge volume index
 - c) Anaerobic digester
 - d) Skimming tank
 - e) Chlorine demand (3 x 5=15)

2. Design a grit chamber having a rectangular cross section and a proportional flow weir as the velocity control device, for the following data :
 - a) Maximum flow = 30 mld
 - b) Diameter of grit particles to be removed = 0.2 mm
 - c) Average temperature = 20°C
 - d) Specific gravity of grit particle = 2.6
 - e) Depth of chamber = 1.1 m
 - f) $a = 0.035$ m, $C = 0.6$
 - g) Use Hazen's modified equation for calculation of settling velocity
 - h) Shield equation coefficient = 4
 - i) Find the value of x coordinate of flow weir for y values vary from 0, 0.01, 0.02, 0.03, 0.04, 0.05 and 0.1 m respectively. (10+15=25)

3. Three million litres of water per day is passing through a Sedimentation Tank which is 7 m wide, 15 m long and having a water depth of 3 m, find the following:
 - a) Detention time for the tank
 - b) Flow through velocity from the tank
 - c) If 50 ppm is the concentration of suspended solids present in turbid water, how much dry solid will be settled in the tank? , assume 75% removal in the basin and specific gravity of particle 2.1.
 - d) Over flow rate (3+3+6+3=15)

4. Design a conventional Activated Sludge Plant for the following data :
 - a) Population = 100000
 - b) Per capita sewage contribution = 150 lpcd
 - c) Inlet BOD = 220 mg/l
 - d) Effluent BOD = 20 mg/l
 - e) F/M ratio = 0.2 day⁻¹
 - f) MLSS = 3000 mg/l
 - g) SVI = 100 ml/g
 - h) Oxygen transfer rate of aerator = 1.4 kg/HP/hourFind efficiency of the plant, Volume of aeration tank, Hydraulic retention time, Volumetric loading, Return sludge ratio, Total horse power of aerators. (3+5+3+3+3+3=20)

5. Design a high rate Trickling filter plant to treat domestic sewage with a BOD of 180 mg/l for an average flow of 40 mld. The desired BOD of effluent is 10 mg/l. Given the following data:
- BOD loading of 0.8 kg BOD applied/m³/day excluding recirculation on first stage filter.
 - Recirculation ratio of first stage filter = 2
 - Recirculation ratio of second stage filter = 1
- Find Volume of first stage filter and second stage filter; Efficiency of first stage filter and second stage filter.

Note: Use NRC equation

(2+6+6+6=20)

6. A 350 mm diameter sewer is to flow at 0.35 m depth on a grade ensuring a degree of self cleansing equivalent to that obtained at full depth at a velocity of 0.8 m/s, find
- The required grade
 - Associated velocity
 - The rate of discharge at this depth

Given:

- Manning's rugosity coefficient = 0.014
- Proportionate area = 0.315
- Proportionate HMD (r/R) = 0.7705
- N = n

Note: Use Manning's Equation

(5+5+5=15)

7. Find the area of paddle of a flocculator for the following data:

- Speed of paddle = 5 rpm
- Velocity ratio k = 0.25
- Coefficient of drag of paddle = 1.8
- $\rho = 998 \text{ kg/m}^3$
- Average value of $G = 50 \text{ s}^{-1}$
- Volume of Tank = 120 m³
- $\mu = 1.0087 \times 10^{-3} \text{ N-s/m}^2$
- r = 0.7 m

(10)

Paper Ends