BACHELOR OF ENGINEERING IN CHHEMICAL ENGINEERING EXAMINATION, 2017

(4 TH YEAR, 1 ST SEMESTER)

ENVIRONMENTAL SCIENCE AND ENGINEERING

TIME: 3 HRS

TOTAL MARKS: 100

REFERENCE: EX/CHE/T/413/2017

ANSWER ANY FOUR QUESTIONS

ALL QUESTIONS CARRY EQUAL MARKS

ASSUME MISSING DATA, IF ANY

1. The porosityof the unstratified bed composed of sharp filter sand is 0.39.The lowest temperatureanticipated of the water to be filtered is 20^0C. Find the head if the sand is to be used in a slow sand filter 75 cm deep operated at 10 mgad.

Sieve size	Average size (mm)	x_i
14 – 20	1.0	0.01
20 – 28	0.70	0.05
28 – 32	0.54	0.15
32 – 35	0.46	0.18
35 – 42	0.38	0.18
42 – 48	0.32	0.27
48 – 60	0.27	0.16

2. A flocculator has three compartments with each compartment having one paddle wheel. The ratio of length of the paddle blades of the largest compartment to that of the length of the paddle blades of the middle compartment is 2.6:2, and the ratio of the length of the paddle blades of the middle compartment to that of the length of the paddle blades of the smallest compartment is 2:1. The flocculator is to flocculate an alum-treated raw water of 50,000 m^3/day at an average temperature of 20^0C. Design for the dimensions of the first compartment.Find also the power requirements assuming a M value of 90% and a η value of 75%. $\mu = 10(10^{-14})$ and $G = 40s^{-1}$.

[Turn over

3. A biotower composed of conventional plastic medium is used to treat the effluent of a primary clarifier with a BOD_5 of 150 mg/L. The flow from the clarifier is 20,000 m^3/day. From a pilot plant study, K' was determined to be 0.117 m/day. The two towers are to be used, each with a square surface and separated by a common wall and a depth of 7,0 m. A recirculation ratio of 2 is to be used. Calculate the dimensions of the units that will produce an effluent of 10 mg/L of soluble BOD_5.

4. An activated sludge is operated at an MCRT of 10 days and an NHRT of 4 h. The volume of the reactor is 1600 m^3 and the rate of sludge wasting is 64 m^3/day.If the MCRT and the NHRT are maintained, what is the sludge underflow concentration corresponding to an MLVSS of 4000 mg/L?

5. Measurement of the dust distribution of a certain industrial operation yields the results in Table I below. These results are to be used to design a plate type ESP. The airstream is 330 m^3/s and the plates are 30 cm apart. The voltage drop between the discharge and collector plates is 70,000 V. The aspect ratio, which is the ratio of the length of the plate to its width is 1.2. The plate width is 10 m and there are a total of 80 channels. The temperature is 650^{0}C and the specific gravity of the particles is 2.0. a) What are the diameter and terminal settling velocity of particles that are removed 100%? b) What is the power requirement assuming that the corona current 2.3A? Assume that βis 0.90.

Table I

Particle size (μm)	Wt%
0 -10	8
10 -20	10
20 -30	12
30 -40	15
40 -50	19
50 -60	14
60 -70	13
70 -80	9

6. Measurement of the dust distribution of a certain industrial operation yields the results shown in Table I. These results are to be used to design a standard conventional cyclone. The airstream is 21.0 m^3/s and the diameter of the cyclone is 2,0 m.The temperature is 650^0C and the specific gravity of the particle is 2.0.

a)What are the diameter and terminal settling velocity of the particle that is **removed 100%?**

B)Determine the expected percent removal of the particles. Assume that β equals 0.90.